ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research

Vol. 17, Issue, 01, pp.31579-31602, January, 2025
DOI: https://doi.org/10.24941/ijcr.48296.01.2025

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

REVEIW ARTICLE

ORIGIN, TAXONOMY, BOTANICAL DESCRIPTION, GENETICS AND CYTOGENETICS, GENETIC DIVERSITY, BREEDING AND CULTIVATION OF BAY LEAF

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ARTICLE INFO

Article History:
Received 20th October, 2024
Received in revised form
17th November, 2024
Accepted 24th December, 2024
Published online 31st January, 2025

Key Words:

Bay Leaf, Origin, Taxonomy, Botanical Description, Genetic Diversity, Breeding.

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ABSTRACT

Bay leaf belongs to the family Lauraceae, genus Laurus and species Laurus nobilis. *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 called *dafni*. In India, specifically in Hindi, it is called *teejpatta*. Common names are Bay Laurel, Bay Leaf Tree, Bay Tree, Grecian Laurel, Laurel, Laurel Tree, Sweet Bag, Sweet Bay, Tree Laurel and True Laurel; Bay, Bay-leaf Laurel, Gekkeiju, Grecian Laurel, lager laurel, Laurier, Lorbeerstrauch, Loureiro, Louro, Louro-comum, Louro-de-apolônio, Louro-europeu, Sweet Bay and Yue Gui. Foreign Name of Bay leaf are in Spanish : Laurel, French : Laurier, German : Lorbeer, Swedish : Lager, Arabic: Ghar, Dutch : Laurier, Italian : Alloro, Portuguese : Loureiro, Russian : Laur, Japanese : Gekkeiju, Chinese : Yuch-kuei, English : Sweet laurel, Bayleaf. The plant is the source of several popular herbs and one spice used in a wide variety of recipes, particularly among Mediterranean cuisines. Most commonly, the aromatic leaves are added whole to Italian pasta sauces. They are typically removed from dishes before serving, although they may also be used as a simple garnish. Whole bay leaves have a long shelf life of about one year, under normal temperature and humidity. Whole bay leaves are used almost exclusively as flavor agents during the food preparation stage. Ground bay leaves, however, can be ingested safely and are often used in soups and stocks, as well as being a common addition to a Bloody Mary. Dried laurel berries and pressed leaf oil can both be used as robust spices, and the wood can be burnt for strong smoke flavoring. *Laurus nobilis* is widely cultivated as an ornamental plant in regions with Mediterranean or oceanic climates, and as a house plant or greenhouse plant in colder regions. It is used in topiary to create single erect stems with ball-shaped, box-shaped or twisted crowns; also for low hedges. However, it is slow-growing and may take several years to reach the desired height. Together with a gold form, *L. nobilis* 'Aurea' and a willow-leaved form *L. nobilis* f. *angustifolia*, it has gained the Royal Horticultural Society's Award of Garden Merit. One of the most important pests affecting ornamental laurels is caused by the jumping plant louse Trioza alacris, which induces the curling and thickening of the edge of the leaves for the development of the insect's nymphs, eventually creating a necrosed gall. The species is also affected by the scale insect Coccus hesperidum. The bay leaf is a powerfully aromatic leaf used primarily for culinary purposes. Although there are multiple varieties of bay leaves cultivated around the world today, the original bay leaf came from the bay laurel tree which is native to the Asian side of the Mediterranean. This form of bay leaf, which is also known as sweet bay and Grecian laurel, is still the herb typically used for infusing soups and sauces with an aromatic flavor. Bay leaves can be used in dried, crushed, and fresh form, but are most commonly sold as dried whole leaves in the spice aisle of any grocery store. Bay leaves have many uses in cooking. They are a common ingredient in the French "bouquet garni," a traditional bundle of herbs that are tied together and added to stews, soups, sauces, and casseroles during the cooking process. In this review article on Origin, Taxonomy, Botanical Description, Genetics and Cytogenetics, Genetic Diversity, Breeding and Cultivation of Bay Leaf are discussed.

Citation: K.R.M. Swamy. 2025. "Origin, Taxonomy, Botanical Description, Genetics and Cytogenetics, Genetic Diversity, Breeding and Cultivation of Bay Leaf". *International Journal of Current Research*, 17, (01), 31579-31602.

INTRODUCTION

Bay leaf belongs to the family Lauraceae, genus Laurus and species Laurus nobilis (Khodja *et al*., 2023; ACIR, 2024; Wikipedia, 2024). *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 called *dafni*. In India, specifically in Hindi, it is called *teejpatta* (Batool *et al*., 2019). Common names are Bay Laurel, Bay Leaf Tree, Bay Tree, Grecian Laurel,

Laurel, Laurel Tree, Sweet Bag, Sweet Bay, Tree Laurel and True Laurel (**NCSU, 2024**); Bay, Bay-leaf Laurel, Gekkeiju, Grecian Laurel, lager laurel, Laurier, Lorbeerstrauch, Loureiro, Louro, Louro-comum, Louro-de-apolônio, Louro-europeu, Sweet Bay and Yue Gui **(**ACIR, 2024**).**

Regional Names of Bay leaf are in **English name**: Lignea, Bay leaf, India Cassia; **Hindi name**: Tejpat; **Assamese name**: Tejpat, Mahpat; **Guajarati name**: Tamala Patra, Develee; **Bengali name**: Tejpatra, Tejpata; **Kannada name** : Dalchini Ele, Tamalapatra; **Kashmiri name**: Dalchini pan, Tajpatra; **Marathi name**: Tamalpatra; **Oriya name:** Tejapatra; **Punjabi name**: Tajapter; **Urdu name**: Tezpat; **Tamil name**: Lavangapatri; **Telugu name**: Akupatri; **Danish name**: IndishLaurbareblad; **Finnish name**: Lauries des Indes; **German name**: IndischesLorburblatt; **Japanese name**: Tamara-nikkei, Tezipatto; **Hungaraian name**: Indiaibaberlevel and **Burmese name**: Thitchabo, Thitkyabo (Chauhan, 2019). Foreign Name of Bay leaf are in Spanish : Laurel, French : Laurier, German : Lorbeer, Swedish : Lager, Arabic : Ghar, Dutch : Laurier, Italian : Alloro, Portuguese : Loureiro, Russian : Laur, Japanese : Gekkeiju, Chinese : Yuch-kuei, English : Sweet laurel, Bayleaf (Indianspices, 2024a).

The name Laurus was derived from the Latin word “laureola”, which means laurel wreath. The word "baccalaureate", whose Latin root comes from bacca lauri meaning bay of laurel, refers to the laurel wreath offered to heroes in antiquity. The Romans spread the species to parts of Europe; the first settlers introduced it to the New World. Today, the species is cultivated in the Mediterranean region, Russia, Central America, and, the southern United States (Khodja *et al*., 2023). The ancient Greeks and Romans used it as a condiment and medicine. In Greek mythology, it was considered sacred, which is why in ancient Greece, receiving a wreath made of bay leaves was considered an honor. Olympic winners, poets, victors, and heroes received the crown to wear on their heads. This habit was also accepted by the Romans (Khodja *et al*., 2023).

The origin of the Laurel tree, known as Daphne in Ancient Greek, is rooted in the Greek myth of the priestess Daphne and the god Apollo. It is said Apollo fell in love with Daphne, a wildly independent and fierce priestess. Rather than give herself over to the god, Daphne called out to Gaia and asked to be saved. Hearing her plea and taking pity on the priestess, Gaia turned Daphne into a Laurel tree. In his lament, Apollo adopted the tree as his sacred plant. Another myth says Apollo was struck by Eros’s arrow, causing him to fall madly in love and chase Daphne down. In her attempt to escape him, she cried out to her father, a river god, who turned her into the tree to save her. Because of the tree’s significance to Apollo, the god’s priestesses ingested and smoked the leaves of the tree to induce prophetic visions. The tree came to symbolize wisdom, peace, and protection in both the Ancient Greek and Roman cultures, and wreaths from the tree were placed atop the heads of scholars, heroes, and athletes. The terms poet laureate and baccalaureate are both derived from the symbolism of wisdom the tree held (Specialtyproduce, 2024).

The plant is the source of several popular herbs and one spice used in a wide variety of recipes, particularly among Mediterranean cuisines. Most commonly, the aromatic leaves are added whole to Italian pasta sauces. They are typically removed from dishes before serving, although they may also be used as a simple garnish. Whole bay leaves have a long shelf life of about one year, under normal temperature and humidity. Whole bay leaves are used almost exclusively as flavor agents during the food preparation stage. Ground bay leaves, however, can be ingested safely and are often used in soups and stocks, as well as being a common addition to a Bloody Mary. Dried laurel berries and pressed leaf oil can both be used as robust spices, and the wood can be burnt for strong smoke flavoring (Wikipedia, 2024). *Laurus nobilis* is widely cultivated as an ornamental plant in regions with Mediterranean or oceanic climates, and as a house plant or greenhouse plant in colder regions. It is used in topiary to create single erect stems with ball-shaped, box-shaped or twisted crowns; also for low hedges. However, it is slow-growing and may take several years to reach the desired height. Together with a gold form, *L. nobilis* 'Aurea' and a willow-leaved form *L. nobilis* f. *angustifolia*, it has gained the Royal Horticultural Society's Award of Garden Merit (Wikipedia, 2024). One of the most important pests affecting ornamental laurels is caused by the jumping plant louse Trioza alacris, which induces the curling and thickening of the edge of the leaves for the development of the insect's nymphs, eventually creating a necrosed gall. The species is also affected by the scale insect Coccus hesperidum (Wikipedia, 2024).

Types of Bay Leaf (Chauhan, 2019; Singha and Mondal, 2024; Wikipedia, 2024a)

- **Bay Laurel (*Laurus nobilis*):** Commonly known as Mediterranean bay leaves, these leaves are used in both fresh and dried forms to flavour dishes like soups, stews, and braised dishes in Mediterranean cuisine. Fresh bay leaves have a gentler flavour, while their full taste develops over several weeks after drying and harvesting. Fresh or dried bay leaves are used in cooking for their distinctive flavour and fragrance. The leaves should be removed from the cooked food before eating (see safety section below). The leaves are often used to flavour soups, stews, braises and pâtés in many countries. The fresh leaves are very mild and do not develop their full flavour until several weeks after picking and drying.
- **California Bay Leaf (*Umbellularia californica*):** This variety, also called California laurel, pepperwood, or Oregon myrtle, closelyresembles Mediterranean bay laurel but has a more intense flavour.
- **Indonesian Bay Leaf (*Syzgium polyanthum*):** Originating from Indonesia, this herb is primarily employed to enhance the taste of meats and is less commonly used with vegetables.
- **West Indian Bay Leaf (*Pimenta racemosa*)**: Instead of culinary purposes, this type is mainly used in the production of a cologne known as bay rum.
- **Indian Bay Leaf (*Cinnamomum tamala*):** Indian bay leaves share a visual resemblance with bay laurel leaves but possess a flavour and aroma reminiscent of cinnamon bark, albeit milder in strength.
- **Mexican bay leaf (Litsea glaucescens*).***

The commodity, traded as sweet bay leaf, and true, Roman, or Turkish laurel, is derived from the leaves of *Laurus nobilis* L. Because of the similarity in the leaves, several other trees are also variously known as: West Indian bay tree (*Pimenta racemosa),* Cherry laurel (*Prunus laurocerasus),* Portugal laurel (*Prunus lusitanica),* Laurel of the southern states (*Prunus caroliniana*), the Laurel or Mountain laurel of California (*Umbellularia californica*). However, the leaves of true *L. nobilis* must not be confused with other laurels (Kumar *et al*., 2012). *L. nobilis* is a native of the Mediterranean and grows spontaneously in scrubland and woods in Europe and in California. It is widely cultivated in Europe, America and in Arabian countries from Libya to Morocco (Kumar *et al.,* 2012). The flavouring properties of *L. nobilis* have been known since antiquity. In biblical times, the bay was symbolic of wealth and wickedness, and in the classical world heroes and victors were decorated with a laurel wreath. In addition to being a very well known culinary herb, the leaves and fruits of *L. nobilis* are used medicinally throughout the world (Kumar *et al.,* 2012). Infusions or decoctions made from these materials have diaphoretic and carminative effects and also serve as a general gastric secretion stimulant. Laurel oil or butter obtained from the fruits (berries) of *L. nobilis* is a vital ingredient of laurin ointment, a popular medicine for rheumatism and gout and for the treatment of spleen and liver diseases. It also finds application in veterinary medicine (Kumar *et al.,* 2012).

Laurus nobilis L. is an evergreen tree or shrub commonly known as laurel, bay laurel or sweet bay. These vernacular names denote its most common usage, traditional cooking (Marzouki *et al.,* 2009). In many Mediterranean countries, leaves collected from both cultivated and wild specimens are used for flavoring and as a spice for marinating and pickling foods (Marzouki *et al.,* 2009). Since antiquity, bay leaves have also been used for medicinal purposes in the Mediterranean. The Greeks and Romans used them to treat digestive disorders or viral infections (Marzouki *et al*., 2009). Recently, their pharmacological properties were confirmed. They include anti-bacterial, anti-fungal, antidiabetes, anti-oxidative and anti-inflammatory effects (Marzouki *et al.,* 2009). Lauraceae are one of the basal angiosperm families with fossils dating back to 100 million years ago (Marzouki *et al*., 2009). The genus *Laurus* is considered as an ancient element of the Tertiary laurifolius flora made of angiosperms (mostly Lauraceae) with large, thick evergreen leaves, which dominated the late Tertiary flora (Miocene and Pliocene, ca. 24 million years) (Marzouki *et al.,* 2009). This flora has now almost vanished from the Mediterranean and, except in the Azores, Madeira and the Canary Islands (Macaronesian islands), can only be found in restricted areas under humid and warm climates (Marzouki *et al.,* 2009). Although *L. nobilis* was initially described using material from Italy and Greece, it is considered native only to Turkey (Anatolia) and the Balkan Peninsula based on the species alkaloid contents (Marzouki *et al.*, 2009). This indicates that the Pyrenees acted as a strong natural geographic barrier against gene flow during the Pleistocene and that laurel from Spain is more related to laurel in the Macaronesian islands (*Laurus azorica* (Seub) Franco) than to *L. Nobilis* (Marzouki *et al*., 2009). A more recent analysis, using chloroplast DNA and populations distributed across the entire Mediterranean Basin, confirmed the existence of separate lineages and challenges the existence of two separate *Laurus taxa* in the Mediterranean (Marzouki *et al*., 2009).

