



REVIEW ARTICLE

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

*Swamy, K.R.M.

Retd. Principal Scientist & Head, Division of Vegetable Crops, ICAR-Indian institute of Horticultural Research, Bangalore-560089

ARTICLE INFO

Article History:

Received 20th January, 2025

Received in revised form

19th February, 2025

Accepted 26th March, 2025

Published online 30th April, 2025

Key words:

In this review article on Origin, Taxonomy, Botanical Description, Genetic Diversity, Breeding and Cultivation of Anise are discussed.

ABSTRACT

Anise belongs to the family Apiaceae (also known as Umbelliferae or parsley family), the genus *Pimpinella*, and the species *Pimpinella anisum*. The word "anise" has a complex etymology, tracing back to ancient Greek and ultimately to a possible pre-Greek substrate language. It's derived from the Greek word *ánison* (ἄνισον), which was sometimes confused with dill, known as *ánēthos* (ἄνηθος). The name "anise" evolved through Latin (*anīsum* or *anēthum*) and Old French (*anis*) before entering English. Levantine plant cultivated for its seeds, which were important sources of chemical oils and flavoring, c. 1300, from Old French *anis* (13c.), from Latin *anīsum*, from Greek *annēson*, which Beekes suggests is from a substrate language. Middle English *sēd*, from Old English *sēd* (Anglian), *sæd* (West Saxon), "that which may be sown; an individual grain of seed," from Proto-Germanic **sediz* "seed". The most common name for the plant *Pimpinella anisum* is anise. It is also known as aniseed, and sometimes referred to as sweet cumin. In some regions, it may be called Anis Vert (France) or Anis. Anise (*Pimpinella anisum* L.) is an annual spice and medicinal plant belonging to the family Apiaceae. Only a limited number of anise breeding studies are available. Therefore, genetic variation among anise landraces has not been extensively examined with molecular markers. Anise has a very strong licorice taste, thus why it is often a divisive flavor among those who are not accustomed to it. Some people also find it offers a subtle sweetness. Generally speaking, anise is used to flavor a wide variety of foods, both sweet and savory. You'll find anise in a number of types of sausage, various processed meats, soups, stews, and anywhere a licorice flavor might be desired. Additionally, the leaves of the anise plant can be used in salads and in cheese spreads. Many are familiar with the flavor of anise because of its use in various liquors and liqueurs, such as Ouzo, Sambuca, Pernod, Absinthe, and Pastis. (Interestingly, these clear liquids turn an opaque, almost milky color when water is added.). Anise is also prominently utilized in candies and baked goods giving them a pronounced licorice flavour. Genetic improvement of seed yield and drought resistance could be simultaneously gained in anise when breeding for drought resistance. Improving the water use efficiency of anise is a primary objective of anise breeding programs aimed at mitigating the impacts of drought stress. This aimed to determine the predominant mechanisms involved in drought tolerance and investigate the genetic control of associated traits with drought tolerance and higher grain yield. Its flavor is similar to other spices, including fennel and liquorice. Anise is used to flavor food, alcoholic drinks, liquor, teas, soups and candies and it is served as a carminative in herbal medicine (Ispiceyou, 2024). Anise is sweet and very aromatic. It has been used for medicinal use throughout history, and was given the name *Solamen intestinorum*—the comforter of the bowels. The Romans often ate anise-spiced cakes, known as mustaceae, to avoid indigestion and flatulence. In the 1800s, Germans believed so strongly in the medicinal value of the spice they flavored their household bread with whole anise seed. It also has a reputation for soothing coughs and muscle affections. Anise is one of the oldest known seeds, and in Biblical times it was considered so valuable it was used as payment for tithes, offerings and taxes. The ancient Romans hung anise plants near their pillows to prevent bad dreams and often concluded wedding ceremonies with the breaking of a wheat or barley cake containing anise over the bride's head as a symbol of good fortune.

*Corresponding author:

K.R.M. Swamy

Copyright©2025, Swamy. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: K.R.M. Swamy, 2025. "Origin, Taxonomy, Botanical Description, Genetics and Cytogenetics, Genetic Diversity, Breeding and Cultivation of Anise". International Journal of Current Research, 17, (04), 32614-32639.

INTRODUCTION

Anise belongs to the family Apiaceae (also known as Umbelliferae or parsley family), the genus *Pimpinella*, and the species *Pimpinella anisum* (Wikipedia, 2024; Wikidoc, 2024). The word "anise" has a complex etymology, tracing back to ancient Greek and ultimately to a possible pre-Greek substrate language. It's derived from the Greek word *ánison* (ἀνίσον), which was sometimes confused with dill, known as *ánēthos* (ἄνηθος). The name "anise" evolved through Latin (*anīsum* or *anēthum*) and Old French (*anis*) before entering English. Levantine plant cultivated for its seeds, which were important sources of chemical oils and flavoring, c. 1300, from Old French *anis* (13c.), from Latin *anisum*, from Greek *annēson*, which Beekes suggests is from a substrate language. Middle English *sēd*, from Old English *sēd* (Anglian), *sæd* (West Saxon), "that which may be sown; an individual grain of seed," from Proto-Germanic **sediz* "seed" (Etymonline, 2024). The most common name for the plant *Pimpinella anisum* is anise. It is also known as aniseed, and sometimes referred to as sweet cumin. In some regions, it may be called Anis Vert (France) or Anis (Wiktionary, 2024). The *Pimpinella anisum* has common names in different countries such as: Anis vert (France); Anise seed (Japan); Anise and Star anise (the USA); Annesella (Italy); Anisa, Badian, Kuppi, Muhuri, Saunf and Sop (Iran and India); Boucage anis, Petit anise (North Africa), and anise (England) (Sun *et al.*, 2019). A significantly higher fruit yield was produced at narrow row spacing of 15 cm among treatments (Ullah *et al.*, 2014). Wider row spacing produced markedly higher essential oil than narrow row spacing. Essential oil accumulation decreased as planting densities increased (Ullah *et al.*, 2014). The major constituent of anise oil was trans-anethole (82.1%) followed by γ -himachalene (7.0%). The quality parameters including estragol, γ -himachalene and trans-anethole were significantly affected by different row spacing (Ullah *et al.*, 2014). Plant grown at 37.5 cm row spacing accumulated the highest estragol and trans-anethole concentration among the row spacing treatments (Ullah *et al.*, 2014). It can be concluded that higher plant density and wider row spacing increased the disease infestation and lodging cultivar Enza Zaden in current study exhibited high concentration trans-anethole in essential oil composition therefore is a good quality chemotype (Ullah *et al.*, 2014). Anise (*Pimpinella anisum* L.), is an annual important spice and medicinal plant belonging to the family of Apiaceae, and native to Mediterranean region (Ullah *et al.*, 2014). Recently, this spice plant has drawn more consideration of consumers due to the antimicrobial, antifungal, insecticidal, and antioxidant effect of this herb on human health (Ullah *et al.*, 2014). The essential oil is characterized by carminative, mild expectorant, diuretic, antiseptic as well as antispasmodic effects (Ullah *et al.*, 2014). Anise fruits contain 1.5-5.0% essential oil with trans-anethole, a phenylpropanoid, as predominant component (Ullah *et al.*, 2014). In addition, the essential oil of the anise fruits contains also small quantity of estragol, anisaldehyde, γ -himachalene and cis-anethole (Ullah *et al.*, 2014). Among other countries Germany remains the largest spice importer of anise. This stimulates the cultivation of anise in European countries including Germany (Ullah *et al.*, 2014). The yield of aniseed may noticeably vary depending on ecological conditions such as temperature, precipitation and soil fertility (Ullah *et al.*, 2014). Plant spacing and seed rate are important factors in determining the microenvironment in the anise field. The optimization of these factors can lead to a higher yield in the crop by favorably affecting the absorption of nutrients and exposure of the plant to the light (Ullah *et al.*, 2014).

Anise is the dried fruit of *Pimpinella anisum* L. (Apiaceae). The schizocarps are 2–5 mm, ovoid–conical, grayish brown, and pubescent, with a pedicel attached; they are crowned with a short, bifurcate stylopod (Wilson, 2016). The mericarps, attached to the carpophore, are broadly ovoid; they are flat or concave on the commissural side and convex and pubescent on the dorsal side (Wilson, 2016). The exocarp has an outer striated cuticle with stomata and rectangular epidermal cells bearing surface hairs up to 150 μ m in length (Wilson, 2016). The mesocarp consists of five fibrovascular bundles underlying ridges, 2–4 vittae on the commissural side and 20–40 vittae on the dorsal side (Wilson, 2016). The endosperm of the seed is composed of thick-walled parenchymatous cells containing oil and aleurone grains and one or two small 'rosette' calcium oxalate crystals (Wilson, 2016). Anise has a characteristic and agreeable aromatic odor and a pleasant taste. Fruits are harvested when their color changes from green to gray; shattering is minimized by avoiding overripening and harvesting during the morning with scythes or reaping machines (Wilson, 2016). The crop is piled into small stacks and allowed to wither for 2–3 days; it is then threshed and dried in partial shade (Wilson, 2016). After winnowing, sieving, and cleaning, the crop is dried naturally to 18% moisture followed by artificial drying at 80–90 °C; it is then packed and stored in a cool, dry room (Wilson, 2016). For keeping, the maximum tolerance limit of moisture is 10%. Reducing the moisture below 8% can generally have a bad effect on the quality due to loss of volatile oils (Wilson, 2016). Crushed or ground spice is stored in airtight containers (Wilson, 2016). Anise extract functions as an antimicrobial agent for *Proteus mirabilis*, *Citrobacter koseri*, *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Enterobacter aerogenes*, *Micrococcus luteus*, *Staphylococcus epidermidis*, and *Candida albicans* (Wilson, 2016). Anise was shown to contain antioxidants powerful enough to pass the same tests as common synthetic antioxidants such as BHA and BHT (Wilson, 2016).