Laurus nobilis is an aromatic evergreen tree or large shrub with green, glossy leaves, native to the Mediterranean region. It is one of the plants used for bay leaf seasoning in cooking (Wikipedia, 2014b). It is known as bay laurel, sweet bay, bay tree, true laurel, Grecian laurel, laurel tree or simply laurel (Wikipedia, 2014b). Worldwide, many other kinds of plants in diverse families are also called "bay" or "laurel", generally due to similarity of foliage or aroma to *Laurus nobilis*, and the full name is used for the California bay laurel (Umbellularia), also in the family Lauraceae (Wikipedia, 2014b). The laurel can vary greatly in size and height, sometimes reaching 10–18 metres tall. Laurus is a genus of evergreen trees belonging to the Laurel family, Lauraceae. The genus includes three species, whose diagnostic key characters often overlap (Wikipedia, 2014b). The laurel is dioecious , with male and female flowers on separate plants. Each flower is pale yellow-green, about 1 cm diameter, and they are borne in pairs beside a leaf. The leaves are 6–12 cm long and 2–4 cm broad, with an entire (untoothed) margin. On some leaves the margin undulates. The fruit is a small, shiny black berry-like drupe about 1 cm long that contains one seed (Wikipedia, 2014b). The plant is the source of several popular herbs and one spice used in a wide variety of recipes, particularly among Mediterranean cuisines. Most commonly, the aromatic leaves are added whole to Italian pasta sauces. However, even when cooked, whole bay leaves can be sharp and abrasive enough to damage internal organs, so they are typically removed from dishes before serving, unless used as a simple garnish (Wikipedia, 2014b). Whole bay leaves have a long shelf life of about one year, under normal temperature and humidity. Bay leaves are used almost exclusively as flavor agents during the food preparation stage (Wikipedia, 2014b). Ground bay leaves, however, can be ingested safely and are often used in soups and stocks, as well as being a common addition to a Bloody Mary. Dried laurel berries and pressed leaf oil can both be used as robust spices, and even the wood can be burnt for strong smoke flavoring. Aqueous extracts of bay laurel can also be used as astringents and even as a reasonable salve for open wounds (Wikipedia, 2014b). In massage therapy, the essential oil of bay laurel is reputed to alleviate arthritis and rheumatism, while in aromatherapy, it is used to treat earaches and high blood pressure. A traditional folk remedy for rashes caused by poison ivy, poison oak, and stinging nettle is a poultice soaked in boiled bay leaves. The chemical compound lauroside B isolated from *Laurus nobilis* is an inhibitor of human melanoma (skin cancer) cell proliferation at high concentrations (Wikipedia, 2014b).

Bay leaves, also called laurel leaves, are very popular as a spice in Europe and North America. This plant is a small evergreen tree, which looks like a bush. The seeds of the laurel plant have a slow germination rate and take a long time to develop. The dried leaf is the raw material for extractives. The full aroma is developed only after slow drying (Attokaran, 2017). The dry leaf consists of 7% protein, 9% fat, 50% carbohydrate, and 25% crude fiber (Attokaran, 2017). The essential oil is its most significant constituent. On steam distillation, dried bay leaves produce 1-3% essential oil. This is a light yellow mobile liquid with a characteristic aromatic and spicy aroma (Attokaran, 2017). Ground dry bay leaf, on extraction with hexane, gives an oleoresin with a yield of between 3 and 4%. In processed foods, extractives such as the oil and oleoresin are very convenient to use to provide a standardized flavour (Attokaran, 2017). Bay leaf has been cultivated throughout the European, tropical, subtropical, and Asian countries (Batool *et al.,* 2019). It has been used for thousands of years for food flavoring, essential oil applications, and in traditional medicine (Batool *et al*., 2019). Mostly, it contains tannins, flavones, flavonoids, alkaloids, eugenol, linalool, methyl

chavicol, and anthocyanins. The extent of each of these chemical constituents varies depending on the type of species or cultivars as well as cultivation conditions such as soil type, weather, irrigation, pruning, and other horticultural practices (Batool *et al*., 2019). Bay is an essential component of several industrial applications that range from food to cosmetics to pharmaceutical products. Bay leaf has many biologic activities such as wound healing activity, antioxidant activity, antibacterial activity, antiviral activity, immunostimulant activity, anticholinergic activity, antifungal activity, insect repellant activity, anticonvulsant activity, antimutagenic activity, and analgesic and antiinflammatory activity (Batool *et al*., 2019).

Bay leaf is a small Mediterranean aromatic evergreen tree or large shrub with green, smooth, and hairless leaves (Chauhan, 2019). This herb is having a distinctive flavor and fragrance (Chauhan, 2019). It is easily found in the kitchen and commonly used in cooking (Chauhan, 2019). The dry leaves have full flavor but the fresh leaves have very mild and do not develop their full flavour (Chauhan, 2019). The leaves of this herb are used in dried form. This herb helps in pacifying the Vata and Kapha Dosha and also helps in increasing the Pitta Dosha (Chauhan, 2019). The bay leaf is a powerfully aromatic leaf used primarily for culinary purposes. Although there are multiple varieties of bay leaves cultivated around the world today, the original bay leaf came from the bay laurel tree (*Laurus nobilis*) which is native to the Asian side of the Mediterranean (MasterClass, 2021). This form of bay leaf, which is also known as sweet bay and Grecian laurel, is still the herb typically used for infusing soups and sauces with an aromatic flavor. Bay leaves can be used in dried, crushed, and fresh form, but are most commonly sold as dried whole leaves in the spice aisle of any grocery store (MasterClass, 2021). Bay leaves have many uses in cooking. They are a common ingredient in the French "bouquet garni," a traditional bundle of herbs that are tied together and added to stews, soups, sauces, and casseroles during the cooking process (MasterClass, 2021). Bay leaves are also commonly used in marinades for meat and fish, added to boiling water to cook seafood like crab and shrimp, and used in pickling solutions. In addition to these various savory applications, bay leaves are also occasionally added to the cream mixture for rice pudding, infusing the dessert with a subtle herbal flavour (MasterClass, 2021). Bay laurel trees, or bay leaf trees, are native to humid climates of the Mediterranean region and can be grown year-round in warm temperatures. The bay laurel tree grows best in USDA hardiness zones 8–10. The best time to plant them is in late spring or early summer when the threat of frost is no longer present. Laurel trees can't survive in temperatures below 20 degrees Fahrenheit and if you live in a cold climate, consider planting your tree as a container plant so you can bring it inside during the winter months (MasterClass, 2021). You can plant an already-established bay laurel tree in your backyard if you want to harvest the leaves quickly. You can also plant a bay laurel tree from seeds found at your local garden center. It may take a couple of years for your tree to mature and produce bay leaves for you to use. Here is how to grow a bay leaf plant from a seed (MasterClass, 2021).

My first bay laurel tree was a tiny four-inch seedling from the nursery. I found out quickly that growing bay leaves is not at all difficult (Heikenfeld, 2021). I put the pot in my herb garden where it got morning sun and afternoon shade. Before long, the little specimen outgrew the pot. Throughout the summer, I repotted it several times. By autumn, the bay tree had grown well over a foot with multiple branches (Heikenfeld, 2021). Bay laurel, or *Laurus nobilis*, is what is known as "true bay." This perennial, evergreen herb is in the Lauraceae plant family which also includes cinnamon and sassafras. Bay has been grown in the Mediterranean region for so long that when we think of bay, we associate it with the Mediterranean (Heikenfeld, 2021). Bay leaf benefits are almost unlimited. From the culinary arena to medical research, bay is attracting the attention of cooks, medical professionals, and herbalists (Heikenfeld, 2021). There are other varieties of bay, including California bay, Umbellularia californica. California bay is native to California and is in the same family as avocados. The difference between bay laurel and California bay is both visual and sensory. True bay has large, somewhat rounded pointed leaves and, when dried, has an herbal, slightly floral, eucalyptus-like flavor. California bay leaves are more pointed and slender, with a much stronger flavour (Heikenfeld, 2021). Fertilize both in the ground in spring and summer. For lush foliage, try a fertilizer that's a little high in nitrogen (Heikenfeld, 2021). Give the leaf a tug, pulling downward. That way, you'll get a clean break without damaging the stem (Heikenfeld, 2021). Dry in a dehydrator or by hanging in bunches upside down, away from light and moisture. When leaves crinkle with your fingers, they're dry. Store away from heat and light (Heikenfeld, 2021). Bay trees aren't usually bothered by diseases and pests, but once in a while, you may see a mealy bug or scale damage. Mealy bug damage makes the leaves look sooty, and sucking scale insects look like soft ovals that attach to the stem or leaf. A good horticultural oil spray will take care of both (Heikenfeld, 2021). Bay is truly an herb with an ancient pedigree. Do you grow bay? Does your climate allow you to grow it outdoors all year? Join in the conversation below (Heikenfeld, 2021).

Medicinal and aromatic plants are mainly used in medicines to prevent diseases, maintain healthiness, or heal illnesses. Medicinal plants are widely used in body care, nutrition, cosmetics, incense, or religious ceremonies, while aromatic plants are used to maintain a pleasant smell and taste. The importance of these plants is increasing day by day with people's tendency towards nature and natural sources in the nutrition, health, and cosmetic sectors (Yilmaz and Çiftçi, 2021). The necessity and significance of medicinal and aromatic plants usage in routine life will never decline, and it will maintain its popularity among the scientific community. Medicinal plants have become increasingly recognized especially in the last decade, particularly in the role of rural people's economies, scope in medicinal practices, use in cultural matters, and ultimately their contribution to the well-being of people (Yilmaz and Çiftçi, 2021). Laurel is not widely recognized compared to other medicinal plants worldwide despite having a high economic value and popularity in Turkey (Yilmaz and Çiftçi, 2021). Currently, it has many synonyms as 'laurel,' 'sweet bay,' 'bay leaf,' and 'bay-tree.' (Yilmaz and Çiftçi, 2021). The laurel plant originated in Anatolia and the Balkans (Yilmaz and Çiftçi, 2021). It naturally grows up to 600– 800 m altitudes through Turkey coastline. Laurel trees are generally grown in America and Europe as an ornamental plant (Yilmaz and Çiftçi, 2021). It is one of the most popular plants in the Mediterranean region having an enormous variety. Its aromatic leaves are grown for commercial purposes in Turkey, Mexico, Portugal, Italy, Spain, France, Algeria, and Morocco. Both essential oils and fixed oils of laurel are used in food, cosmetics, and medicine. Laurel leaves are also extensively used in folk medicine to treat rheumatism, gastrointestinal, and urinary problems (Yilmaz and Çiftçi, 2021). Turkey is the largest

exporter in the world at laurel trade. Laurel has a lot of usage areas in Turkey. One of them is the production of essential oils with the export of asmall amount (Yilmaz and Çiftçi, 2021). In 21st-century, crop breeding programs researching natural biodiversity as a source of novel alleles to increase adaptability, yield, health properties, and nutritional value of crops have gained considerable importance (Yilmaz and Çiftçi, 2021). The trend towards molecular methods has increased due to the insufficiency of these data in plant systematics descriptions for taxonomy studies in recent years. Hereby molecular techniques were developed concerning DNA for genotyping (Yilmaz and Çiftçi, 2021). Genetic diversity of laurel plant has been investigated in some studies. In brief, limited number of molecular characterization studies have been performed related to this subject on local laurel genotypes (Yilmaz and Çiftçi, 2021).

Laurus nobilis L. is an aromatic medicinal plant widely cultivated in many world regions (Paparella *et al.,* 2022). *L. nobilis* has been increasingly acknowledged over the years as it provides an essential contribution to the food and pharmaceutical industries and cultural integrity (Paparella *et al*., 2022). The commercial value of this species derives from its essential oil, whose application might be extended to various industries (Paparella *et al.,* 2022). The chemical composition of the essential oil depends on environmental conditions, location, and season during which the plants are collected, drying methods, extraction, and analytical conditions (Paparella *et al.*, 2022). The characterization and chemotyping of *L. nobilis* essential oil are extremely important because the changes in composition can affect biological activities (Paparella *et al*., 2022). Several aspects of the plant's secondary metabolism, particularly volatile production in *L. nobilis*, are still unknown. However, understanding the molecular basis of flavor and aroma production is not an easy task to accomplish (Paparella *et al*., 2022). Nevertheless, the time-limited efforts for conservation and the unavailability of knowledge about genetic diversity are probably the major reasons for the lack of breeding programs in *L. Nobilis* (Paparella *et al.,* 2022). *Laurus nobilis* L. is an aromatic and medicinal plant belonging to the Lauraceae family, which comprises approximately 2500–3500 species. The genus Laurus consists of two species: *Laurus azorica* and *Laurus nobilis*. The generic half of the binomial, *Laurus,* comes directly from the Latin name for the tree and is probably taken from a more ancient Celtic word, blaur, meaning green, while *nobilis* is a Latin word meaning noble and famous (Paparella *et al*., 2022). It is an evergreen shrub native to Mediterranean regions, also known as sweet bay, bay laurel, Grecian laurel, true bay, or simply bay (Paparella *et al.,* 2022). Turkey is the major producer of *L. nobilis* and exports it to 64 countries. Almost 97% of the world's total production comes from Turkey. The amount of annual production ranges between 7000 and 7500 tons (Paparella *et al.,* 2022). *L. nobilis* is not only an aromatic plant but has also been valued for thousands of years for its cleansing properties. *L. nobilis* is widely cultivated in many regions of the world, primarily used as a culinary herb (Paparella *et al.,* 2022). The different body parts of *L. nobilis* and its essential oil (EO) have been recognized to possess many interesting properties that have potential applications in many areas, including agriculture, medical, food, pharmaceutical industries (Paparella *et al.,* 2022). The leaves are commonly used as a spicy, aromatic flavoring agent for soups, fish, meats, stews, puddings, vinegar, and beverages (Paparella *et al.,* 2022). The pharmaceutical properties of *L. nobilis* leaves and fruits have been known (Paparella *et al.,* 2022). Due to its antimicrobial and insecticidal activities, bay is used in the food industry as a food preservative (Paparella *et al*., 2022). The cosmetic industry also uses the *L. nobilis* in creams, perfumes, and soaps (Paparella *et al.,* 2022). Essential oil exhibits beneficial functions such as antibacterial, antifungal, and antioxidant activities (Paparella *et al*., 2022). The seeds are reported to have antiulcer and antidiabetic effects (Paparella *et al*., 2022). Currently, the request for natural products for novel applications is increasing day by day; for example, bay laurel berries are used as a natural anthocyanin instead of synthetic dyes in the food, pharmaceutical, and cosmetic industries (Paparella *et al*., 2022). The commercial value of this species derives from its essential oil and from its volatiles in general. The volatiles are secondary plant metabolites found in different parts of plants, including flowers, roots, bark, leaves, seeds, fruit, and wood, produced in the cytoplasm and plant cells plastids (Paparella *et al*., 2022). The volatiles are odorous compounds (<C15) with low molecular mass (<300 Da), high vapor pressure, low boiling point, and a lipophilic moiety (Paparella *et al*., 2022). Essential oils are volatile, complex mixtures of compounds characterized by a strong flavor and aroma formed by plants as specialized metabolites. Volatile compounds are essential components of flavor and aroma in many crops. It has recently been suggested that plant volatiles, due to their aroma, provide sensory clues as to foodstuffs' health and nutritional status (Paparella *et al*., 2022).

Bay leaf is an evergreen perennial shrub in the laurel family (Lauraceae). It has been used for 1000 years and is an essential ingredient in many traditional dishes (Kumari *et al.,* 2023). The genus *Laurus* contains between 2400 to 2500 species, with many varieties found in the Southern Mediterranean region, Eastern Asia's subtropics and tropics, South and North America, the Balkans, and Asia Minor (Kumari *et al*., 2023). The high variability among species is largely due to uncertainty about the exact number of species. Variability is found in the morphology, flower color, growth habitat, leaves, stems, and chemical composition (Kumari *et al.,* 2023). Traditional laurel species include *Laurus azorica* and *L. nobilis*. There are several plants with the common name bay laurel that are not in the genus *Laurus*, including bay rum tree (*Pimenta racemosa)* (Kumari *et al*., 2023). Various names have been given to *L. nobilis.* It is known as teejh pat in Urdu. It is commonly known as bay leaf or sweet bay in English. It is known as waraq ghaar in Arabic. It is known as lorbeer in German. It is known as Dafni in Greek. It is known as teejpatta in India, specifically in Hindi (Kumari *et al*., 2023). Bay leaf unit production ranges from 30 to 70 kg per tree per year in Meghalaya, but the average range is 13 kg of dry leaves in Nepal. In the Udaipur district, approximately 900 tonnes of bay leaf are produced, with Nepal exporting 2100 tonnes to India (Kumari *et al.,* 2023). The Aegean and Eastern Mediterranean regions have the most bay leaf collection areas for export. In 2002, Turkey exported 4869 tonnes of bay leaf to the United States. Bay leaf has 32 genera. Sweet Bay, bay laurel, Grecian Laurel, true bay, and bay tree are all names for Laurus (Kumari *et al.*, 2023). It grows in the tropical and subtropical Himalayas at altitudes ranging from 900 to 2500 meters. It can also be found in tropical and subtropical Asia, as well as Australia, the Pacific region, and South Asia. It is found in various parts of India including Uttarakhand and Himachal Pradesh along with the Western Himalayas, as well as Sikkim, Assam, Mizoram, and Meghalaya (Kumari *et al*., 2023). It is a tough multi-branched tree with smooth bark that can grow up to 10 m tall. It has narrow oblong-lanceolate alternate leaves. The flowers are four-lobed and small; the female has 2-4 staminodes and the male has 8-12 stamens.

When ripe, the fruit becomes ovoid, black, and 10-15 in diameter (Kumari *et al.,* 2023). These are fragrant and aromatic plants native to southern Europe that produce fixed and volatile oil as well as camphor (Kumari *et al.,* 2023). *Laurus nobilis* is an industrially important plant that is used in foods, drugs, and cosmetics. The dried leaves and essential oils are widely used in the food industry to season meats, soups, and fish (Kumari *et al.,* 2023). Its antimicrobial and insecticidal properties are another reason why the bay is used in the food industry as a food additive (Kumari *et al.,* 2023). The fruits contain both volatile oils and fixed oils, which are primarily used in the production of soap (Kumari *et al.,* 2023). It has traditionally been used to treat dermatitis and rheumatism, as well as gastrointestinal issues such as flatulence, eructation, impaired digestion, and epigastric bloating (Kumari *et al.,* 2023). In Turkish folk medicine, the aqueous extract of bay leaf is used for stomachache treatment, as an anti-hemorrhoidal, antirheumatic, diuretic, and snakebite antidote. It has recently been used to prevent migraines and treat diabetes (Kumari *et al.,* 2023). Several studies have shown that flavonoids and phenolic acids, two classes of polyphenolic compounds, have antioxidant properties such as anti-inflammatory actions, inhibition of oxidative enzymes, and free radical scavenging (Kumari *et al.,* 2023). The essential oil (0.8 to 3%) from the leaves contains mostly 1,8-cineol (up to 50%) but also contains eugenol, acetyl and methyl eugenol, alpha, and beta-pinene, phellandrene, linalool, geraniol, and terpineol. The essential oil in dried laurel fruits ranges from 0.6 to 10% (Kumari *et al*., 2023). Essential oil's aroma is primarily due to terpenes (cineol, terpineol, - and -pinene, citral), but it also contains cinnamic acid and its methyl ester. The potential antimicrobial role of laurel essential oil has also been investigated. The anticonvulsant activity of laurel essential oil is due to methyl eugenol, and pinene. Cineol, eugenol, and methyl eugenol, on the other hand, also cause motor impairment and sedation. The essential oil of laurel leaves is also known to have analgesic and anti-inflammatory properties. *L. nobilis* methanolic extracts contain polar compounds (such as phenols, flavones, and flavanols) and exhibit antioxidative activity (Kumari *et al.,* 2023). Bay leaves and fruits have traditionally been used to treat skin rashes, earaches, and rheumatism. It is also a stomachic, astringent, carminative, diaphoretic, stimulant, emetic, emmenagogue, abortifacient, and insect repellent. The cosmetic industry uses essential oil in creams, perfumes, and soaps (Kumari *et al*., 2023).

Laurus nobilis is native to the southern Mediterranean region. It is a small tree from the Lauraceae family (Khodja *et al*., 2023). The leaves of *L. nobilis* are the most exploited part of the plant due not only to the high produced quantity but to the large benefits and extensive use in different fields including culinary, cosmetic, therapeutic, and pharmacologic (Khodja *et al*., 2023). The various beneficial health properties attributed to bay leaves are related to the presence of various bioactive compounds. Chemically, they contain numerous essential elements, some vitamins, and many secondary metabolites such as essential oils (cineole, linalool, and eugenol), phenolic compounds, particularly phenolic acids (ferulic, protocatechuic, and caffeic acids, etc.) and flavonoids (such as catechin, kaempferol, apigenin, quercetin, and their derivatives), and alkaloids (noraporphins and aporphins) (Khodja *et al*., 2023). Laurel leaves are not only used to flavor dishes, but present several beneficial properties that justified their traditional use against numerous illnesses, particularly for rheumatism, indigestion, and diarrhea (Khodja *et al*., 2023). Bay leaves are an essential component of several industrial applications including agrifoods, cosmetics, and pharmaceuticals (Khodja *et al*., 2023). Due to the presence of cited chemical constituents in bay leaves, various biological and pharmacological properties have been reported such as antioxidant, antibacterial, fungicidal, antiviral, insecticidal, wound healing, antimutagen, anticonvulsant, analgesic, anti-inflammatory, and immunostimulatory activities (Khodja *et al*., 2023). Laurel (L. nobilis, family Lauraceae) is an evergreen tree that has been used for 1000 years and is an essential ingredient in cooking and many traditional uses (Khodja *et al*., 2023). The leaves are used in fresh or dried form to flavor culinary preparations and scented and aromatic essential oil in perfumery (Khodja *et al*., 2023). Laurel has been traditionally used for years in traditional medicine, due to its various pharmacological activities, including antimicrobial, antioxidant, anticancer, insecticide, and antifungal (Khodja *et al*., 2023). This tree is native to the southern Mediterranean region. It is cultivated commercially for its aromatic leaves in Algeria, Türkiye, Morocco, Portugal, Spain, Italy, France, and Mexico. It is widely cultivated in Europe and the United States as ornamental (Khodja *et al*., 2023).

Laurus nobilis is an aromatic evergreen tree or large shrub with green, glabrous (smooth) leaves. It is in the flowering plant family Lauraceae (Wikipedia, 2024). It is native to the Mediterranean region and is used as bay leaf for seasoning in cooking (Wikipedia, 2024). Its common names include bay tree (esp. United Kingdom), bay laurel, sweet bay, true laurel, Grecian laurel, or simply laurel (Wikipedia, 2024). *Laurus nobilis* figures prominently in classical Greco-Roman culture. Worldwide, many other kinds of plants in diverse families are also called "bay" or "laurel", generally due to similarity of foliage or aroma to *Laurus nobilis* (Wikipedia, 2024).

Bay leaf**,** leaf of the sweet bay tree, an evergreen of the family Lauraceae, indigenous to countries bordering the Mediterranean (Petruzzello, 2024). A popular spice used in pickling and marinating and to flavour stews, stuffings, and fish, bay leaves are delicately fragrant but have a bitter taste (Petruzzello, 2024). They contain approximately 2 percent essential oil, the principal component of which is cineole (Petruzzello, 2024). The smooth and lustrous dried bay leaves are usually used whole and then removed from the dish after cooking; they are sometimes marketed in powdered form (Petruzzello, 2024). Bay has been cultivated from ancient times; its leaves constituted the wreaths of laurel that crowned victorious athletes in ancient Greece. During the Middle Ages bay leaves were used medicinally (Petruzzello, 2024).

The bay leaf is an aromatic leaf commonly used as a herb in cooking. It can be used whole, either dried or fresh, in which case it is removed from the dish before consumption, or less commonly used in ground form. The flavor that a bay leaf imparts to a dish has not been universally agreed upon, but many agree it is a subtle addition (Wikipedia, 2024a). Bay leaves come from various plants and are used for their distinctive flavor and fragrance. The most common source is the bay laurel. Other types include California bay laurel, Indian bay leaf, West Indian bay laurel, and Mexican bay laurel. Bay leaves contain essential oils, such as eucalyptol, terpenes, and methyleugenol, which contribute to their taste and aroma (Wikipedia, 2024a). Bay leaves are used in cuisines

including Indian, Filipino, European, and Caribbean. They are typically used in soups, stews, meat, seafood, and vegetable dishes. The leaves should be removed from the cooked food before eating as they can be abrasive in the digestive tract (Wikipedia, 2024a). Bay leaves are used as an insect repellent in pantries and as an active ingredient in killing jars for entomology. In Eastern Orthodoxy liturgy, they are used to symbolize Jesus' destruction of Hades and freeing of the dead (Wikipedia, 2024a). While some visually similar plants have poisonous leaves, bay leaves are not toxic. However, they remain stiff even after cooking and may pose a choking hazard or cause harm to the digestive tract if swallowed whole or in large pieces. Canadian food and drug regulations set specific standards for bay leaves, including limits on ash content, moisture levels, and essential oil content (Wikipedia, 2024a).

Fresh and dried Bay leaves are available year-round (Specialtyproduce, 2024). Bay leaves are the leaves of the perennial evergreen shrub *Laurus nobilis*, more commonly known as Laurel (Specialtyproduce, 2024). Laurel trees are a part of the Lauraceae plant family and are related to cinnamon and sassafras (Specialtyproduce, 2024). The leaves of the *Laurus nobilis* tree are also known as Turkish Bay, Grecian Bay, and Mediterranean Bay. Turkish Bay leaves are considered true Bay leaves and should not be confused with California bay leaves, which come from a different plant entirely and have a much more robust and sharp eucalyptus flavor. The easiest way to know the difference between the two leaves is by sight (Specialtyproduce, 2024). California bay leaves are long and thin with a blade-like shape, while Turkish Bay leaves are shorter and rounder. Along with California bay leaves, there are also Mexican bay leaves and Indian bay leaves on the market. These leaves have similar flavor profiles to the Turkish Laurel leaves but are not true Bay leaves (Specialtyproduce, 2024). It is a common misconception that bay leaves are poisonous and should not be consumed. The *Laurus nobilis* plant is not poisonous, however, the leaves and stems of the wild mountain laurel and cherry laurel trees are poisonous, so it is essential to use only culinary-grade bay leaves found in markets for culinary use (Specialtyproduce, 2024). Bay leaves are endemic to the Asia Minor region of the Middle East along the coast of what is now Turkey (Specialtyproduce, 2024). The tree was discovered by the Ancient Greeks over 3,000 years ago and was brought back to Greece and Rome for cultivation (Specialtyproduce, 2024). The leaves were considered sacred in Greek and Roman cultures and were revered for their medicinal properties (Specialtyproduce, 2024). By the Middle Ages, the leaves grew in popularity throughout Europe for both medicinal and culinary use and were cultivated in medieval monasteries (Specialtyproduce, 2024). The leaves were brought to the New World, where they became staples in Mexican and American cuisine (Specialtyproduce, 2024). By the 16th and 17th centuries, the mythical power of the leaves made them famous in England as a ward against witches and the devil, and in Belgium, the trees were cultivated in Bruges to create wreaths and trimmings for export to imperial and royal courts (Specialtyproduce, 2024). A few of these ancient trees can still be found in Bruges, although the bulk of the trees were cut down to provide fuel during the winters of WWI when coal was scarce (Specialtyproduce, 2024). Today Bay Laurel trees are propagated throughout the Mediterranean basin for culinary and ornamental use, thriving in the sun-drenched and fertile lands along the coast (Specialtyproduce, 2024). Turkey remains the world's largest exporter of Bay leaves (Specialtyproduce, 2024). Due to its popularity in many different cuisines, dried Bay leaves can be found easily in any grocery store's spice aisle (Specialtyproduce, 2024).