Aromatic plants such as anise seed have a long traditional use in both folk and conventional medicine and of course in the pharmaceutical industry (Sun *et al.*, 2019). Important compounds found in anise seed include estragol, p-anisaldehyde, anise alcohol, acetophenone, pinene, and limonene, but the most important volatile oil that gives the characteristic sweet, aromatic flavor to seeds is anethole (Sun *et al.*, 2019). The recent studies have shown that anise seeds and essential oil have antioxidant, antibacterial, antifungal, anticonvulsant, anti-inflammatory, analgesic, gastro-protective, antidiabetic, and antiviral activities (Sun *et al.*, 2019). Other important benefits of anise seeds are stimulant, carminative, expectorant, insecticide, vermifuge, digestive, antispasmodic, antirheumatic, antiseptic, antiepileptic, antihysterical, culinary significance, keeps the heart strong by its importance role to control the blood pressure, one of the best gas-releasing agent, eases many hormonal problems in females, hair benefits, skin benefits, and it may reduce symptoms of depression (Sun *et al.*, 2019). Anise seed and its extract also use in savory dishes, baked goods, and different drinks in both ancient and modern time (Sun *et al.*, 2019). Anise seeds are good source of many essential B-complex vitamins such as pyridoxine, niacin, riboflavin, and thiamine (Sun *et al.*, 2019). Traditional medicinal herbs have been used for both food and medicinal purposes, which have obvious role in maintaining human health and improving human

life quality for thousands of years (Sun *et al.*, 2019). China has important potential to produce aromatic and medical plants and herbs due to its various biological diversity and different climatic conditions (Sun *et al.*, 2019). Aromatic plants such as anise seed have a long traditional use in both folk and conventional medicine and of course in the pharmaceutical industry (Sun *et al.*, 2019). Anise is a herbaceous annual plant, native to Mediterranean region and primarily grown for both fruits and seeds (Sun *et al.*, 2019). It has been reported, it is also indigenous to Iran, India, and Turkey (Sun *et al.*, 2019). Its fruits, known also as aniseed, were used as traditional medicine in China as early as in the 5th century. Fruits of this plant contain fatty oil, proteins, carbohydrates, and cellulose fibers. In European countries, consumption of anise fruits is more than its production so the amount of imported anise fruits reached about 2,000 t in 2004 (Sun *et al.*, 2019). Among other countries Germany remains the largest spice importer of anise (Sun *et al.*, 2019). Anise usually grows on dry rocky places, rocky crevices, fields, meadows, mountains pastures, and grasslands, and its seed germination in nature is very poor (Sun *et al.*, 2019).

Herbalist Laurel Dewey sees the personality of anise as a perfectionist who hates being hurried and prefers to take their sweet time, making sure that no mistakes are made (Herbal Academy, 2020). Unwavering and hardy in its decisions, the plant matures after a long growth period to produce a dazzling seed head; this can be seen as a statement to the world that slow and steady does, in fact, win the race (Herbal Academy, 2020). This idealist tendency does come with tension and pressure. The constant need for excellence and accomplishment can sometimes cause this plant to snap, resulting in the stalk “bending over backwards” or “breaking its back” under the weight of its seed head (Herbal Academy, 2020). As a nervine and parasympathetic relaxant, *P. anisum* works well with those of a *kapha* constitution, which matches the traits mentioned above: endurance, strength, and stamina. *Kapha* is the energy of structure and smooth movement, ultimately establishing and organizing the systems in the body (Herbal Academy, 2020). *Kapha* energy can be described as the glue that holds the basic building blocks of all living things together, and is associated with the tendons, muscles, and bones. It helps to maintain the immune system and provides lubrication to the joints and moisture to the skin (Herbal Academy, 2020). If *kapha* becomes out of balance, selfishness, rivalry, and attachment can begin to show patterns in one’s actions. However, when in balance, the *kapha* energy can encourage compassion, tranquility, and respect, creating a sweet and loving frame of mind (Herbal Academy, 2020). Revered for its fragrant, delicately spicy, and sweet flavor, *P. anisum*’s calming and restoring actions on the nervous system are used for those with a predominately *kapha* constitution who are experiencing stress and exhaustion. It is particularly indicated for respiratory and digestive issues (Herbal Academy, 2020). *Pimpinella anisum* is a true delicacy from its dainty appearance to its sensitive growth conditions to its distinctive aroma (Herbal Academy, 2020). This plant has gracefully made its mark in both the culinary and herbalism worlds as a sophisticated carminative and nervine over the course of history (Herbal Academy, 2020). The earliest known use of *P. anisum* is documented in Egypt through the Ebers Papyrus dated 1500 BCE, which states that the seeds of the plant were used for flatulence (Herbal Academy, 2020). During the 1st century BCE, the Roman Empire constructed a trading center in Alexandria, Egypt that regulated all of the spices arriving into the Greco-Roman region and linked with the network of sea routes that spread to include Persia, Arabia, China, India, and Rome through a route known as the Silk Road (United Nations Educational, Scientific, and Cultural Organization). Through this trade, anise seed was able to become a staple throughout Europe, East Asia, and the Mediterranean (Herbal Academy, 2020).

Anise also known as aniseed, is a flowering plant in the family Apiaceae that originated in the eastern Mediterranean and Southeast Asia (McCann, 2021). Anise has a very strong licorice taste, thus why it is often a divisive flavor among those who are not accustomed to it. Some people also find it offers a subtle sweetness (McCann, 2021). Generally speaking, anise is used to flavor a wide variety of foods, both sweet and savory (McCann, 2021). You'll find anise in a number of types of sausage, various processed meats, soups, stews, and anywhere a licorice flavor might be desired. Additionally, the leaves of the anise plant can be used in salads and in cheese spreads (McCann, 2021). Many are familiar with the flavor of anise because of its use in various liquors and liqueurs, such as Ouzo, Sambuca, Pernod, Absinthe, and Pastis. (Interestingly, these clear liquids turn an opaque, almost milky color when water is added.) (McCann, 2021). Anise is also prominently utilized in candies and baked goods giving them a pronounced licorice flavour (McCann, 2021).

The early Arabic name of anise was anysum from which derived the Greek anison and the Latin anisun (Aishwath *et al.*, 2021). It is one of the oldest known spice plants used both for culinary and medicinal purposes since ancient times—Carminative properties of anises have been known (Aishwath *et al.*, 2021). There is evidence that anise was used in Egypt as early as 1500 B.C and it was well known to the Greeks, being mentioned by Dioscorides and Pliny and was cultivated in Tuscany in Roman times (Aishwath *et al.*, 2021). In the Middle Ages its cultivation spread to Central Europe (Aishwath *et al.*, 2021). Aniseed commonly called as anise and vilayati saunf belongs to the family Apiaceae (Aishwath *et al.*, 2021). It is used widely to flavour materials, and is also a constituent of traditional medicine (Aishwath *et al.*, 2021). Anise is botanically different from fennel and a native of East Mediterranean region (Aishwath *et al.*, 2021). Anise is cultivated both in temperate as well as subtropical or Mediterranean climate (Aishwath *et al.*, 2021). Numerous alcoholic drinks and cordials are flavoured with aniseed. Medicinally it is a mild expectorant and often being used in cough mixtures and lozenges. It is also an antiseptic, antispasmodic, soporific and a few seeds taken with water will often cure hiccups (Aishwath *et al.*, 2021). Its decoction helps to overcome the oxygen deficiency while moving on high altitude (Aishwath *et al.*, 2021). Besides that it also has very good culinary use (Aishwath *et al.*, 2021). The liqueur Anisette added to cold water on a hot summer's day makes a most refreshing drink (Aishwath *et al.*, 2021). Anise is one of the herbs that was supposed to avert the Evil Eye (Aishwath *et al.*, 2021). The oil extracted from the seed is said to prove capital bait for mice, if smeared on traps. It is poisonous to pigeons (Aishwath *et al.*, 2021).