Bay leaf is an aromatic evergreen tree native to the Mediterranean region (Singha and Mondal, 2024). It has been revered for its culinary and medicinal properties for centuries (Singha and Mondal, 2024). The leaves of this tree are widely used as a flavoring agent in various cuisines and for their potential health benefits due to their rich content of essential oils, antioxidants, and other bioactive compounds (Singha and Mondal, 2024). Additionally, *Laurus nobilis* has a long history of cultural and symbolic significance (Singha and Mondal, 2024). Bay leaves are widely employed as a seasoning in cooking, notably in Mediterranean, Indian, and Caribbean culinary traditions. They impart a subtle, earthy taste to soups, stews, sauces, various dishes, and it is also used in oils, teas, cheeses, and liquors (Singha and Mondal, 2024). Many countries, particularly those with Mediterranean climates, cultivate and export bay leaves. These leaves are often dried and packaged for international markets, bolstering the income of growers and exporters and enhancing their economic importance (Singha and Mondal, 2024). Bay leaves have a long history in herbal medicine due to their potential health benefits, including anti-inflammatory, antioxidant, and digestive properties (Singha and Mondal, 2024). The extraction of essential oils from bay leaves also holds economic value for the pharmaceutical and cosmetics industries. To treat headache, leaf of bay is kept in a nostril or under the headbands to relieve this pain (Singha and Mondal, 2024). 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 (Singha and Mondal, 2024). It has contained valuable essential oils used in perfumes, soaps, and other fragrant products, contributing to the economic significance of bay leaves in the essential oil industry (Singha and Mondal, 2024).

The bay tree is indigenous to Asia Minor. It spread from there to the Mediterranean and then to other countries with similar climates (HFNZ, 2024). According to legend the Delphi oracle chewed bay leaves, or sniffed the smoke of burning leaves to promote her visionary trances (HFNZ, 2024). Bay, or laurel, was famed in ancient Greece and Rome. Emperors, heroes and poets wore wreaths of laurel leaves. The Greek word for laurel is dhafni, named for the myth of the nymph Daphne, who was changed into a laurel tree by Gaea, who transformed her to help her escape Apollo's attempted rape (HFNZ, 2024). Apollo made the tree sacred and thus it became a symbol of honour. The association with honour and glory continue today; we have poet laureates (Apollo was the God of poets), and bacca-laureate means "laurel berries" which signifies the completion of a bachelor degree (HFNZ, 2024). Doctors were also crowned with laurel, which was considered a cure all. Triumphant athletes of ancient Greece were awarded laurel garlands and they have also been given to winners at Olympic games since 776 BC (HFNZ, 2024). Today, grand prix winners are bedecked with laurel wreaths. It was also believed that the laurel provided safety from the deities responsible for thunder and lightning. The Emperor Tiberius always wore a laurel wreath during thunderstorms (HFNZ, 2024). In this review article on Origin, Taxonomy, Botanical Description, Genetics and Cytogenetics, Genetic Diversity, Breeding and Cultivation of Bay Leaf are discussed.

ORIGIN AND DISTRIBUTION

The origin of bay leaf is most probably South Asia, from where it spread to Asia Minor and all over the world (Batool *et al*., 2019). This plant is widespread in the Mediterranean countries, *e.g.,* Algeria, Turkey, Spain, Morocco, Italy, Greece, and Portugal, and cultivated in other temperate and warm parts of the world. It is also found in tropical and subtropical Asia, Australia, the Pacific, and South Asia. Turkey, Italy, Belgium, Algeria, France, Tunisia, Iran, Morocco, Serbia, Greece, Portugal, Centers America, and the Southern United States are the commercial production centers of bay leaves. It is a slow-growing, natural evergreen member of Mediterranean region vegetation. More than 20 million years ago, laurel forests (Laurisilva) covered a large part of the Mediterranean basin in the Tertiary period. However, due to glaciations in the Quaternary period, these subtropical forests moved to more temperate areas: North Africa and the Macaronesian archipelagos. It is grown commercially for its aromatic leaves but is also widely cultivated in Europe and the USA as an ornamental plant (Paparella *et al.,* 2022). *L. nobilis* is native to the Mediterranean region (Khodja *et al*., 2023). The cultivation of laurel grows in the following countries: Türkiye, Algeria, Morocco, Portugal, France, Spain, Greece, India, Pakistan, other Southeast Asian countries, some Pacific Islands, Australia, America Central, Mexico, southern United States, and Canary Islands (Khodja *et al*., 2023). South Europe/ Mediterranean region (Singha and Mondal, 2024). It can be found in tropical and subtropical regions, including the Himalayas, such as the tropical and subtropical Himalayas, the Nilgiris hill, and the Khasi hills.It is also present in various countries, including Pakistan, several Southeast Asian nations, certain Pacific islands, Australia, coastal regions around the Mediterranean, Southern Europe, Greece, Portugal, France, Turkey, Spain, Algeria, Morocco, Belgium, Central America, Mexico, the southern United States, and the Canary Islands. These trees thrive in places with warm climates (Singha and Mondal, 2024). Bay leaf is a native of Mediterranean and grows widely in scrub land woods in Europe and California. It widely cultivated in Europe, America and Arabian countries. It is not cultivated as a commercial crop in India (Indianspices, 2024a). Bay leaf is native to Albania, Algeria, Corse, Cyprus, East Aegean Is., France, Greece, Italy, Kriti, Lebanon-Syria, Libya, Morocco, Palestine, Sardegna, Sicilia, Tunisia, Turkey, Turkey-in-Europe, Yugoslavia. It was introduced to Azores, Baleares, Great Britain, Ireland, Korea, Krym, North Caucasus, Portugal, Spain, Transcaucasus, Vietnam (POWO, 2024**).**

TAXONOMY

Laurus is a genus of evergreen trees or shrubs belonging to the laurel family, Lauraceae. The genus contains three or more species, including the bay laurel or sweet bay, *L. nobilis*, widely cultivated as an ornamental plant and a culinary herb. The number of species in the genus has not yet been fully resolved. 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 (Batool *et al*., 2019). Three species are currently accepted (Wikipedia, 2014c): 1) Laurus azorica, (Seub.) Franco – Azores laurel. Native to the Azores. 2) Laurus nobilis L. – bay laurel, true laurel, or sweet bay. Native to the Mediterranean region. Used as an ornamental plant and culinary herb (one type of bay leaf) used in Mediterranean style dishes. It was also the original source of the laurel wreath of ancient Greece. 3) Laurus novocanariensis Rivas Mart., Lousã, Fern.Prieto, E.Días, J.C.Costa & C.Aguiar – native to Madeira and the Canary Islands. Formerly included in *L. azorica*. Bay leaf has been used for 1000 years, and it is an essential ingredient in cooking and in many traditional practices (Batool *et al.,* 2019). 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**)** (Batool *et al*., 2019).

The laurel belongs to the Lauraceae family. It is also known as the laurel sauce or the laurel of Apollo. The Laurales constitute a large order which brings together 9 families and about 3000 species. The main families of this order are Calycanthaceae, Lauraceae, and Monimiaceae. The Lauraceae family comprises more than 55 genera and 2500-3500 species. The genus Laurus includes three major species: *Laurus azorica*, also called *Laurus canariensis*, growing in the forests of the Azores islands; *L. nobilis*, in the Mediterranean region and *Laurus novocanariensis*, present on the island of Madeira, the Canaries and Morocco (Khodja *et al*., 2023).

Laurus is a genus of evergreen trees or shrubs belonging to the laurel family, Lauraceae. The genus has three or more species, including bay laurel or sweet bay widely cultivated as a ornamental plant and culinary herb. Other species include *Laurus azorica* (*Azores laurel*) and *Laurus novocanariensis*. Bay laurel's symbolism decorates many pages of Roman and Greek mythologies. Many version of the Bay Laurel legend are profusely colored with name-dropping of Apollo, Cupid, Daphne, Bay laurel was used to fashion the laurel wreath of ancient Greece, a symbol of highest status. A wreath of bay laurel was used as the prize at the Pythian Games in honor of Apollo. Pythia the priestess of Apollo was reputed to chew laurel leaves from a sacred tree to induce a trance from which she uttered oracular prophecies. In Roman culture, the laurel was a symbol of victory and immortality. In the language of achievement, it provided roots to words like baccalaureate and poet laureate, along with expressions like "assuming the laurel"and resting on one's laurels" (Yue gui, 2024).

Heterotypic Synonyms (POWO, 2024):

- ***Laurus angusta***
- ***Laurus nobilis*** *var.* ***angustifolia***
- ***Laurus nobilis*** *var.* ***floribunda***
- ***Laurus nobilis*** *var.* ***flos-pleno***

- ***Laurus nobilis*** *var.* ***lanceolata***
- ***Laurus nobilis*** *f.* ***lanceolata***
- ***Laurus nobilis*** *var.* ***latifolia***
- ***Laurus nobilis*** *f.* ***latifolia***
- ***Laurus nobilis*** *var.* ***longifolia***
- ***Laurus nobilis*** *var.* ***rotundifolia***
- ***Laurus nobilis*** *var.* ***undulata***
- ***Laurus nobilis*** *var.* ***variegata***
- ***Laurus papillosa***
- ***Laurus salicifolia***
- ***Laurus tenuifolia***
- ***Laurus undulata***

BOTANICAL DESCRIPTION

L. nobilis is an evergreen shrub, or more rarely a tree attaining a height of 15–20 m. The smooth bark may be olive green or of reddish hue. The luxurious, evergreen leaves are alternate with short stalks, lanceolate or lanceolate oblong, acuminate, 5–8 cm or longer and 3–4 cm wide, coriaceous, pellucid-punctate, and with revolute, entire wavy margins; the upper surface is glabrous and shiny, olive green to brown and the lower surface is dull olive to brown with a prominant rib and veins. The flowers are small, yellow in colour, unisexual and appear in clusters. The fruits (berries) are cherry-like, succulent, purple to black in colour, void, coarsely wrinkled and contain a single seed with loose kernel. The dried fruits are drupaceous, ovoid, about 15 mm long and 10 mm wide. The outer surface is glabrous, shining, nearly blackand is coarsely wrinkled owing to the shrinkage of the narrow succulent region beneath epidermis. The remain soft the style appear as a small point at the apex and a small scar at the base marks the point of attachment of the fruit to the thalamus. The endocarp is thin and woody and the testa is adherent to its inner surface. The entire pericarp is about 0.5 mm thick. The kernel of the seed consists of two large plano-convex cotyledons and small superior radicle; it is brownish-yellow, starchy and oleaginous, with an aromatic odour and aromatic and bitter taste (Kumar *et al.,* 2012). Bay leaf is native to South Europe. It is a multibranched, 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. 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 (Batool *et al.,* 2019).

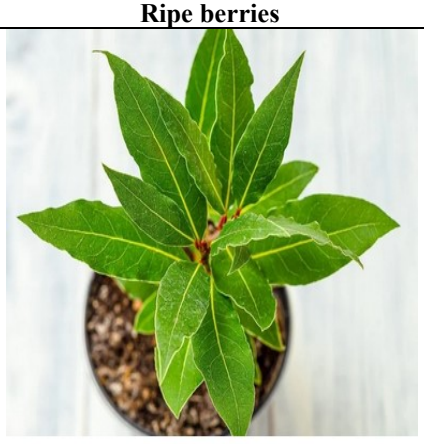
L. nobilis is an evergreen shrub that can reach a height of 15 to 20 m in the natural environment. However, the dimensions are usually smaller (4–6 m) in gardens and yard spaces. It can be grown as a single-trunked tree or a multi-trunked shrub and adapts well to pruning and shaping, and can be used for topiary or grown as a standard. The bark is smooth and has an olive green or reddish hue. The leaves are lanceolate or lanceolate-acuminate, having an alternate leaf arrangement with short stalks. They are 5–8 cm in length or longer and 3–4 cm wide, coriaceous, pellucid-punctate, and with revolute, entire wavy margins. The leaves upper surface is glabrous and shiny, olive-green to brown, while the lower surface is dull olive to brown with a prominent mid-rib and veins. When crushed, the leaf has a characteristic fragrance, and its taste is bitter and aromatic. The plants are dioecious, with star-shaped male and female flowers on different plants. The flowers are small, yellow-white with four tepals. It blooms in the spring, between March and May. The flowers are fragrant, gathered in inflorescences that develop in leaf axils or branch tips. The female inflorescence possesses few flowers with a superior ovary containing one loculus, while the male inflorescence has numerous flowers with several stamens attached to the corolla. The fruits are berry type, single-seeded with a loose kernel. The olive-like berries of bay laurel are green in color. Firstly, when it matures, it becomes a bright bluish-black color. The *L. nobilis* dried fruits are drupaceous, ovoid, about 15 mm long, and 10 mm wide (Paparella *et al*., 2022).