Anise seeds that date to 1500 BCE have been found in Egypt, where anise was heavily cultivated (De and De, 2022). It has been often mentioned in the Bible and in the works of many Greek and Roman authors, such as the herbalist Pliny, who recommended chewing anise seed in the morning to rid the mouth of bad odors (De and De, 2022). Romans enjoyed anise in mustaceus—an

aromatic spice cake that was eaten to aid digestion after feasts and rich meals (De and De, 2022). In the 15th century, King Edward IV of England must have been fond of anise; it was used to perfume his personal linens (De and De, 2022). Anise fruit is used as an ingredient in cordial liquors in Europe; in India it is used largely as a flavoring agent in the preparation of sweets, cake, cookies, soups, stews, and breads (De and De, 2022). Oil of anise is also used in soap making and toiletries. It is also utilized in perfuming sachels or school bags, dental preparations, and mouthwashes. It finds an important application in the preparation of lacquers and varnishes (De and De, 2022). Recently, it has been shown that anise seeds and root have estrogenic activity in rats. Anise has also been shown to possess antiinflammatory and wound-healing properties (De and De, 2022). The oil of anise is used as an antiseptic for the treatment of cholera and has fungicidal properties (De and De, 2022). An alcoholic extract of aniseed kills fungi and is thus useful in treating fungal skin diseases (De and De, 2022). Anise is carminative and has expectorant properties. Some preparations from semiparched anise seeds are recommended for dysentery (De and De, 2022). It is employed in flatulent colics, in the preparation of powders for asthma, and in a few veterinary medicines. As an insecticide, aniseed is used against small insects such as mites, lice, and vermin (De and De, 2022). Anise seed has been used since ancient times, with references to its use tracing back as far as 4000 years ago in Egypt! (De and De, 2022). It was grown and harvested as both a culinary spice and an herbal remedy (De and De, 2022). There are references to its use to treat digestive complaints, toothaches, and as a diuretic (De and De, 2022). Greek writings refer to how anise was used to help breathing problems, as an analgesic, as a diuretic, and more (De and De, 2022). It was even used in desserts in Roman times to provide a sweet treat that also prevented indigestion after a rich meal (De and De, 2022).

Anise, also known as "aniseed" or "sweet cumin" is a spice well-known and loved for its licorice flavor, per Healthline (Bailey, 2022). Anise belongs to the same plant family (Apiaceae family) and is actually a small, pungent, fruit, despite the fact that we call it a seed (Bailey, 2022). The spice is rich in iron, antioxidants, manganese, reduces the symptoms of depression, prevents stomach ulcers, and helps ease menopause. It's quite a beneficial plant! According to Taste of Home, anise seeds are perfect for grinding into a powder and are commonly used to flavor beverages like ouzo, sambuca, pastis and foods like Italian sausage, cakes, and all kinds of baked goods (Bailey, 2022). Cooking Chew claims that anise is native to Egypt and supports using it in both sweet and savory dishes due to its dark taste (Bailey, 2022). It was a common plant to use as an oil or powder throughout the ancient world including Egypt, Rome, Greece, and the Middle East (Bailey, 2022). The seed's flavor comes from a chemical compound called "anethole" which makes it taste quite a bit like fennel and star anise though they are not the same thing, *let alone* the same kind of plant (Bailey, 2022).

Anise is an aromatic annual herb native to the eastern Mediterranean region and western Asia (Singletary and Keith, 2022). Although the small fruit is incorrectly referred to as a seed, nonetheless, the fruit is commonly known as aniseed (Singletary and Keith, 2022). When ripe and dried, it is the popular spice. Aniseed and its essential oil are used in traditional therapies, for example, for relief of coughs, respiratory congestion, migraines, gastrointestinal distress, and colic; for treatment of skin infections; as a tranquilizer and aphrodisiac; and to improve lactation (Singletary and Keith, 2022). Limited and preliminary clinical research has examined the efficacy of aniseed toward diabetes, dysmenorrhea, and menopausal hot flashes. Antioxidant, anti-inflammatory, and antimicrobial properties also were identified (Singletary and Keith, 2022).

Anise seeds lend a licorice flavor to baked goods and more (Alfaro, 2023). This spice is widely used in Middle Eastern, Italian, German, Indian, and Mexican cooking. Anise seed is used in Italian biscotti, desserts, and charcuterie. Its extract flavors alcohol including anisette and ouzo (Alfaro, 2023). Anise seed is used as a spice, either ground or whole. Anise essential oil and extract are also made from the seeds. The seeds are produced by the *Pimpinella anisum* plant, which has been cultivated in Egypt, the Middle East, and Europe for many centuries. The seeds are small, brownish-gray, and slightly curved, with an aroma of licorice. The plant also has aromatic leaves and stems that can be used as an herb, tasting like licorice, fennel or tarragon (Alfaro, 2023). Anise has a licorice flavor that is sweet, mildly spicy, and very aromatic. This flavor is produced by anethole, an organic compound related to estragole, which produces flavors in tarragon and basil (Alfaro, 2023). One key characteristic of anethole is that it is very soluble in alcohol but only slightly soluble in water. As a result, when you add water to liqueurs that contain anise extract, the drink turns cloudy. This is known as the ouzo effect after one of the characteristic anise-flavored liqueurs (Alfaro, 2023).

Anise is a polarizing spice. With its strong licorice flavor, some people love it and some people can't stand it (Baessler, 2023). If you're someone in the former camp, however, there's nothing easier or more rewarding than growing and saving your own anise seeds to use year round (Baessler, 2023). **Anise**, with its captivating aroma and distinctive flavor, is a spice that has been cherished for centuries (Ispicefoods, 2023). Derived from the seeds of the *Pimpinella anisum* plant, anise adds a touch of sweetness and complexity to culinary creations (Ispicefoods, 2023). But its allure extends beyond the realm of taste (Ispicefoods, 2023). Anise also offers a range of potential health benefits and therapeutic uses. Join us as we delve into the enchanting world of anise, exploring its history, culinary applications, and the remarkable ways it can enhance both your cooking and well-being (Ispicefoods, 2023). Anise has a rich and illustrious history that spans thousands of years (Ispicefoods, 2023). Originating from the Mediterranean region, it quickly spread to other parts of the world, including Europe, Asia, and the Middle East (Ispicefoods, 2023). Anise seeds were highly valued for their aromatic and medicinal properties (Ispicefoods, 2023). They were used in culinary practices, religious ceremonies, and as natural remedies (Ispicefoods, 2023). Today, anise remains a beloved spice in diverse cultural traditions (Ispicefoods, 2023).

Anise which belongs to the family Umbelliferae, is an aromatic annual herb, native to the eastern Mediterranean region and western Asia (Abouelela *et al.*, 2023). The fruit is incorrectly referred to be a seed. Nonetheless, the fruit is often known as aniseed, and when ripe and dried, it is a popular spice (Abouelela *et al.*, 2023). In traditional medicine, anise seeds are used to treat

migraines as well as a carminative, fragrance, disinfectant, and diuretic (Abouelela *et al.*, 2023). Aniseed is traditionally used for milk production, menstruation, urine and sweat discharge, and skin health (Abouelela *et al.*, 2023). In folk medicine, it is used to polish teeth, for treat nightmares, convulsions, and epilepsy (Abouelela *et al.*, 2023). Also, anise tea has long been used to treat upper respiratory infections, and bronchial asthma in children (Abouelela *et al.*, 2023). Along with, its usage as an expectorant, lozenge, and lactagogue (Abouelela *et al.*, 2023). In addition to, utilization of the plant for helping with delivery and as a mild laxative (Abouelela *et al.*, 2023). Anise is used in the culinary industry as a flavoring and aromatic ingredient in fish items, ice cream, sweets, and gums (Abouelela *et al.*, 2023). Several chemical components, primarily anethole, were extracted as essential oils from aniseed (Abouelela *et al.*, 2023). Several pharmacological studies on anise have been published, including antibacterial, antifungal, insecticidal, antiviral, muscle relaxant, antispasmodic and relaxant of smooth muscle, anticonvulsant, antiulcer, antidiabetic, hypolipidemic, and pain relief in dysmenorrhea (Abouelela *et al.*, 2023).

Anise is an aromatic annual herb hardy, pubescent, 60 cm tall native to the eastern Mediterranean region and western Asia (Abouelela *et al.*, 2023). It is a member of the Umbelliferae family, primarily its fruits (Abouelela *et al.*, 2023). It is known by various names in different countries, such as Annesella in Italy; Anisa, Badian, Saunf, and Sop in Iran and India; and Boucage anis, in North Africa (Abouelela *et al.*, 2023). It is grown in a variety of places, including China, Japan, South America, northern Africa, and southern Europe (Abouelela *et al.*, 2023). The small fruit is wrongly called a seed. Nonetheless, the fruit is popularly known as aniseed, which is a popular spice when mature and dried (Abouelela *et al.*, 2023). The plant grows from September to March, with blooming and fruits occurring between January and March (Abouelela *et al.*, 2023). Since ancient times, anise seeds have been used for food and medicine, both of which play a clear part in preserving human health and enhancing the quality of life (Abouelela *et al.*, 2023). Due to its diverse biological diversity and varied climatic circumstances, China has significant potential to produce fragrant and medicinal plants and herbs (Abouelela *et al.*, 2023). It has been used in Chinese traditional medicine since the Fifth century and other traditional Iranian and Indian medicine (Abouelela *et al.*, 2023).

Anise seeds are used traditionally as an analgesic for migraines, as well as a carminative, fragrant, disinfectant, and diuretic (Abouelela *et al.*, 2023). In folk medicine, it is used to promote milk production, menstruation, urine, and perspiration secretion, as well as a healthy complexion (Abouelela *et al.*, 2023). Moreover, in certain traditional literature, it is also useful for polishing teeth, treating nightmares, and the treatment of seizures and epilepsy (Abouelela *et al.*, 2023). Anise tea has traditionally been used in children to treat upper respiratory infections, and bronchial asthma (Abouelela *et al.*, 2023). It is also used as an expectorant and lozenge, and to assist women in making more milk. It is generally used to aid childbirth and as a mild laxative (Abouelela *et al.*, 2023). Anise is used as a flavoring and aromatic agent in the culinary sector for fish products, ice cream, candies, and gums (Abouelela *et al.*, 2023). Several chemical constituents were isolated from aniseed as essential oils mainly anethole, estragole, and limonene (Abouelela *et al.*, 2023). Also, phenolic compounds were reported as gallic acid, naringin, and quercetin (Abouelela *et al.*, 2023). Several pharmacological studies were reported in anise as; antibacterial, antifungal, insecticidal, antiviral, muscle relaxant, antispasmodic and relaxant of smooth muscle, anticonvulsant, antiulcer, antidiabetic, hypolipidemic, and reduction of pain in dysmenorrhea which assured its traditional uses (Abouelela *et al.*, 2023). Anise, scientifically known as *Pimpinella anisum*, is an annual spice and medicinal plant belonging to the Apiaceae family (Abouelela *et al.*, 2023). Anise has a long history of cultivation, with evidence of its use in Egypt and later in Greece, Rome, and the Middle East (Abouelela *et al.*, 2023). The essential oil of anise contains compounds like anethole and methyl chavicol (Abouelela *et al.*, 2023).

Plant chromosome manipulation is a powerful tool in plant breeding due to its significant impact on various genetic traits and diversity (Ahmadinia and Heidari, 2023). To investigate the effect of polyploidy induction in anise, three different concentrations (0.01%, 0.5%, and 5%) of colchicine were tested (Ahmadinia and Heidari, 2023). The seeds and terminal buds of five-week-old plants were treated with colchicine, and the process was repeated for three consecutive days (Ahmadinia and Heidari, 2023). Subsequently, molecular, physiological, and morphological traits of both control (diploid) and induced (autotetraploid) plants were investigated. The results revealed that 0.01% colchicine had no significant effect on ploidy induction, while significant effects were observed at 0.5% and 5% (Ahmadinia and Heidari, 2023). Seedlings treated with concentrations higher than 0.5% colchicine exhibited larger stomatal size, lower stomatal density, and darker leaf color (Ahmadinia and Heidari, 2023). In addition, the contents of DNA, RNA, and total protein increased in seedlings treated with concentrations of 0.5% and 5% (Ahmadinia and Heidari, 2023). Karyotype observation confirmed polyploidy induction in plants treated with colchicine concentrations above 0.5% (Ahmadinia and Heidari, 2023). It can grow up to 1 meter tall and produces a small white fruit known as anise seeds. These anise seeds have a licorice-like taste and are used as a flavoring to enhance the taste of drinks and desserts. These seeds are also popular for their nutritional benefits and often provide a natural remedy to many diseases (Ahmadinia and Heidari, 2023).

Anise is an aromatic herb valued throughout recorded history for its medicinal and culinary properties (Dyer, 2022). These days, many gardeners enjoy growing anise for its licorice-like flavor and ornamental value, as anise sports feathery, bright green foliage and umbels of dainty white or pale yellow, late summer blooms (Dyer, 2022). The history of anise herbs can be traced back at least 2,000 years, when the plant was cultivated in Egypt and Greece, finding its way to Central Europe by the Middle Ages (Dyer, 2022). According to plant historians, anise was highly prized by Ancient Romans, who baked the seeds into spicy cakes that were served at the end of feasts in order to prevent flatulence, hiccups and indigestion that could befall dinner guests (Dyer, 2022). Anise was also believed to act as an aphrodisiac and was used to prevent nightmares and ward away the evil eye (Dyer, 2022). When mixed with lard, anise served as an effective treatment for insect bites and other annoying skin irritations (Dyer, 2022). Anise made a dandy breath freshener. It was valued as a treatment for stubborn coughs and sore throats, and it is still used for this purpose today, often in lozenge form (Dyer, 2022). It is also used to flavor baked goods, fruit, cheese, candy and soups (Dyer, 2022).

Plant chromosome manipulation is a powerful tool in plant breeding due to its significant impact on various genetic traits and diversity (Ahmadinia and Heidari, 2024). To investigate the effect of polyploidy induction in anise, three different concentrations (0.01%, 0.5%, and 5%) of colchicine were tested (Ahmadinia and Heidari, 2024). The seeds and terminal buds of five-week-old plants were treated with colchicine, and the process was repeated for three consecutive days (Ahmadinia and Heidari, 2024). Subsequently, molecular, physiological, and morphological traits of both control (diploid) and induced (autotetraploid) plants were investigated (Ahmadinia and Heidari, 2024). The results revealed that 0.01% colchicine had no significant effect on ploidy induction, while significant effects were observed at 0.5% and 5%. Seedlings treated with concentrations higher than 0.5% colchicine exhibited larger stomatal size, lower stomatal density, and darker leaf color (Ahmadinia and Heidari, 2024). In addition, the contents of DNA, RNA, and total protein increased in seedlings treated with concentrations of 0.5% and 5%. Karyotype observation confirmed polyploidy induction in plants treated with colchicines concentrations above 0.5%. Overall, this study shows that colchicine can alter anise plants' ploidy by 0.5% and 5% and boost leaf size and pigments associated with photosynthesis, resulting in stronger plants (Ahmadinia and Heidari, 2024). Anise, $2n = 2x = 18$, is a medicinal and aromatic plant belonging to the Apiaceae family that is used in the pharmaceutical, perfume production, and food industries (Ahmadinia and Heidari, 2024). Additionally, the fruits and essential oils of this plant have antispasmodic, antioxidant, antimicrobial, insecticidal and antifungal effects (Ahmadinia and Heidari, 2024). The seeds of this plant contain 5 to 5.5% essential oil, which is mainly composed of volatile phenylpropanoids such as transanthol (Ahmadinia and Heidari, 2024). In addition, anise seed essential oil contains a small amount of estragole, anisaldehyde and cis-anthole (Ahmadinia and Heidari, 2024). Anise seed and its essential oil are used both in ancient and modern times in salty foods, baked goods and various drinks. Anise seeds are a good source of many essential B complex vitamins, such as pyridoxine, niacin, riboflavin and thiamine (Ahmadinia and Heidari, 2024). Considering all the positive features, including anti-diabetes, blood fat reduction, antioxidant activities, anticancer and antimicrobial properties, anise seeds and essential oils are recommended for safe use as dietary supplements (Ahmadinia and Heidari, 2024). Today, various methods, such as metabolite engineering, cell culture and the use of elicitors, are used to increase the production of secondary metabolites in medicinal plants. Increasing the ploidy level (polyploidy) is also known as an effective method for producing new genotypes and increasing the yield of plants (Ahmadinia and Heidari, 2024). Polyploidy can also affect secondary metabolites in terms of quantity and chemical diversity. These changes are due to structural and functional modifications caused by an increase in the allelic level (Ahmadinia and Heidari, 2024). Polyploid plants are larger than diploids in terms of morphological characteristics such as leaf, stem, and root size, which can be beneficial for yield and crop production, especially for fodder, vegetables, and medicinal plants (Ahmadinia and Heidari, 2024). Polyploidy occurs spontaneously in plants but can be induced in a short period of time by using antimitotic substances such as colchicine, which interferes with spindle formation. Polyploidized plants are more tolerant to adverse environmental conditions due to their relatively stronger foundation (Ahmadinia and Heidari, 2024). Additionally, polyploidy affects the increase in photosynthesis by increasing the amount of chlorophyll, and as a result, polyploid plants have a stronger foundation than their ancestors (Ahmadinia and Heidari, 2024). Polyploidization is often associated with morphological and physiological changes that can increase plant growth rate and yield other commercially beneficial traits (Ahmadinia and Heidari, 2024). It was previously reported that polyploid plants have advantages in terms of creating tissues and organs; in general, compared with those of diploid species, the size of vegetative tissues, the shape of large flowers and resistance to environmental stresses are improved. For example, autotetraploid lavenders (*Lavandula angustifolia*) had larger flowers and leaves, thicker peduncles and larger shield hairs on their leaves than did their diploid genotypes (Ahmadinia and Heidari, 2024). Treating the terminal bud of watercress plants (*Nasturtium officinale*) with 0.5% colchicines was able to induce tetraploidy. Similarly, compared with diploid plants, tetraploid plants exhibit significant differences in leaf dimensions, stomatal number and chlorophyll content (Ahmadinia and Heidari, 2024).