Laurel is an evergreen shrub or tree up to 12 m tall in the wild and cultivation is usually pruned to 2-3 m tall. The species naturally has several trunks. The bark of the stem and branches is dark brown to almost black. The foliage of *L. nobilis* is evergreen with a dark green color above and lighter below. The leaf shape is elongated, even lanceolate, with pointed tips and a short petiole. The blade has a slightly thickened, wavy edge that curves inward. The leaves are approximately 3 to 5 cm wide by 10 cm long. Hairy at first, they then take on a shiny and hairless appearance. Laurel is a dioecious plant, that is, the male and female flowers are on separate feet. Flowering takes place from March to May. The inflorescence is made up of small umbels of four or five axillary flowers. It is creamy-white to greenish-white in color, unlike other Lauraceae which are trimers, the flower of the genus Laurus is a dimer, which can be seen more easily on a floral diagram. As a bud, the flowers are enclosed in an involucre of bracts. Since the petals and sepals are not distinct, we will speak of tepals. The tepals are arranged in two whorls, with a slightly smaller size for those located internally (Khodja *et al*., 2023).

The laurel is an evergreen shrub or small tree, variable in size and sometimes reaching 7–18 m tall. The genus *Laurus* includes three accepted species, whose diagnostic key characters often overlap. The bay laurel is dioecious (unisexual), with male and female flowers on separate plants. Each flower is pale yellow-green, about 1 cm diameter, and they are borne in pairs beside a leaf. The leaves are glabrous, 6–12 cm long and 2–4 cm broad, with an entire (untoothed) margin. On some leaves the margin undulates. The fruit is a small, shiny black drupe-like berry about 1 cm long that contains one seed (Wikipedia, 2024). Bay Leaf or Laurel Leaf are dried leaves or an evergreen shrub or more rarely a tree attaining a height of 15 to 20 m. The upper surface of the

leaf is glabrous and shiny, olive green, and lower surface is dull olive to brown with a prominent rib and veins. The aroma of the crushed leaves is delicate and fragrant and taste is aromatic and bitter. The size of the leaves is ranging from 2.5 to 7.5 cm in length and 1.6 to 2.5 cms in breadth. The shape is elliptical and tapering to a point at the base and tip of the leaves (Indianspices, 2024a). Bay leaves are elliptic to oval in shape, measuring 5 to 10 cm in length, and taper to a slender point. When fresh, these short-stemmed, dark green leaves are smooth with a glossy sheen and have a light green underside. When dried, the leaves take on an ashy, olive-green hue and have a brittle texture, while the edges of the leaf are jagged and slightly curled. Bay leaves give off a woodsy aroma of balsam and honey with hints of nutmeg, clove, and pepper. Crushing the dried leaves also releases a strong scent of menthol and eucalyptus. The immediate flavor of Bay leaves is astringent and bitter with a bite of eucalyptus and menthol that lingers on the palate. When cooked, the more bitter and astringent qualities of the leaf mellow, leaving a nuanced savory and slightly sweet tea-like flavor with mild hints of pepper, clove, and mint (Specialtyproduce, 2024).

Bay leaf is an evergreen shrub that can attain heights ranging from 15 to 20 meters when growing naturally. However, in cultivated gardens and yards, it typically assumes more modest dimensions, generally around 4 to 6 meters. This plant is versatile in its growth patterns and can be nurtured as either a single-trunked tree or a multi-trunked shrub. It responds well to pruning and shaping, making it suitable for topiary designs or as a standard tree. The bark is smooth and can exhibit shades of olive green or reddish hues. The leaves are lance-shaped with pointed tips and are arranged alternately on short stems. They typically measure between 5 to 8 cm in length, occasionally longer, and 3 to 4 cm in width. These leaves are leathery in texture, adorned with tiny translucent dots. On the upper side, the leaves are smooth and shiny, varying in color from olive-green to brown, while the underside appears dull in shades of olive to brown, displaying a noticeable central rib and veins. When the leaves are crushed, they emit a distinctive fragrance and possess a bitter and aromatic taste. Bay leaf is dioecious characteristics, meaning male and female flowers appear on separate plants. Bay laurel has small, fragrant yellow-white flowers with four tepals, clustered in leaf axils. Female inflorescences have few flowers with a single ovary, while males have many flowers with multiple stamens. The green fruit resembles olives but matures into bluish-black berries, each containing a single seed in a loose kernel. When dried, the fruit becomes ovoid, measuring about 15 mm in length and 10 mm in width (Singha and Mondal, 2024). An evergreen shrub, a bay tree can reach over 7 m and 2 m wide if not clipped. The distinctive leaves are dark green, leathery and ovate, making this an ornamental as well as useful plant. The bark of this tree is smooth and has a reddish-green color. The stems are woody and make an ideal base for herbal and floral arrangements. Flowers bloom in late spring and are small and yellow, appearing at the base of the leaf stem. These flowers then turn into hard, green berries which will eventually become purple/black. Sweetly aromatic, the leaves have a strong, distinctive taste and retain their flavor well during cooking (HFNZ, 2024). Botanical description is given in Figure 1.

		
Bay leaf tree	**Ripe berries**	**Seeds**
		
Seedling	**Seedling**	**Male flowers**

Continue ……

Female flowers

Newly opening flowers

Berries

Drying

Left: fresh bay leaf. Right: dried bay leaf.

Powder

Essential oil

Tea

Fig. 1. Botanical Description

Fruit

The fruit is a fleshy aromatic drupe, 10-15 mm long, ovoid, bright green at first and purplish black when ripe in autumn. It is made up, from the outside to the inside of the pericarp, mesocarp, and endocarp and contains a single seed, formed by two cotyledons rich in fat. The first two parts are dark, a few millimeters thick and makeup about 36% of the weight of the fresh fruit, the remainder, 64%, being made up of the endocarp and the seed. The berries remain on the plant all winter, sometimes until spring, which may coexist with the new flowering (Khodja *et al*., 2023).

Sex Determination

Considering that L. nobilis is a dioecious plant, identifying sex is the most daunting task to differentiate male and female flowers at an early stage of development. Morphological characters of flower height, flowering time, and flower numbers were used for the sex differentiation in L. nobilis. Male flowers were reported to have 8–14 stamens, while female flowers have 2–4 staminodes. Male plants produce a higher number of flowers than female plants, and male flower life is shorter than female flowers. Mature male flower height is between 5.7–6.2 mm, which is more or less double the size of the female flower. The mechanism of sex expression has not been investigated at the molecular level in L. nobilis. Sex determination by external morphology and cytogenetic studies is not user-friendly. Compared to these techniques, sex determination on a molecular basis is more effective and timesaving and provides more accurate results. Moreover, a molecular approach would help reduce the efforts of breeders and cultivators in saving field space and time. Several molecular markers have been developed and characterized to a certain extent, proving beneficial for discriminating male from female plants in several dioecious crops (Paparella *et al*., 2022).

Pollination

Bay leaf flowers are small and yellow-green, typically arranged in clusters. This unique shape and color not only make them visually appealing but also play a crucial role in attracting specific pollinators. The arrangement of these flowers facilitates both self-pollination and cross-pollination. By clustering together, they increase the chances of pollen transfer, ensuring that the plant

can reproduce effectively. The structure of bay leaf flowers promotes self-pollination through the close proximity of male and female parts within the same flower. This design allows for efficient pollen transfer, even without external pollinators. In addition to self-pollination, the color and scent of the flowers attract bees and butterflies. These pollinators are essential for cross-pollination, which enhances genetic diversity and strengthens the overall health of the bay leaf population. The interplay between flower structure and pollination mechanisms is vital for the survival of the species. By ensuring both self and cross-pollination, bay leaves can thrive in various environments, adapting to changing conditions and maintaining their genetic integrity (Rankel, 2024). As we delve deeper into the pollination process, we'll explore how these mechanisms work in practice, ensuring the continued success of bay leaf plants. Self-pollination occurs when pollen transfers within the same flower. This process ensures that the Bay Leaf plant can reproduce even when pollinators are absent, providing a reliable means of propagation. Cross-pollination involves the transfer of pollen between different flowers, enhancing genetic diversity. Primary pollinators for Bay Leaf include bees, butterflies, and other beneficial insects, all of which play a crucial role in successful fertilization. These pollinators are attracted to the Bay Leaf's yellow-green flowers, which offer both color and scent. Their interactions not only facilitate the transfer of pollen but also contribute to the resilience of the plant population (Rankel, 2024). Genetic diversity is vital for the health of Bay Leaf plants, as it leads to stronger offspring. By promoting cross-pollination, these interactions help ensure the long-term survival and adaptability of the species. With a solid understanding of the pollination process, we can now explore the natural mechanisms that support pollen transfer. Pollen transfer is a crucial process in the reproductive cycle of bay leaf plants. It involves the movement of pollen from the male parts, known as stamens, to the female parts, called pistils. Wind and pollinators play significant roles in this transfer. While some plants rely on the breeze to carry pollen, bay leaf plants benefit greatly from the activity of bees, butterflies, and other beneficial insects. Successful pollination directly impacts seed production and overall plant health. When pollen reaches the stigma of a flower, it triggers fertilization, leading to the formation of seeds. Moreover, cross-pollination enhances genetic diversity, resulting in stronger offspring. This diversity is vital for the resilience of bay leaf plants, enabling them to adapt to changing environmental conditions. Understanding these mechanisms not only highlights the beauty of nature but also emphasizes the importance of protecting our pollinators. As we delve deeper into the next section, we will explore effective hand pollination techniques to support bay leaf reproduction (Rankel, 2024).

Pollination Type

Bay leaf has separate male and female flowers on distinct trees, a condition known as dioecious. This means that individual flowers are either exclusively male or female, and trees themselves produce only one type of flower. While both male and female trees are needed for seed production, the main utility of bay laurel lies in its leaves, which are harvested for culinary purposes. These leaves can be collected from either male or female trees. The pollination process in bay laurels is facilitated by bees. Successful pollination, crucial for fruit development, is achieved through cross-pollination. This involves the transfer of pollen from male flowers to female flowers, ensuring the production of bay leaf seeds and the continuation of the species (Singha and Mondal, 2024

Hand Pollination Techniques

Hand pollination can be a rewarding way to ensure the successful reproduction of your bay leaf plants. This technique is especially useful when natural pollinators are scarce. Start by identifying the male and female parts of the flowers. The male parts, known as stamens, produce pollen, while the female parts, called pistils, are responsible for receiving it. Next, gather pollen from the male flowers. Use a small brush or cotton swab to gently collect the pollen, ensuring you don't damage the flower in the process. Once you have collected the pollen, it's time to transfer it. Carefully apply the pollen to the stigma of the female flowers, which is the receptive part of the pistil. Timing is crucial for effective hand pollination. Aim to perform this task during the peak flowering periods, as this is when the flowers are most receptive to fertilization. By following these steps, you can enhance the chances of successful pollination in your bay leaf plants. This not only ensures their reproduction but also contributes to the overall health of your garden. As you explore hand pollination, consider the broader context of supporting pollinators in your environment. This will help create a thriving ecosystem for your plants and their pollinators (Rankel, 2024).

GENETICS AND CYTOGENETICS

Different ploidy levels (2n = 36, 42, 48, 54, 60, 66, 72) have been reported in *Laurus,* with tetraploidy (2n = 4x = 48) being the most frequent karyotype. Thus, the chromosome number in most of the laurel is 2n = 48. Out of 48, 40 are metacentric, and eight are submetacentric chromosomes. The mean chromosome length is 4.01 ± 0.1 µm (Paparella *et al*., 2022). 2n = 48 (most common number in a polyploid series of 36, 42, 48, 54, 60, 66, 72) (Singha and Mondal, 2024).