Anise seed (sometimes called "aniseed") is believed to have been first cultivated in Egypt and the eastern Mediterranean (Aman, 2024). It's derived from the anise plant, a herb in the parsley family that's native to that region (Aman, 2024). The seeds are small and oblong, similar to fennel seeds (Aman, 2024). Anise seed is often used in liqueurs, like ouzo, sambuca, and absinthe. It can be used in both sweet and savory recipes (Aman, 2024). Anise is mentioned as early as the famous Ebers papyrus, written about 1550 B.C. In antiquity, anise was an ingredient in the panacea 'theriak', which Pliny claimed was effective against all diseases and poisonings (Avogel, 2024). Since anise was considered an appetite-stimulator, it was also called aniketon (= the invincible). In his *Materia Medica*, the Roman military physician Dioscorides called anise "an especially good medication" (Avogel, 2024). The origin of the Romanic term *pimpinella* is unknown. The Italian physician Benedictus Crispus made the earliest surviving reference to it in the 7th century. The name was used for a wide variety of plants and it is no longer possible to identify the species referred to (Avogel, 2024). Down the centuries anise has been very popular. Many liqueurs, such as Ouzo, Raki, Pernod, Pastis, Goldwater or Anisette are testament to this (Avogel, 2024).

Anise or Aniseed, less commonly anís (stressed on the second syllable), is a flowering plant in the family Apiaceae, native to the eastern Mediterranean region and southwest Asia (Bionity, 2024). It is a herbaceous annual plant growing to 1m tall. The leaves at the base of the plant are simple, 2-5 cm long and shallowly lobed, while leaves higher on the stems are feathery pinnate, divided into numerous leaflets. The flowers are white, 3 mm diameter, produced in dense umbels. The fruit is an oblong dry schizocarp, 3-5 mm long (Bionity, 2024). *Pimpinella* species are used as food plants by the larvae of some Lepidoptera species, including the lime-speck pug and wormwood pug (Bionity, 2024). Anise originated in the eastern Mediterranean basin and by the 15th century, the spice was cultivated as far north as England (Sobrin, 2024). From the beginning, anise was as important in medicine as it was as a spice in food (Sobrin, 2024). Ancient Egyptians placed it in pharaohs' tombs because of its medicinal benefits, such as treating digestive problems and toothaches (Sobrin, 2024). In the first century CE, Pliny the Elder wrote highly of the spice's medicinal properties: in *The Natural History*, he asserts that the anise of Crete and Egypt "alleviates headache," "arrests cancer of the nose," cures tonsillitis, and "purges off phlegm from the chest." (Sobrin, 2024). During the Middle Ages, anise spread throughout the continent and was used as a seasoning in cakes and other recipes (Sobrin, 2024). Medieval Europeans used sugar-

coated anise as “one of the *comfits* eaten at the end of a meal in order to sweeten the breath and aid digestion, a bodily function likened to the cooking process.” (Sobrin, 2024). Food historian Ken Albala discusses the role of anise as an aphrodisiac during the Early Modern period in his book *Eating Right in the Renaissance* (Sobrin, 2024). Colonists brought the seed to the New World, where it entered native recipes, such as mole poblano (Sobrin, 2024). In 1597, English botanist John Gerard published *The Herball or General History of Plants*, which draws heavily from Rembert Dodoens’s *Pemptades*. The continued effort to improve upon herbals and descriptions of plants suggests the popularization of gardening and the cultivation of exotic plants, including anise (Sobrin, 2024). Because many people began growing the plant outside of “Candie, Syria, Egypt, and other countries of the east,” where it is native, botanists were required to detail the exact climate necessary for it to thrive (Sobrin, 2024). In his work, Gerard lists anise’s names in Latin, Greek, Dutch, Italian, Spanish, and French, emphasizing just how widely the spice’s influence reached. He speaks to its medicinal qualities, noting that the seed “is good against belchings,” fights against “gripings of the belly,” and helps produce “white flux” [breast milk] in women,” which recalls the seed’s uses during the Middle Ages (Sobrin, 2024). Like the medieval Europeans, Gerard asserts that chewing anise “maketh the breath sweet” and “quencheth thirst.” (Sobrin, 2024). It was introduced to Europe in the 17th century, when it became common in early-modern baked goods, jams, fruit compotes, and anise-flavored liquors (Sobrin, 2024). The stress Gerard and other botanists, such as Dodoens, place on anise’s medicinal qualities implies that its presence in Mexican mole poblano was not purely for flavor, but also for the very humoral health that people in the Old World valued (Sobrin, 2024). By incorporating the seeds into foods that were regularly eaten, people were able to receive both anise and star anise’s health benefits before having to suffer from the physical ailments it cures (Sobrin, 2024). Paxton’s depiction of star anise also reflects the improvement of printing technologies over the early modern period: his use of color in a magazine allows him to convey the wealth and prestige associated with this plant (Sobrin, 2024). Colonists and conquistadores would not have exerted the time, effort, nor money to transport a spice from Europe to the New World unless it would prove useful (Sobrin, 2024). Because of European reliance on anise and star anise, the plant thrived and spread throughout South America and the New World (Sobrin, 2024).

Today, the anise seed is widely used in various world cuisines to make anise seed recipes like anise seed cookies (Herbco, 2024). When you buy anise seeds online, you can take advantage of various anise seed benefits and medicinal uses, such as helping with digestion, aiding in sleep, spicing up a variety of foods, and making anise seed tea (Herbco, 2024). Anise is an annual plant from the Apiaceae family, primarily cultivated for its aromatic seeds. These seeds are known for their sweet, licorice-like flavour (Öztekin, 2024). Many people recognize anise from popular herbal tea blends with fennel and caraway or in baked goods. The use of anise dates to ancient times (Öztekin, 2024). Originally native to the eastern Mediterranean, anise was valued by ancient Egyptians, Greeks, and Romans (Öztekin, 2024). In antiquity, it was not only used as a spice but also as a medicinal herb with various applications. Pliny the Elder and Hippocrates praised anise for its healing properties (Öztekin, 2024). During the Middle Ages, anise spread across Europe through trade routes and became a staple in various culinary cultures (Öztekin, 2024). The warm, intense aroma of anise blossoms wonderfully when brewed, especially with other herbs, spices, and tea. A well-known blend in our regions contains fennel and caraway, often used as a nursing tea. Anise is also a key component in Indian chai variations (Öztekin, 2024). In the Mediterranean, anise-flavored spirits like raki, ouzo, or pastis are popular and often enjoyed during social gatherings or with fish dishes (Öztekin, 2024). Anise’s harmonious flavors enhance culinary creations, while its essential oil, anethole, is used in perfumes to add a warm, seductive note (Öztekin, 2024).

Anise is an annual herb of the parsley family that's said to have health benefits including relieving menstrual cramps and menopausal symptoms (Phan , 2024). It's also thought to help manage diabetes, indigestion, irritable bowel syndrome, migraines, nasal allergies, and more (Phan , 2024). Anise is native to Egypt and the eastern Mediterranean region. However, it also grows in other parts of the world, such as areas in Europe, Asia, Africa, and the Americas (Phan , 2024). Anise, also known as *Pimpinella anisum* L., is a plant species native to the Mediterranean region (Ontosight, 2024). It is widely cultivated for its fragrant fruit, which is commonly used as a spice and for its medicinal properties. Anise is known for its distinct licorice-like flavor and aroma (Ontosight, 2024). *Anisum officinarum*, *pimpinella anisum* or green anise is a herbaceous plant of the Apiaceae family (Davidvanille, 2024). It is its seeds that interest us here, those that we consume in a variety of dishes from appetizer to dessert (Davidvanille, 2024). However, the anise is a fabulous plant which we can exploit all the parts, from the leaves to the roots through the stems (Davidvanille, 2024). This plant is native to the Mediterranean basin (green anise comes from Syria). It was used as early as 1550 BC to treat digestive disorders (Davidvanille, 2024). In France, it is Charlemagne who imposes its use, it appears besides in the famous capitular De Villis (Davidvanille, 2024). In the Middle Ages, in France, elixirs are made from this aniseed while in England this plant is considered a drug (Davidvanille, 2024). Today, the green aniseed has imposed itself in our kitchens and seduces both for its gustatory properties and its therapeutic virtues. We like its olfactory power, but also, and especially this fresh and delicately sweet flavour (Davidvanille, 2024). The *pimpinella anisum* produces very pretty white flowers which will give these famous seeds of color gray-green. They are harvested in late summer when they begin to dry and they are easily detached (Davidvanille, 2024). Green aniseed is a beautiful product that will accompany you throughout the day. If it is integrated into all your recipes, it is also very appreciated in infusion. As an aperitif, green anise is used in anisette, raki and ouzo (Davidvanille, 2024).

Anise seed is a powerhouse of a spice. You probably know it by its strong licorice flavor. It’s a key ingredient in liquors like ouzo and absinthe and in holiday cookies like Pfefferneusse and Springerle (WebMD, 2024). Anise’s use in cooking dates back to the ancient Egyptians, though it was the Romans who ate anise seed cakes after meals to ease digestion (WebMD, 2024). Anise is also a traditional digestive aid in India, where people also know it as a breath freshener (WebMD, 2024). Anise is easy to grow in the garden, where it serves as a natural insecticide. But it’s after harvest when it can really go to work for you nutritionally (WebMD, 2024). Anise seed, renowned for its distinct, sweet licorice flavor, is a versatile spice used in a variety of culinary and medicinal applications (Fullle, 2024). It's packed with essential nutrients and has been traditionally used to aid digestion, alleviate cramps,

and reduce nausea (Fullle, 2024). Additionally, anise seed is known for its antifungal and antibacterial properties, making it a valuable ingredient in natural remedies for respiratory health (Fullle, 2024). Its aromatic quality also makes it a popular choice in baking, cooking, and preparing aromatic teas (Fullle, 2024). Anise seed has a rich history, tracing back to ancient civilizations where it was prized for its distinctive flavor and medicinal properties (Fullle, 2024). Used by the Egyptians, Greeks, and Romans, it was valued for its digestive benefits and was often included in dishes and bread. The Romans even celebrated with anise-flavored cakes after feasts to aid digestion (Fullle, 2024). Through trade and exploration, anise seed spread globally, becoming a staple in various cultural cuisines and traditional health remedies (Fullle, 2024).

Also known as aniseed, the seeds of the dill-like plant *Pimpinella anisum* are light green, near grey in colour and fairly flat (Boroughmarket, 2024). It is the anethole compound in this spice that (traditionally) provides the flavour in so many digestifs (pastis, ouzo, arak, sambuca) (Boroughmarket, 2024). Indeed, the spice has been employed as a digestive throughout history and across continents: aniseed-flavoured cakes called mustaceoe were served by the Romans at the end of gluttonous feasts; and the seeds on their own are used in India for the same purpose (Boroughmarket, 2024). Anise is aromatic and sweet, and though we can note things like menthol, the flavour is distinctly and characteristically, well, that of anise (Boroughmarket, 2024). The seeds can be left whole for use in teas and infusions, but if adding to food, you're more likely to toast the seeds to encourage a release of oils, and then grind into a powder – as you would with fennel seeds (Boroughmarket, 2024). As ever, the whole seeds will be good for around a year if kept in an air tight container. The powder is best used within a few months (Boroughmarket, 2024). Anise also called aniseed or rarely anix, is a flowering plant in the family Apiaceae native to the eastern Mediterranean region and Southwest Asia (Wikipedia, 2024). The flavor and aroma of its seeds have similarities with some other spices and herbs, such as star anise, fennel, liquorice, and tarragon (Wikipedia, 2024). It is widely cultivated and used to flavor food, candy, and alcoholic drinks, especially around the Mediterranean (Wikipedia, 2024).

In this country Anise has been in use since the fourteenth century, and has been cultivated in English gardens from the middle of the sixteenth century, but it ripens its seeds here only in very warm summers, and it is chiefly in warmer districts that it is grown on a commercial scale, Southern Russia, Bulgaria, Germany, Malta, Spain, Italy, North Africa and Greece producing large quantities. It has also been introduced into India and South America (Botanical, 2024). The cultivated plant attains a considerably larger size than the wild one (Botanical, 2024). In the East Anise was formerly used with other spices in part payment of taxes. 'Ye pay tithe of Mint, Anise and Cummin,' we read in the 23rd chapter of St. Matthew, but some authorities state that Anise is an incorrect rendering and should have been translated 'Dill.' (Botanical, 2024). In Virgil's time, Anise was used as a spice. Mustaceae, a spiced cake of the Romans introduced at the end of a rich meal, to prevent indigestion, consisted of meal, with Anise, Cummin and other aromatics (Botanical, 2024). Such a cake was sometimes brought in at the end of a marriage feast, and is, perhaps, the origin of our spiced wedding cake (Botanical, 2024). On the Continent, especially in Germany, many cakes have an aniseed flavouring, and Anise is also used as a flavouring for soups (Botanical, 2024). It is largely employed in France, Spain Italy and South America in the preparation of cordial liqueurs. The liqueur Anisette added to cold water on a hot summer's day, makes a most refreshing drink (Botanical, 2024). Anise is one of the herbs that was supposed to avert the Evil Eye (Botanical, 2024). The oil extracted from the seed is said to prove a capital bait for mice, if smeared on traps. It is poisonous to pigeons (Botanical, 2024). Turner's *Herbal*, 1551, says that 'Anyse maketh the breth sweter and swageth payne.' 'The seeds,' says Delamer, *Kitchen Garden*, 1861, 'are much used by distillers to give flavour to cordial liqueurs.' Anisette is a liqueur flavoured with aniseed (Botanical, 2024). Langham, *Garden Health*, 1683, says: 'For the dropsie, fill an old cock with Polipody and Aniseeds and see the him well, and drink the broth.' The leaves are useful for seasoning some dishes (Botanical, 2024). The essential oil of Anise is a good preventive of mould in paste. The ground seeds form an ingredient of sachet powder (Botanical, 2024).

This article is about the *Pimpinella* species, but the name "anise" is frequently applied to Fennel (Wikidoc, 2024). Anise or Aniseed, less commonly anís (stressed on the second syllable) (*Pimpinella anisum*), is a flowering plant in the family Apiaceae, native to the eastern Mediterranean region and southwest Asia (Wikidoc, 2024). It is a herbaceous annual plant growing to 1m tall. The leaves at the base of the plant are simple, 2-5 cm long and shallowly lobed, while leaves higher on the stems are feathery pinnate, divided into numerous leaflets. The flowers are white, 3 mm diameter, produced in dense umbels. The fruit is an oblong dry schizocarp, 3-5 mm long (Wikidoc, 2024). *Pimpinella* species are used as food plants by the larvae of some Lepidoptera species, including the lime-speck pug and wormwood pug (Wikidoc, 2024). In Biblical times, anise was so highly prized that it was often used for tithes, offerings and payment of taxes in Palestine (Ourherbgarden, 2024). Many of the well known Greek and Roman authors, including Dioscorides, Theophrastus, Pliny and Paladus spoke of the cultivation and uses of anise (Ourherbgarden, 2024). Charlemagne, in the ninth century, commanded that anise be grown on the imperial farms. Albertus Magnus (1193/1206 – 1280), a priest who was perhaps the most widely read author of his time, speaks highly of anise (Ourherbgarden, 2024). Despite being cultivated for at least 2,000 years, there has been very little development of improved varieties (Ourherbgarden, 2024).

Anise also called aniseed or rarely anix is a flowering plant in the family Apiaceae native to the eastern Mediterranean region and Southwest Asia (Gardens, 2024). The flavor and aroma of its seeds have similarities with some other spices and herbs, such as star anise, fennel, licorice, and tarragon. It is widely cultivated and used to flavor food, candy, and alcoholic drinks, especially around the Mediterranean (Gardens, 2024). *Pimpinella anisum* L. is an aromatic species of the Apiaceae (Parsley) family, commonly known as anise or aniseed (Kılıç, 2024). Fruits of the plant, which are also known as seeds, have widespread usage throughout the world for culinary and medicinal purposes, in cosmetics industry, and also is used in the flavoring of some alcoholic beverages, candies (Kılıç, 2024). Usage of the plant for medicinal purposes dates back to ancient Egypt and the plant is currently being used mainly for its digestive properties and hormonal activities such as increasing milk production in breast feeding mothers (Kılıç, 2024).

Anise, or *Pimpinella anisum*, is also called aniseed. It is a flowering plant in the Apiaceae family and is native to the eastern Mediterranean region and Southwest Asia (Ispiceyou, 2024). Its flavor is similar to other spices, including fennel and liquorice. Anise is used to flavor food, alcoholic drinks, liquor, teas, soups and candies and it is served as a carminative in herbal medicine (Ispiceyou, 2024). Anise is sweet and very aromatic (Ispiceyou, 2024). First cultivated in Egypt and the Middle East, anise was brought to Europe for its medicinal value (Ispiceyou, 2024). It has been used for medicinal use throughout history, and was given the name *Solamen intestinorum*—the comforter of the bowels (Ispiceyou, 2024). The Romans often ate anise-spiced cakes, known as mustaceoe, to avoid indigestion and flatulence (Ispiceyou, 2024). In the 1800s, Germans believed so strongly in the medicinal value of the spice they flavored their household bread with whole anise seed (Ispiceyou, 2024). It also has a reputation for soothing coughs and muscle affections. Anise is one of the oldest known seeds, and in Biblical times it was considered so valuable it was used as payment for tithes, offerings and taxes (Ispiceyou, 2024). The ancient Romans hung anise plants near their pillows to prevent bad dreams and often concluded wedding ceremonies with the breaking of a wheat or barley cake containing anise over the bride's head as a symbol of good fortune (Ispiceyou, 2024).