GENETIC DIVERSITY

Laurus nobilis L. (Lauraceae), common laurel, has a scattered distribution throughout the Mediterranean, with only few autochthonous populations. Our goal was to elucidate if this species has range-wide genetic structure and if planted material can be traced back to its origin. Genetic diversity was investigated using 4 polymorphic nuclear microsatellites (nSSR) transferred from two species of Lauraceae. Sixty-six laurel trees were selected from 7 widely separated populations within the Mediterranean distribution area of the species. A total of 34 alleles (9 alleles per locus on average) were found. Mean genetic diversity within-population (Hs), was 0.558. Genetic differentiation among populations (GST = 0.243) was high compared to that of other angiosperms. *Laurus nobilis* can be separated into two main gene pools, one from western (Tunisia, Algeria and France) and the other from eastern Mediterranean (Turkey). The Algerian, Tunisian and French populations presented a strong genetic similarity,

compatible with the fact that North African laurel populations could be recently introduced from north-western Mediterranean stock (Marzouki *et al.,* 2009). Molecular characterization and genetic relationships of 94 Turkish laurel genotypes were determined by ISSR and SCoT markers. The experiment was conducted with 16 ISSR and 10 SCoT markers. While 348 of 373 bands were polymorphic with a 94.04% polymorphism rate, Nei's genetic distances ranged between 0.17 and 0.70 with 0.39 mean in ISSR. In SCoT, 175 of 227 bands were polymorphic with 76.07% polymorphism rate, and Nei's distances varied between 0.12 and 0.51. Sufficient genetic diversity determined with diversity parameters consisting the average Shannon's information index (ISSR:0.46, SCoT:0.35), the overall gene diversity (ISSR:0.19, SCoT:0.18), and the effective number of alleles. AMOVA (Analysis of molecular variance) revealed most of the variation was within genotypes (%96). Neighbor- joining algorithms, principal coordinate analysis (PCoA), and model-based structure resulted in harmony and clustered according to the geographical regions and provinces they collected. Genotypes were divided into two groups in ISSR and SCoT with UPGMA clustering resulting in a similar polymorphism distribution. The correlation coefficient (r) determined by marker systems' Nei's genetic distance matrices was 0.88. The results of the study put forward resources for advanced breeding techniques, and contribute to the preservation of genetic diversity, and management of genetic resources for the breeders (Yilmaz and Çiftçi, 2021). A total of 203 genotypes were characterized by various morphological and biochemical traits from Hatay province, Turkey, and 95 genotypes were selected for their superior traits, considering the following characteristics: fruit weight, kernel weight, kernel ratio, dry leaf ratio, leaf area, berry oil content, berry flesh oil content, kernel oil content, ovality coefficient, lauric acid ratio, oleic acid ratio, palmitic acid ratio, chlorophyll SPAD value, EO content, 1,8-cineol content, EO components. Furthermore, 149 female trees were preselected from the same region, and then four berries of 48 female genotypes were characterized for their pomological and chemical properties. Significant variation was recorded among the genotypes for different traits, including berry weight (0.77–1.76 g), kernel weight (0.49–1.12 g), kernel ratio (51.73–77.44%), dry matter ratio (44.89–69.44%), berry oil ratio (18.92–37.85%), berry flesh oil ratio (20.76–53.98%) and kernel oil ratio (11.75–27.49%). In the same study, the fatty acid content ranged between 12.74–31.19% for lauric acid, 12.35–19.91% for palmitic acid, 30.35–44.43% for ole acid, and 15.93–26.75% for linoleic acid. Among the genotypes, genotype K9 for high lauric acid and low palmitic acid ratio, genotype ER6 for berry weight, B30 for kernel weight, and ER14 for kernel oil ratio were found to be promising genotypes (Paparella *et al*., 2022). Genetic diversity of 20 phenotypes was studied using 10 RAPD primers. The percentage of oil extracted from fruits and leaves was estimated to select the best genotype. The percentage of seed germination was estimated and some selected genotypes were propagated by rooting mature cuttings, grafting, and cuttings. The results showed differences between the studied genotypes in terms of fruit shape (elongated, oval, spherical), gradient in size, weight, and mottled trait. The fruits of the KSS8 genotype were the best in terms of weight and size, with an average fruit weight (2.56 g) and an average size of (2.35 cm^3) and its fruits were oval in shape. The results of RAPD showed a genetic diversity of bay leaf with a percentage of 78.3. The best genotypes KSS1, KSS5, KSS8 and KA0 were selected. Based on the percentage of oil in fruits that reached more than 58% in the tissues of the pericarp and more than 42% in the tissues of the endocarp, the percentage of seed germination was 85% without significant differences between the genotypes. The treatment 2000 ppm showed a rooting rate of more than 66% after 6 months. The percentage of grafting was 10%. We suggest introducing bay leaf into the agricultural system as a medicinal, aromatic, nutritional plant with a high investment value (Mazen *et al.,* 2024**).**

BREEDING

Plant Genetic Resources

This plant has been extensively studied for its essential oil and its volatile composition, having various medicinal properties. However, almost no effort has been made regarding the breeding aspects such as genetic resource characterization, conservation, genetic improvement, and genomics. Variations in *L. nobilis* have not been fully catalouged. Usually, the leaves are collected from naturally grown trees, which have a wide variation in morphological and biochemical traits. For example, there are no registered *L. nobilis* cultivars in Turkey. A collection of 203 genotypes were characterized for morphological and biochemical traits from Hatay province, and 95 genotypes were selected for their superior characteristics (Paparella *et al*., 2022). According to gardeners' preference, most of these cultivars are developed by commercial nurseries, like "Sunspot," a cultivar with gold-variegated foliage, and "Brilliant times," with a reddish stem with bright yellow leaves. There is an urgent need to develop the *L. nobilis* genebank for the collection, documentation, regeneration, distribution, and conservation of genotypes worldwide. The germplasm must be collected from diversity-rich areas of the world to enrich the genetic resources. It will act as a reservoir of useful genes and alleles, contributing to the genetic enhancement and providing raw material for further improvement programs. Several studies have been conducted on the *L. nobilis* species and their variability, especially for the essential oil and its volatile composition and various medicinal properties. These collections could be further utilized for *L. nobilis* improvement (Fig. 2) (Paparella *et al*., 2022).

Propagation: Bay laurel trees can be reproduced using various methods, such as cuttings, layering shoots, seeds in vitro culture techniques. Bay laurel trees can be multiplied by taking cuttings from their stems or using layering shoots. However, it is worth noting that stem cuttings can be slow to establish roots. Another option is to propagate bay laurel trees from seeds. In early autumn, when the trees berries ripen, you can extract the individual seeds from the berries and plant them directly in the soil. Keep in mind that bay laurel seeds may take anywhere from six months to a year to germinate. Once the seeds have germinated, you can transplant the seedlings into pots and nurture them in a greenhouse during their first year of growth. After this initial period, they can be planted in their permanent outdoor locations in early summer. It is advisable to protect these young trees from frost until they are one to two years old. Alternatively, you can propagate bay laurel trees by digging up rooted suckers that grow at the base of established trees and transplanting them into pots or directly into the ground (Singha and Mondal, 2024). When it comes to relocating bay leaf trees, it is vital to provide ample space for each tree. It is recommended to maintain approximately 4 to 6 m between individual trees. This spacing allows them sufficient room for growth and optimal development. If you have one acre of land, you can accommodate roughly 300 bay laurel plants. The best time to undertake the transplanting process is during the

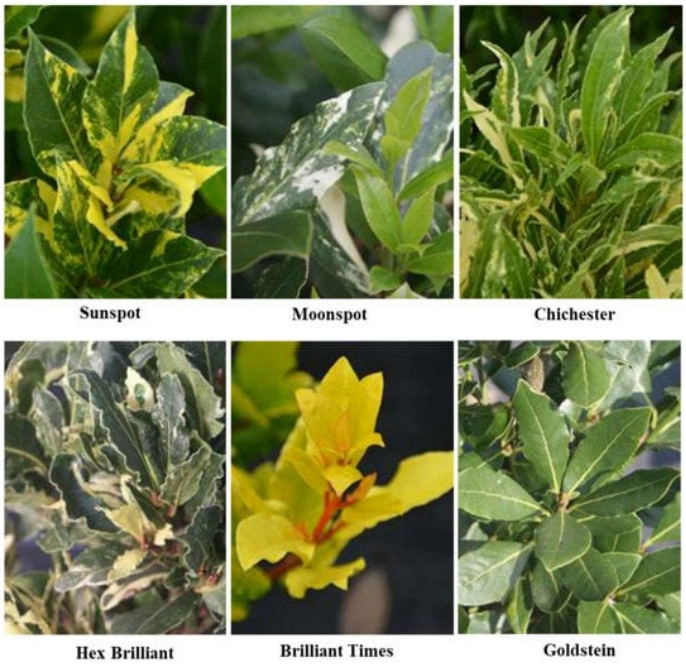


Figure 2. Variation in leaf morphology of some of the *L. nobilis* L. cultivars

cooler months, During the transplanting procedure, take care when handling the root ball to prevent any harm to the plant (Singha and Mondal, 2024). Bay leaf trees grow slowly, meaning they do not have high nutrient requirements when cultivated in outdoor landscapes. However, if growing in containers, providing extra nutrients is beneficial. For containers, it is recommended to apply additional fertilizer during the spring season. You can use a balanced organic fertilizer like fish emulsion and kelp. It is also a good idea to freshen the top layer of soil in the container each spring, taking care not to disturb the shallow roots. For improve soil quality, particularly in outdoor planting, you can enrich the soil by incorporating well-rotted farmyard manure as an organic fertilizer. If there are specific deficiencies in soil nutrients, you can also consider applying nitrogen and potash to address those deficiencies (Singha and Mondal, 2024). Bay laurel trees can be reproduced using various methods, such as cuttings, layering shoots, seeds in vitro culture techniques. Bay laurel trees can be multiplied by taking cuttings from their stems or using layering shoots. However, it is worth noting that stem cuttings can be slow to establish roots. Another option is to propagate bay laurel trees from seeds. In early autumn, when the trees berries ripen, you can extract the individual seeds from the berries and plant them directly in the soil. Keep in mind that bay laurel seeds may take anywhere from six months to a year to germinate. Once the seeds have germinated, you can transplant the seedlings into pots and nurture them in a greenhouse during their first year of growth. After this initial period, they can be planted in their permanent outdoor locations in early summer. It is advisable to protect these young trees from frost until they are one to two years old. Alternatively, you can propagate bay laurel trees by digging up rooted suckers that grow at the base of established trees and transplanting them into pots or directly into the ground (Singha and Mondal, 2024).

Usually, sweet bay is purchased as a seedling from a nursery, but growing bay tree seeds is also possible, provided the grower has some patience since bay seed germination is a slow process. As mentioned, while not the usual method of propagation, growing bay tree seeds is possible, if at times frustrating. Why frustrating? Bay seed germination is notoriously long, up to six months. With such a lengthy germination period, seeds may rot before germination occurs. To hasten guarantee viable germination, never plant seeds that are dried out. Order your seeds from a reputable purveyor and when they arrive, soak them in warm water for 24 hours and then plant them immediately. Also, germinate multiple seeds to allow for germination failure and rotting. If you plan to harvest seeds from an existing tree, look for a female. Sweet laurels are dioecious, meaning that male and female flowers are borne on separate plants. In the spring, inconspicuous pale yellow-green flowers bloom followed by small, purplish black, oval berries. Each berry has a single seed found on mature female trees. Fill a seed tray with a layer of moist soilless seed mix. Spread the seeds out over the surface, keeping them about 5 cm apart and press them gently into it. Cover the seeds with a bit more moist soilless mix. Dampen the medium with a spray bottle. Make sure to just lightly moisten, not saturate the mix or the seeds will rot. Keep the seeds moist to slightly on the dry side as they germinate. Keep an eye on the progress of the seeds and be patient. It can take from ten days to up to six months for the bay seeds to germinate. Transplant the bay seedlings into pots or into the garden proper when leaves begin to appear. Or Look for small drupes that have turned dark purple or black. Pluck them and remove the pericarp. Plant them as soon as possible after taking the coating off.Or buy *L. nobilis* seeds

Varieties: The most common variety of bay leaf is that of the bay laurel tree, which are also known as Turkish bay leaves. There is, however, another variety of bay leaves known as California bay leaves. These come from the California bay tree, or California laurel, which is a different type of tree. California bay leaves are thinner, longer, stronger in flavor, and have a minty taste. They are not interchangeable due to their flavor differences.

When a recipe calls for bay leaves, you can assume it means dried Turkish bay leaves unless otherwise noted.

Harvest (MasterClass, 2021).

- **Pick your leaves**. It's best to wait two years before harvesting any leaves from your bay tree. Once your green leaves have grown to a healthy, large size, harvesting is as easy as picking the leaves off the tree. The best time of day to pick bay leaves is early in the morning because they will retain their aromatic qualities best at this time.
- **Dry your leaves**. Lay your bay leaves out on a piece of parchment paper in a warm, dry room. Leave your leaves to dry for two weeks. Once they are dried, you can use them whole or crush them.
- **Store your leaves**. You can store fresh leaves in the fridge in an airtight container for up to two weeks. Dried leaves can be left at room temperature for up to two years before they start to lose their aroma. Alternatively, you can freeze dried bay leaves to ensure that they maintain their flavor for longer.

Chemical constituents

The most abundant component found in laurel essential oil is 1,8-cineole, also called eucalyptol. The leaves contain about 1.3% essential oils (*ol. lauri folii*), consisting of 45% eucalyptol, 12% other terpenes, 8–12% terpinyl acetate, 3–4% sesquiterpenes, 3% methyleugenol, and other α- and β-pinenes, phellandrene, linalool, geraniol, and terpineol. It contains lauric acid also. Both essential and fatty oils are present in the fruit. The fruit is pressed and water-extracted to obtain these products. The fruit contains up to 30% fatty oils and about 1% essential oils (terpenes, sesquiterpenes, alcohols, and ketones). This laurel oil is the characteristic ingredient of Aleppo soap. The chemical compound lauroside B has been isolated from *Laurus nobilis* (Wikipedia, 2024).

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–trinidrokside benzoic acid) and glucose. 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. 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 (Batool *et al.,* 2019). 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.The essential oils in leaves vary from 0.8% to 3% and dry bay fruits from 0.6% to 10% (Batool *et al.,* 2019).

Bay leaves are an excellent source of vitamin A and vitamin C. The leaves are also high in folic acid, niacin, pyridoxine, pantothenic acid, and riboflavin. Trace amounts of minerals, including copper, potassium, calcium, manganese, iron, selenium, zinc, and magnesium, can also be found in the leaves. The leaves are high in the essential oils cineol and eugenol, giving the leaves their eucalyptus and menthol aroma. The high levels of these oils within the leaves have led to their use to soothe stomach ulcers, relieve gas and colic, and soothe the throat and cough. Historically the leaves were also used as a bug repellent and to treat insect bites (Specialtyproduce, 2024). The leaves of the European / Mediterranean plant Laurus nobilis contain about 1.3% essential oils (*ol. lauri folii*), consisting of 45% eucalyptol, 12% other terpenes, 8–12% terpinyl acetate, 3–4% sesquiterpenes, 3% methyleugenol, and other α- and β-pinenes, phellandrene, linalool, geraniol, terpineol, and also contain lauric acid (Wikipedia, 2024a). In the fruit there are essential oils and fatty oils present. The fruit is pressed and water extracted to obtain these products. The fruit contains up to 30% fatty oils and about 1% essential oils (terpenes, sesquiterpenes, alcohols and ketones). The leaves contain about 1.3% essential oils (Ol. Lauri folii), consisting of 45% eucalyptol, 12% terpenes, 3-4% sesquiterpenes, 3% methyleugenol and other α- und β-pinenes, phellandrene, linalool, geraniol and terpineol (HFNZ, 2024).

Uses

Bay leaf can be used in the form of Powder, paste, whole leaf, decoction. It can be used both external and internal purposes (Chauhan, 2019).

External use (Chauhan, 2019): Make the paste of the leaves, apply it on the chest and leave overnight. Inhaling the vapor also shows similar effects and eliminates bacteria that causes bad effects on respiratory tract. To improve the health of hair follicles and eliminate dandruff, soak some bay leaves in the water when leaves become soft and then after shampooing rub them on your scalp. Apply the bay leaf paste on the painful conditions like headache, migraine (Chauhan, 2019).

Internal use (Chauhan, 2019)**:** Bay leaf shows a very strong effect on the gastrointestinal system. It helps in removing toxins from the stomach. It is also helpful in various conditions like Irritable Bowel Syndrome (IBS), or even reduces the symptoms of Celiac's disease. Bay leaf contains anti-bacterial properties. The essential oil from bay leaves can be apply on chest, it will help to reduce various respiratory condition. Bay leaf helps in reducing inflammation throughout the body. Bay leaf helps to eliminate low-density lipoprotein (bad cholesterol) and beneficial in cardiovascular system. Bay leaves improve insulin receptor function

and help to regulate blood sugar levels in the body. It reduces the level of LDL which is known as bad cholesterol and increased levels of HDL (good cholesterol) in patients with type 2 diabetes. Bay leaf also has antifungal properties which especially fight against the Candida infection. The leaf prevents the adhesion of candida to the cell walls, thereby stopping its penetration through the membranes. Bay leaves contain phytonutrients, catechins, Linalool, and parthenolide in it which helps to protect our body from the influence of cancer-causing free radicals. Free radicals can convert healthy cells into cancerous cells and Bay leaves may stop this activity because it contains these antioxidants and organic compounds. Bay leaves containLinalool which can help to reduce the stress hormone level in the body, especially when used as an aromatherapy. An increase in stress hormone levels can be dangerous, so bay leaves provide you with calming effect and relaxation even when you are in high-anxiety moments (Chauhan, 2019):

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 stomach aches, clear up mucus in the lungs, colds, and sore throat. Poultice of bay leaves is used for the treatment of rheumatism and neuralgia. 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. Bay is great to add flavor and taste to food and many dishes with added health benefits (Batool *et al*., 2019). 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 (Batool *et al*., 2019). 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 odour 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 (Batool *et al.,* 2019). Bay leaves having antidiarrheal, antiinflammatory, and antidiabetic 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*., antiinflammatory, inhibition of alcohol absorption, and may improve liver glutathione S-transferase activity. 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. Essential oil of this leaf also has analgesic and many antiinflammatory activities. Many polar compounds such as flavones, flavonol, and phenols are present in the methanolic extract of bay leaf and show antioxidative activity (Batool *et al.,* 2019). Traditionally, it has been used as herbal medicine against number of diseases such as rheumatism, sprains, indigestion, earaches, and to enhance perspiration. It was reported by different researches that bay leaf can also be used to treat diabetes and migraine. 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. 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 antistress 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 (Batool *et al.,* 2019).

Medicinal Uses: Traditionally, bay leaves have been used in herbal medicine against several diseases such as rheumatism, sprains, indigestion, and earaches. The leaves having anti-diarrheal, anti-inflammatory, and anti-diabetic activity are used for improving the response of the immune system. These leaves contain numerous molecules, which are responsible for anti-inflammatory

activity, inhibiting alcohol absorption, and which can enhance the activity of glutathione S-transferase in the liver (Khodja *et al*., 2023).

Culinary Uses: Different parts of plants can be eaten as spices, including bark, flowers, leaves, roots, stems, and seeds. Spices can also be consumed in fresh, dried, and powdered forms. Laurel leaves are mainly used to flavor several dishes, stews, soups, sauces, fish, meats, and drinks. As the fresh leaves are bitter, the leaves are usually dried before use. The dried and powdered leaves are used industrially in the manufacture of various foods (Khodja *et al*., 2023).

Cosmetic Uses: Laurel contains essential oil which can be obtained from the leaves by steam distillation; the oil is used in industry to scent candles, perfumes, creams, and soaps. In Syria, it is a main component of the traditional and very old Aleppo soap, which also contains olive oil and caustic soda, and Salicornia ashes (Khodja *et al*., 2023).

Pharmacological Uses: Due to the presence of various antioxidant molecules in bay laurel, several biological and pharmacological activities have been reported by researchers, such as antioxidant, antibacterial, antifungal, antiviral, and insecticidal activities (Khodja *et al*., 2023).

In Indian cuisine, bay laurel leaves are sometimes used in place of Indian bay leaf, although they have a different flavour. They are most often used in rice dishes like biryani and as an ingredient in garam masala. Bay leaves are called *tezpattā* in Hindi), Tejpātā in Bengali, and usually rendered into English as Tej Patta. In the Philippines, dried bay laurel leaves are used in several Filipino dishes, such as menudo, beef pares, and adobo. Bay leaves were used for flavouring by the ancient Greeks. They are a fixture in the cooking of many European cuisines (particularly those of the Mediterranean), as well as in the Americas. They are used in soups, stews, brines, meat, seafood, vegetable dishes, and sauces. The leaves also flavour many classic French and Italian dishes. The leaves are most often used whole (sometimes in a bouquet garni) and removed before serving (they can be abrasive in the digestive tract). Thai and Laotian cuisine employs bay leaf in a few Arab-influenced dishes, notably massaman curry. Bay leaves can also be crushed or ground before cooking. Crushed bay leaves impart more fragrance than whole leaves, but are more difficult to remove and thus they are often used in a muslin bag or tea infuser. Ground bay laurel may be substituted for whole leaves and does not need to be removed, but it is much stronger (Wikipedia, 2024a). Bay leaves are also used in the making of jerk chicken in the Caribbean Islands. The bay leaves are soaked and placed on the cool side of the grill. Pimento sticks are placed on top of the leaves, and the chicken is placed on top and smoked. The leaves are also added whole to soups, stews, and other Caribbean dishes. Bay leaves can also be used scattered in a pantry to repel meal moths, flies, and cockroaches. The essential oil to be usable as an insect repellent. Bay leaves have been used in entomology as the active ingredient in killing jars. The crushed, fresh, young leaves are put into the jar under a layer of paper. The vapors they release kill insects slowly but effectively and keep the specimens relaxed and easy to mount. The leaves discourage the growth of molds. They are not effective for killing large beetles and similar specimens, but insects that have been killed in a cyanide killing jar can be transferred to a laurel jar to await mounting. There is confusion in the literature about whether *Laurus nobilis* is a source of cyanide to any practical extent, but there is no evidence that cyanide is relevant to its value in killing jars. It certainly is rich in various essential oil components that could incapacitate insects in high concentrations; such compounds include 1,8-cineole, alpha-terpinyl acetate, and methyl eugenol. It also is unclear to what extent the alleged effect of cyanide released by the crushed leaves has been mis-attributed to *Laurus nobilis* in confusion with the unrelated Prunus laurocerasus, the so-called cherry laurel, which certainly does contain dangerous concentrations of cyanogenic glycosides together with the enzymes to generate the hydrogen cyanide from the glycocides if the leaf is physically damaged (Wikipedia, 2024a). Bay leaves are used in Eastern Orthodoxy liturgy. To mark Jesus' destruction of Hades and freeing of the dead, parishioners throw bay leaves and flowers into the air, letting them flutter to the ground. Some members of the laurel family, as well as the unrelated but visually similar mountain laurel and cherry laurel, have leaves that are poisonous to humans and livestock. While these plants are not sold anywhere for culinary use, their visual similarity to bay leaves has led to the oft-repeated belief that bay leaves should be removed from food after cooking because they are poisonous. This is not true; bay leaves may be eaten without toxic effect. However, they remain unpleasantly stiff even after thorough cooking, and if swallowed whole or in large pieces they may pose a risk of harming the digestive tract or causing choking. Thus, most recipes that use bay leaves will recommend their removal after the cooking process has finished. The Canadian government requires that ground bay leaves contain no more than 4.5% total ash material, with a maximum of 0.5% of which is insoluble in hydrochloric acid. To be considered dried, they must contain 7% moisture or less. The oil content cannot be less than 1 mm per 100 grams of the spice (Wikipedia, 2024a). Bay leaves are used as flavouring in soups, stews, meat, fish, sauces and in confectionaries. Both leaves and fruits possess aromatic, stimulant and narcotic properties. The essential oil from the leaves are also used as spice and food flavouring agent and has wider application in traditional medicines of different countries. The major functional properties are anti-microbial, anti-fungal, hypoglycaemic, anti-ulcerogenic (Indianspices, 2024a).

Bay leaves are primarily utilized whole and dried. The leaves are commonly simmered into soups, broths, and curries as a flavor enhancer. Fresh Bay leaves have an astringent aroma and flavor that can overpower a dish, but after about an hour of simmering, these harsh chemicals break down, giving way to subtle, nuanced flavors. Bay leaves are not toxic to humans, but they can be harmful to horses, dogs, and cats. The leaves can also cause choking or lacerations to the digestive tract if consumed, so the whole leaf must be removed before serving. To make this easier, the leaf is often added to a simmering broth in a bouquet garni, cheese cloth, or ground into a powder. Bay leaves are popular in many cuisines across the Mediterranean, France, America, and Mexico. The leaves are crucial in gumbo and Texas chilli, and in Jamaica, the leaves and wood of the Laurel tree are used for smoking meats like jerk chicken. Recently, it has become popular to use Bay leaves in desserts to incorporate a minty, aromatic element that adds a layer of dimension to the overall sweetness of the confection. Check for freshness by crumbling the dried leaf. The leaf

should release a pungent and herbaceous aroma. If there is no aroma or only a slight aroma, the leaves have lost their potency and should be discarded. Dried leaves can be stored in a cool, dry cupboard for up to six months, but to increase the shelf life and ensure the freshest flavor, Bay leaves should be stored in the freezer for 3-4 years (Specialtyproduce, 2024).

In herbal medicine, aqueous extracts of bay laurel have been used as an astringent and salve for open wounds. It is also used in massage therapy and aromatherapy. A folk remedy for rashes caused by poison ivy, poison oak, and stinging nettle is a poultice soaked in boiled bay leaves. The Roman naturalist Pliny the Elder listed a variety of conditions which laurel oil was supposed to treat: paralysis, spasms, sciatica, bruises, headaches, catarrhs, ear infections, and rheumatism. An early Chinese etiological myth for the phases of the moon involved a great forest or tree which quickly grew and lost its leaves and flowers every month. After the Sui and Tang dynasties, this was sometimes connected to a woodsman named Wu Gang, sentenced to cut at a self-repairing tree as a punishment for varying offenses. The tree was originally identified as a *guì* and described in the terms of the osmanthus (*Osmanthus fragrans*, now known in Chinese as the "*gui* flower"), whose blossoms are still used to flavor wine and confections for the Mid-Autumn Festival. However, in English, it is often associated with the more well-known cassia (*Cinnamomum cassia*, now known in Chinese as the "meat *gui*") while, in modern Chinese, it has instead become associated with the Mediterranean laurel. By the Qing dynasty, the chengyu "pluck osmanthus in the Toad Palace" meant passing the imperial examinations, which were held around the time of the lunar festival. The similar association in Europe of laurels with victory and success led to its translation into Chinese as the "Moon *gui*" (Wikipedia, 2024).

Pharmacological Uses (Batool *et al*., 2019).

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*

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 µg/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.

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.

Analgesic and Antiinflammatory: **L. nobilis** essential oil showed analgesic and antiinflammatory activities in mice and rats . Ethanol extract obtained from the leaves and seeds of bay leaf also show the highest antiinflamatory activities by using a carrageenan-induced hind paw edema model.

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.

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.

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 IC_{50} value of 120 µg/mL and selectivity index of 4.16.

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.

Insect Repellent Activity: *L. nobilis* essential oils extracted from seeds were reported to have insect repellant activity against Culex pipiens.

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. 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. 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 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%.

Health Benefits (Chauhan, 2019).

Cough and cold: Powder the bay leaf and boil it in the water and drink it. It can provide relief from sneezing, running nose, burning sensation and headache.

Headache: Make a paste of bay leaf with 10 ml water and then apply it on the forehead.

Head lice: Add 5-6 bay leaves in a cup of water and bring it to boil and reduce it to half. Massage this water and wash the hair after an hour.

Tooth cleanliness: use the tejpatra powder instead of using toothpaste, use it twice daily it will help in making your teeth shine.

Vomiting: take bay leaf powder 2-4gms. It will help to control vomiting.

Jaundice: chew 5-6 bay leaves after 2-3 times in a day, it will help in reducing the intensity of the disease.

Delivery: provide fumes of bay leaves it will help in easy birth of a child.

Uterine cleaning: the decoction of bay leaf will help to get relief in uterine pain

Bleeding: In case of bleeding from any part of the bod, give 1 teaspoonful of bay leaf powder with 1 cup of water 2-3 times a day to get immediate effects.

Ayurvedic Properties of Bay leaf (Chauhan, 2019).

- **Digestive system:** This herb is helpful in increasing digestive power thus beneficial in the problems of digestive system
- **Cardiovascular system:** It helps in reducing cholesterol and also helps in strengthening the walls of the heart.
- **Respiratory system:** it helps in the condition like asthma and bronchitis.
- **Urinary system:** it acts as diuretic in nature and helps in production of adequate urine.
- **Reproductive system:** It is used in uterine inertia. It also helps in fertilization and overcomes habitual abortion.

The leaf is infused to relieve indigestion, colic and flatulence and to stimulate the appetite. The essential oil is used to calm the autonomic nervous system and when added to a bath, it stimulates the circulatory system. The oil is also a useful antiseptic, used for bronchial problems. Massage blended essential oil around sprains and into rheumatic joints (HFNZ, 2024). If eaten whole, *Laurus nobilis* bay leaves are pungent and have a sharp, bitter taste. As with many spices and flavourings, the fragrance of the bay leaf is more noticeable than its taste. When the leaf is dried, the aroma is herbal, slightly floral, and somewhat similar to oregano and thyme. Myrcene, a component of many essential oils used in perfumery, can be extracted from this bay leaf. They also contain eugenol (Wikipedia, 2024a).