Anise is mentioned as early as the famous Ebers papyrus, written about 1550 B.C. (Avogel, 2024). In antiquity, anise was an ingredient in the panacea 'theriak', which Pliny claimed was effective against all diseases and poisonings (Avogel, 2024). Since anise was considered an appetite-stimulator, it was also called aniketone (= the invincible). In his *Materia Medica*, the Roman military physician Dioscorides called anise "an especially good medication". The origin of the Romanic term *pimpinella* is unknown. The Italian physician Benedictus Crispus made the earliest surviving reference to it in the 7th century (Avogel, 2024). The name was used for a wide variety of plants and it is no longer possible to identify the species referred to. Down the centuries anise has been very popular. Many liqueurs, such as Ouzo, Raki, Pernod, Pastis, Goldwater or Anisette are testament to this (Avogel, 2024). The sweet and exceptionally intense flavor of anise fruits is a little like fennel and licorice. Anise has been used as bread seasoning since ancient Roman times (Kotanyi, 2024). The sweet, bitter flavor of anise is reminiscent of licorice and leaves a pleasant taste on your tongue. Kitchens around the world are filled with the spicy aroma of anise — but the fruits are particularly popular in bakeries, as anise has been used as seasoning for bread and cakes since ancient times (Kotanyi, 2024). They are also hugely popular outside of the culinary world and numerous alcoholic drinks get their flavor from anise. Whether it's Greek ouzo, French Pernod or Turkish raki, anise is used to flavor spirits around the world with its characteristic spicy taste (Kotanyi, 2024).

There is evidence that the Egyptians used anise as early as 1500 B.C. and in the book of Mathew in the Bible, there is mention of paying tithe with anise and the Roman poet Virgil mentioned in his writings that a sweet cake called "mustaceum" heavily laced with anise was served at the end of heavy banquets to aid digestion (Fooduniversity, 2024). Anise was brought to the New World by settlers from England and in 1619, the first Assembly of Virginia announced that each family that was given a plot of land was required to grow certain plants, among them was required six anise plants (Fooduniversity, 2024). Anise, also referenced as Aniseed (Anise seed) and anís, is a herbaceous plant with feathery leaves and white flowers which are produced in dense umbels (individual flower stalks called pedicels that are close to equal in length which arise from about the same point on the stem concluding in a cluster at the top of the peduncle ...think "umbrella") (Herbbee, 2024). The leaves and seeds (fruit) have a pungent licorice flavor and scent, due to the anethole, and are sometimes chewed to freshen breath (Herbbee, 2024). Chewing the seeds can also be helpful for those who are trying to quit smoking. Anise is also claimed to aid digestion (Herbbee, 2024). It is said that in Holland, anise seeds are steeped in milk to induce sleep (Herbbee, 2024). *P. anisum* was first cultivated as a spice by the ancient Egyptians and later by the Greeks, Romans, and Arabs. Although widely grown commercially, it (Anise) has declined in recent years through competition with cheaper anise flavorings, such as *Illicium verum* [Star Anise] and synthetic anethole (Herbbee, 2024). According to *New Age Herbalist*, Aniseed tea eases indigestion, flatulence and colic. Its relaxing and expectorant action makes it useful to treat tight coughs (Herbbee, 2024).

The ancient Egyptian term, *inst*, is equated with anise and is mentioned in the *Papyrus Ebers* (c. 1550 BCE) as a medicine used to treat abdominal and dental diseases (NG, 2025). Pliny, the Roman generalist, who lived during the first century of the Common Era, reported two esteemed varieties of anise, one from the Mediterranean island of Crete and the second from Egypt (NG, 2025). Pliny also reported that anise mixed with wine was used by the Egyptians to treat bites from poisonous snakes (asps) and when anise was mixed with cucumber seeds, linseed, and white wine, the mixture dispelled childbirth-related vertigo (NG, 2025). Anise relieved thirst, was an aphrodisiac, and when mixed with wine promoted perspiration (NG, 2025). Anise has been used medicinally from antiquity into the Middle Ages and used to treat a wide range of disorders, among them: gallbladder, kidney, and liver complaints, hiccup, and "falling sickness" (epilepsy) in children (NG, 2025). It is used to reduce/prevent belching and *upbraidings of the stomacke* [i.e. gastric-reflux]; sweetens the breath; quenches thirst; when dried and mixed with honey it cleans the chest from *flegmatike superfluities*, and when eaten with bitter almond, helps relieve cough; recommended for children who have the falling sickness; and when prepared as a garble and mixed with honey, vinegar, and hyssop then boiled, can be used as a gargle (NG, 2025). Anise also has been considered a remedy to expel intestinal parasites, treat lice infestations, and to combat nausea and vertigo (NG, 2025). Traditionalists hold that individuals who consume the leaves or seeds of anise leaves, or who wear garlands of the leaves, will not be attacked by the Evil Eye (NG, 2025). Anise seeds also have been used as galactagogues to increase the milk supply of nursing mothers (NG, 2025). During the American Civil War preparations of anise had reported uses as antiseptics. And, of course, seeds of anise provide the flavor for the Greek beverage, *ouzo* (NG, 2025).

Anise, annual herb of the parsley family (Apiaceae), cultivated chiefly for its fruits, called aniseed, the flavour of which resembles that of licorice (Petruzzello, 2025). Native to Egypt and the eastern Mediterranean region, anise is cultivated in southern Europe, southern Russia, the Middle East, North Africa, Pakistan, China, Chile, Mexico, and the United States (Petruzzello, 2025). Anise seed, renowned for its distinct, sweet licorice flavor, is a versatile spice used in a variety of culinary and medicinal applications (FLTC, 2025). It's packed with essential nutrients and has been traditionally used to aid digestion, alleviate cramps, and reduce

nausea (FLTC, 2025). Additionally, anise seed is known for its antifungal and antibacterial properties, making it a valuable ingredient in natural remedies for respiratory health (FLTC, 2025). Its aromatic quality also makes it a popular choice in baking, cooking, and preparing aromatic tea (FLTC, 2025). Scientifically known as *Pimpinella anisum*, anise seed belongs to the Apiaceae family (FLTC, 2025). Native to the eastern Mediterranean region and Southwest Asia, this annual herb is cultivated for its distinctive, sweet seeds (FLTC, 2025). The plant grows to about 3 feet tall and produces small, white flowers in umbels, followed by the characteristic oval, grayish-brown seeds (FLTC, 2025). The genus *Pimpinella* contains over 150 species, but *Pimpinella anisum* is the most renowned for its culinary and medicinal uses (FLTC, 2025). The name 'anise' is believed to derive from the Greek word 'anison', reflecting its ancient origins (FLTC, 2025). In traditional medicine across various cultures, anise has been used to aid digestion, relieve flatulence, and as a mild expectorant (FLTC, 2025). Its sweet, licorice-like flavor has made it a popular ingredient in cooking, baking, and herbal preparations for thousands of years (FLTC, 2025).

In this review article on Origin, Taxonomy, Botanical Description, Genetic Diversity, Breeding and Cultivation of Anise are discussed.