Side Effects and Toxicit: 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 (Batool *et al*., 2019).

CULTIVATION

Soil Requirements: Bay laurel plants generally thrive in fertile soils that have good drainage properties and contain a healthy amount of organic matter. It thrives in a variety of garden soils, including loamy, sandy, and even clay soils It prefers a pH of 5–6.5 but can tolerate 4.5–8.2. For container cultivation, ordinary commercial potting mix can be used effectively. When it comes to propagating new bay leaf trees, saplings are typically used and transplanted into the main field during the summer season. Interestingly, during this transplantation process, no additional manure or fertilizers are typically introduced into the surrounding soil to supplement nutrients for the plant. In some cases, the plant may be placed in direct sunlight without immediate watering or fertilization (Singha and Mondal, 2024).

Climate and season: Bay leaf plants do well in India's warm climate and can be cultivated throughout the year. However, the optimal time to plant them is during the monsoon season, which usually spans from June to September. Thisis because the increased humidity and rainfall during this period create ideal growing conditions. These plants require either full sunlight or partial shade and thrive in temperatures ranging from 15°C to 25°C. It is essential to protect them fromcold draftsand frost duringthe winter monthsto ensure their health and continued development (Singha and Mondal, 2024).

Field preparation: Ommence by thoroughly ploughing the land until it achieves a fine, crumbly texture. This process is essential to break up the soil and create an ideal planting surface. Ensure that the field is completely clear of weeds. Remove any existing weeds to prevent them from competing with bay leaf plants for nutrients and space. Blend well-rotted farmyard manure into the soil while ploughing. This ensures that the manure is evenly mixed with the soil, enriching it with vital nutrients that promote robust bay leaf growth and higher yields. Maintain a weed-free and finely-tilled main field through multiple ploughings and regular hoeing. Ongoing weed control is crucial to create a favourable environment for the cultivation of bay leaf plants (Singha and Mondal, 2024).

Propagation: Bay laurel trees can be reproduced using various methods, such as cuttings, layering shoots, seeds in vitro culture techniques. Bay laurel trees can be multiplied by taking cuttings from their stems or using layering shoots. However, it is worth noting that stem cuttings can be slow to establish roots. Another option is to propagate bay laurel trees from seeds. In early autumn, when the trees berries ripen, you can extract the individual seeds from the berries and plant them directly in the soil. Keep in mind that bay laurel seeds may take anywhere from six months to a year to germinate. Once the seeds have germinated, you can transplant the seedlings into pots and nurture them in a greenhouse during their first year of growth. After this initial period, they can be planted in their permanent outdoor locations in early summer. It is advisable to protect these young trees from frost until they are one to two years old. Alternatively, you can propagate bay laurel trees by digging up rooted suckers that grow at the base of established trees and transplanting them into pots or directly into the ground (Singha and Mondal, 2024). Usually, sweet bay is purchased as a seedling from a nursery, but growing bay tree seeds is also possible, provided the grower has some patience since bay seed germination is a slow process. As mentioned, while not the usual method of propagation, growing bay tree seeds is possible, if at times frustrating. Why frustrating? Bay seed germination is notoriously long, up to six months. With such a lengthy germination period, seeds may rot before germination occurs. To hasten guarantee viable germination, never plant seeds that are dried out. Order your seeds from a reputable purveyor and when they arrive, soak them in warm water for 24 hours and then plant them immediately. Also, germinate multiple seeds to allow for germination failure and rotting. If you plan to harvest seeds from an existing tree, look for a female. Sweet laurels are dioecious, meaning that male and female flowers are borne on separate plants. In the spring, inconspicuous pale yellow-green flowers bloom followed by small, purplish black, oval berries. Each berry has a single seed found on mature female trees. Fill a seed tray with a layer of moist soilless seed mix. Spread the seeds out over the surface, keeping them about 5 cm apart and press them gently into it. Cover the seeds with a bit more moist soilless mix. Dampen the medium with a spray bottle. Make sure to just lightly moisten, not saturate the mix or the seeds will rot. Keep the seeds moist to slightly on the dry side as they germinate. Keep an eye on the progress of the seeds and be patient. It can take from ten days to up to six months for the bay seeds to germinate. Transplant the bay seedlings into pots or into the garden proper when leaves begin to appear. Or Look for small drupes that have turned dark purple or black. Pluck them and remove the pericarp. Plant them as soon as possible after taking the coating off. Or buy *L. nobilis* seeds

Planting: When it comes to relocating bay leaf trees, it is vital to provide ample space for each tree. It is recommended to maintain approximately 4 to 6 m between individual trees. This spacing allows them sufficient room for growth and optimal development. If you have one acre of land, you can accommodate roughly 300 bay laurel plants. The best time to undertake the transplanting process is during the cooler months, ideally within early to late winter. Select a site that receives abundant sunlight or partial shade and features well-draining soil. During the transplanting procedure, take care when handling the root ball to prevent any harm to the plant (Singha and Mondal, 2024).

Nutrient management: Bay leaf trees grow slowly, meaning they do not have high nutrient requirements when cultivated in outdoor landscapes. However, if growing in containers, providing extra nutrients is beneficial. For containers, it is recommended to apply additional fertilizer during the spring season. You can use a balanced organic fertilizer like fish emulsion and kelp. It is also a good idea to freshen the top layer of soil in the container each spring, taking care not to disturb the shallow roots. For improve soil quality, particularly in outdoor planting, you can enrich the soil by incorporating well-rotted farmyard manure as an organic fertilizer. If there are specific deficiencies in soil nutrients, you can also consider applying nitrogen and potash to address those deficiencies (Singha and Mondal, 2024).

Irrigation: Watering is a crucial factor in the successful cultivation of bay laurel. It is essential to maintain consistent soil moisture levels throughout the year, but without causing water logging. During the summer months, it's vital to provide thorough watering. For mature bay laurel plants, this should be done at least once a week, while smaller plants may require watering every 2 to 3 days. During the monsoon season, proper drainage management becomes important. Ensuring effective drainage facilities are in place allows excess water to be removed, preventing water logging and maintaining suitable moisture levels throughout the season (Singha and Mondal, 2024).

Weed Management: Managing weeds is vital, especially during the first two years of cultivating the crop. Weed control can be achieved through manual removal or by introducing intercropping during the initial two years to boost earnings and increase overall profitability. Additionally, mulching is a commonly employed technique to inhibit weed growth and reduce soil moisture evaporation (Singha and Mondal, 2024).

Intercropping: Intercropping with vegetables is a common practice during the initial two years of bay leaf cultivation. However, it becomes impractical as the bay laurel plants grow beyond this stage. Common choices for intercropping in regions with suitable weather conditions include root vegetables like carrots, beetroot, potatoes, onions, and garlic. Essentially, any annual vegetable crop can be grown alongside bay leaf plants, if they do not overshadow or compete for sunlight with the bay laurel plants (Singha and Mondal, 2024).

Training and pruning: Training and pruning are essential horticultural practices for maintaining healthy and well-shaped bay leaf plants. Pruning is best done in late spring to early summer, promoting new growth in the desired direction. Avoid pruning during or just before the monsoon season to prevent rot and infections. Bay laurels tolerate light pruning well, and it is crucial for removing dead or damaged leaves and directing growth. For shaping purposes, heavier pruning in the spring may be necessary, with a secondary, lighter pruning session in summer to maintain a rounded form. Pruning can be used to encourage branching, while training to control height is generally not required (Singha and Mondal, 2024).

Crop protection management: Three common pests that affect bay leaves are thrips, aphids, scaleinsect, psyllids, caterpillars of codling moth and mites. For organic pest control, a mixture of neem oil and soap can be used, which can be sprayed when you observe these pests. The use of chemical formulations is typically discouraged as they may leave undesirable residues on the leaves (Singha and Mondal, 2024). In bay leaf farming, the occurrence of bay leaf spots can be attributed to fungal infections. To tackle this problem, it is advisable to remove the affected leaves and administer a sulfur spray. This helps in preventing the spread of the infection and the formation of black spots (Singha and Mondal, 2024).

Harvesting: Bay leaves can be harvested during the entire year because the plant is evergreen. However, leaves are generally collected for the herbal plants when the plants bear flowers. The berries are collected at about 40% moisture when they reach physiological maturity. Usually, one or two harvests a year are recommended for the highest yield and the highest dry leaf quality. Weather conditions like dew, high humidity, and rains are avoided during harvesting as these can cause deterioration and discoloration. Collection of the leaves is generally carried out by hand or using small farming tools such as rakes. Sometimes, the plant stems are cut, and the leaves or fruits are removed following the harvesting. Bay leaves are classified according to shape, size, color, and aroma before packaging. According to the various quality standards and consumer preferences, the leaves are packaged and kept in a cool and dry place. The suggested storage conditions for spices are 10–15 °C and 55–65% relative humidity (Paparella *et al.,* 2022).

Laurel leaves can be harvested all year round thanks to the fact that the plant is evergreen. In the Mediterranean region, the optimum time for harvesting is in the autumn season. For example, in Türkiye, Greece, and the former Yugoslavia, bay leaves are harvested from August to October, for Morocco and Portugal the recommended harvest period is July to August. Harvesting should be done in optimal conditions avoiding dew, humidity, and heavy rains, as these can accelerate deterioration and discoloration and thus result in a poor quality product. The collection of bay leaves is usually done by hand or using small agricultural tools such as Rakes (Khodja *et al*., 2023).

Bay leaves are ready to be harvested when they attain a dark green colour and reach full maturity. The best time for harvesting is in the early morning when the leaves are most flavourful. Carefully pick individual leaves, being mindful not to damage the stem or nearby leaves. Bay leaf harvesting can be done year-round, but it is typically carried out post- monsoon when the weather is dry and sunny. Harvested leaves need to undergo a drying process, which can be challenging during bad or rainy weather. Spring is often considered an optimal time for a good harvest. After harvesting, the leaves should be dried for a period of 5-7 days. Sun drying is the preferred method, and leaves are usually ready for packaging within 7 days. Typically, there is no further processing required post-harvest (Singha and Mondal, 2024).

Drying of leaves: Drying is the oldest method used for preserving food. By definition, drying is the operation aimed at evaporating free water from a foodstuff to minimize microbial growth and chemical and enzymatic reactions. Drying is a process that can bypass the seasonal overproduction of crops and spread their availability throughout the year. In addition, the fresh plant cannot be cost-effectively supplied to all places in the world, due to the high water content, it suffers deterioration caused by the growth of microorganisms and biochemical changes. The elimination of water by dehydration reduces this growth and keeps the organoleptic characteristics of the plant (Khodja *et al*., 2023). Small farmers and large producers of bay leaves wash the leaves after harvest and then proceed to drying. Leaf moisture levels are reduced to less than 10% using drying to improve the stability of their quality in storage. Drying of bay leaves is carried out by several methods such as sun drying, in shade, artificial process using dryers, or in hot air. Sun drying is an easy and inexpensive method, but direct sunlight can cause leaf discoloration and the use of high temperatures in other drying methods can cause a loss of volatiles. Drying in the shade or artificial drying is particularly recommended to achieve better quality. Hot air drying is a method applicable when air drying cannot be practiced due to atmospheric conditions. This method also allows a considerable reduction in drying time. In addition to these traditional methods, new drying methods have recently been introduced, such as oven and microwave drying; these can both comply with microbiological safety and food quality regulations and reduce the energy costs of drying (Khodja *et al*., 2023).

Yield: The yield of bay leaves can vary depending on factors such as climate, soil conditions, and cultivation practices. On average, a mature bay laurel tree has the potential to yield approximately 35 kg of bay leaves per year. However, actual yields may vary, and skilled cultivation and care practices can help optimize the yield of bay leaves from each tree (Singha and Mondal, 2024). 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.

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 (Batool *et al*., 2019).

Storage: Bay leaf harvesting typically occurs between November and February, with a frequency of once every two years. The harvesting process is carried out manually by farmers using sickles or through handpicking. After harvesting, the bay leaves are left in the field for a period of 2 to 3 Weeks to undergo natural drying (Singha and Mondal, 2024). Once dried, farmers transport the bay leaves to their own premises. Sorting and grading are performed by the farmers in the field based on quality criteria. The sun-dried bay leaves are commonly stored in gunny bags within the farmers' homes before being sold to the nearest market or middlemen. This storage process ensures that the bay leaves remain in good condition and are ready for distribution and sale (Singha and Mondal, 2024).

Postharvest Technology: 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 (Batool *et al*., 2019).

Processing

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. 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 (Batool *et al*., 2019).

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 Provencal 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. Chilling of bay leaf retains the taste of this shrub more effectively than drying (Batool *et al.,* 2019).

Essential Oils

Over 150 components have been identified in bay leaf essential oil by GC-MS, with 1,8-cineole generally being the major component. The other main compounds are α-pinene, β-pinene, sabinene, limonene, and linalool. Other parts of the plant, other than leaves, have also been explored regarding their volatile composition. Thus, the essential oils of bay fruits, seeds, flowers, stems, and bark have also been studied repeatedly, although to a lesser extent than leaves. 1,8-cineol (26 to 51%), α-terpinyl acetate (5% to14%), and a-pinene (4 to 6%) were the main components of the essential oil of the stem and fruits. Compounds like eugenol (11 to 12%), methyl-eugenol (9% to 12%), and elemicin (1% to 12%) are important for the spicy aroma of noble bay leaves and they are used as important indicators in determining the quality of these leaves. This essential oil can also be used as a conservator of many foodstuffs such as table oils (Khodja *et al*., 2023).

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