ORIGIN AND DISTRIBUTION

Mediterranean (Egypt?) or West Asia. Turkey is still an important producer in our days, but still better qualities come from Spain. In Far Eastern cuisines (India, Iran, Indonesia), no distinction is made between anise and fennel (see below). Therefore, the same name is usually given to both of them. On the Philippines, star anise is a popular spice and referred to as *anise* for short (Katzner, 1998). *P. anisum* is most likely native to the Eastern Mediterranean region (Global Information Hub on Integrated Medicine, most notably the Anatolian peninsula, Greece, and Egypt (Herbal Academy, 2020). *P. anisum* was well known in the spice trade due to its seeds, which led to its distribution in China. Since then, its cultivation has broadened, and it can now be found growing in various different countries, including northern Africa, Iran, Eastern Europe, Bulgaria, Romania, Japan, Argentina, Chile, and Mexico (Herbal Academy, 2020). Anise is native to the eastern Mediterranean region and has been cultivated for thousands of years (Google, 2024a). Anise, scientifically known as *Pimpinella anisum*, is a flowering plant in the Apiaceae family, native to the Mediterranean region and Southwest Asia, prized for its aromatic seeds with a distinctive licorice-like flavor, used as a spice and in various culinary and medicinal applications (Google, 2024). Native to the eastern Mediterranean region and Southwest Asia (Google, 2024). It is believed that anise originated in the Mediterranean region and western Asia. Today it is cultivated primarily in southern Europe, the Mediterranean region, the Near East, India, and in the territory of the former Soviet Union. Anise is seldom found growing wild. At harvest-time, the plants are pulled up and after drying, the fruits are threshed and gathered (Avogel, 2024). Anise, *Pimpinella anisum*, is native to the Mediterranean region and Egypt; it is also cultivated in Europe, Asia, India, Mexico, North Africa, and the USSR (Herbco, 2024). It is a native of East Mediterranean Region. It is widely cultivated in Bulgaria, Cyprus, France, Germany, Italy, Mexico, South America, Syria, Turkey, Spain, UK and USSR. In India, it is grown to a small extent as a culinary herb or as a garden plant. The major products are anise oil and oleoresin anise (Indianspices, 2024). Origin of anise is Egypt, Greece, Asia Minor (Fooduniversity, 2024). Native to the eastern Mediterranean region and Southwest Asia, this annual herb is cultivated for its distinctive, sweet seeds (Fullle, 2024). Anise is originally from the eastern Mediterranean region, but Russia, Africa, Central America and Italy are all important producing countries today (Kotanyi, 2024). Anise is native to the Mediterranean region, perhaps Egypt (NG, 2025).

TAXONOMY

Anise belongs to the genus *Pimpinella*, specifically the species *Pimpinella anisum*, and is part of the carrot family (Apiaceae/ Parsley family). While anise and star anise share a similar name and flavor profile, they belong to different plant families and are not closely related. Anise is an herbaceous annual plant, while star anise is a medium-sized evergreen tree. The genus *Pimpinella* contains over 150 species, but *Pimpinella anisum* is the most renowned for its culinary and medicinal uses (Fullle, 2024).

Illicium anisatum, also known as Japanese star anise, is another species in the *Illicium* genus, but it is not edible and contains a toxic compound called anisatin. The term "anise" is also sometimes used to refer to certain cultivars of fennel (*Foeniculum vulgare*), which also have a similar flavour (Anon, 2024). The plant grows to about 3 feet tall and produces small, white flowers in umbels, followed by the characteristic oval, grayish-brown seeds.

Synonym

In some texts, anise is referred to as *Anisum vulgare* or *A. officinarum* (Drugs, 2024).

BOTANICAL DESCRIPTION

Pimpinella anisum is a delicate herbaceous plant with a soft, branching, green stem that grows up to 1 meter in height. The lower leaves are dark green with a cordate, slightly lobed shape and serrated edges. The middle leaves are pinnate with lanceolate or cuneate lobes that embrace the upper linear leaves, which can have trifid or undivided margins. In the summer, it produces compound umbels of tiny, white delicate flowers that develop fruit in the fall. The fruit, or seeds as they are more commonly called, ripen from August to September. *P. anisum* is an annual that will self-seed if the seeds are not harvested (Herbal Academy, 2020). Anise is an annual plant, which grows about 100 to 120 cm high. It has feathery leaves; the lower leaves are broad, toothed and triangular with upper leaves that are smaller, divided and narrow. It has umbrella-like clusters of dainty,

creamy-white flowers and thin roots. The seeds are grey-green to brownish, ribbed and ovate, measuring 2–4 mm long they have the flavour of licorice and the aroma of sweet fennel (Oseltamivir Phosphate).

Anethole, the principal component of anise oil, is a precursor that can eventually produce 2,5-dimethoxybenzaldehyde which can be used in the clandestine synthesis of psychedelic drugs (Aishwath *et al.*, 2021). Anise is an herbaceous annual plant grows 90 to 120 cm tall with an erect branching stem. In temperate regions it also shows the biennial characteristics. The leaves at the base of the plant are simple, 0.52 in (1.35.1 cm) long and shallowly lobed triangular, while leaves on the upper of stems are feathery pinnate, divided into numerous leaves. The flowers are white, approximately 3 mm diameter, produced in dense compound umbels. The fruit is an oblong dry schizocarp, 3–5 mm long. It is these seedpods that are referred to as "aniseed". The seed is oval in shape, about 5mm long with a short stalk, laterally compressed and having five longitudinal ridges on the pericarp. The two carpels containing the seed are hairy, aromatic greenish brown to grayish. Anise is a cross-pollinated crop and is genetically heterogenous in nature (Aishwath *et al.*, 2021).

Anise is an herbaceous annual plant growing to 60–90 cm or more. The leaves at the base of the plant are simple, 1–5 cm long and shallowly lobed, while leaves higher on the stems are feathery or lacy, pinnate, divided into numerous small leaflets. Both leaves and flowers are produced in large, loose clusters. The flowers are either white or yellow, approximately 3 mm in diameter, produced in dense umbels. The fruit is a dry oblong and curved schizocarp, 4–6 mm long, usually called "aniseed" (Wikipedia, 2024). Anise is an annual herb that grows 0.3 to 0.6 m and is cultivated widely throughout the world. The flowers are yellow, compound umbels and its leaves are feather shaped. The greenish-brown, ridged seeds are used for food or the drug. They are harvested when ripe in autumn. Aniseed has an anethole-like odor and a sweet "licorice-like" aromatic taste, which has led to the traditional use of anise oils in licorice candy (Drugs, 2024). Plant: An annual herb. The plant has feathery leaves, yellow-white flower clusters, and green fruit (the "seeds"). Widely cultivated for its fruits (seeds) (Google, 2024). The plant reaches a height of about 0.75m and requires a warm and long frost-free growing season of 120 days. It has long-stalked basal leaves and shorter, stalked stem leaves. Its small and yellowish white flowers form loose umbels. The fruit is nearly ovoid in shape, about 3.5 mm long, and has five longitudinal dorsal ridges. The fruit consists of two united carpels each containing an anise seed. The seed is small and curved, about 0.5 cm long and grayish brown. Its usually contains hair-like protrusions from each end (KSSDB, 2024).










Anise is an annual, herbaceous plant growing up to 60cm in height. The lower leaves have a roundish, kidney shape, while the stalk leaves are pinnatifid to tripinnatifid and become more and more finely divided the higher up the stalk they grow. The round, grooved stalks branch in the upper part of the plant and form apical, composite umbels with white blossoms. The grey-green, pear-shaped fruits are thickly covered with hair and consist of two halves with light-coloured ridges. The whole plant smells aromatically of aniseed. Anise blooms from July to August (Avogel, 2024). A member of the *Apiaceae* (*Umbelliferae*) family, Anise is a herbaceous annual plant growing to 3 feet or more. The leaves at the base of the plant are simple, $\frac{3}{8}$ -2 inches long and shallowly lobed, while leaves higher on the stems are feathery pinnate, divided into numerous leaves. The flowers are white, approximately $\frac{1}{8}$ inches in diameter, produced in dense umbels. The fruit is an oblong dry schizocarp, $\frac{1}{8}$ - $\frac{1}{4}$ inches long, usually called "aniseed" (Herbco, 2024).

Aniseed is an annual plant with an average height of 30 to 50 cm. The plant is completely covered with fine hairs. Aniseed is ground-grey to greyish brown in colour, 3 to 5mm in length, oval in shape with short stalk attached. Five longitudinal ridges are visible on each pericarp. Vittae (oil ducts) are almost always present embedded in the fruit wall beneath the ridges. It has a characteristic agreeable odour and a pleasant aromatic taste (Indianspices, 2024). Anise is an annual herbaceous plant in the *Umbelliferae* family that is primarily grown for its fruits, which are used as a spice. The plant has alternately arranged leaves and a grooved stalk. The petioles on the lower leaves can range in length from 4 to 10 cm and they are rounded with a serrated edge. As the plant grows taller, the upper leaves get increasingly shorter and feathery. The aniseed plant produces umbels of white flowers as well as an oval, hairy fruit with one seed that is flattened and hairy. An annual plant, anise has a height range of 45 to 60 cm and only has one growing season. Anise may also be referred to as aniseed and originates from the Mediterranean (Plantvillage, 2024).












Anise is a dainty annual that grows from 1 ½ to 2 feet high. It has finely, cut serrated leaves and very small, whitish flowers in flat clusters. The leaves and seeds have a warm, sweet taste that suggests licorice (Extension, 2024). Anise is an annual, herbaceous plant growing up to 60cm in height. The lower leaves have a roundish, kidney shape, while the stalk leaves are pinnatifid to tripinnatifid and become more and more finely divided the higher up the stalk they grow. The round, grooved stalks branch in the upper part of the plant and form apical, composite umbels with white blossoms. The grey-green, pear-shaped fruits are thickly covered with hair and consist of two halves with light-coloured ridges. The whole plant smells aromatically of aniseed. Anise blooms from July to August (Avogel, 2024). The annual anise plant grows to up to 60 centimeters tall, and its relatively small, white flowers are in bloom from June to September. It's actually the fruits that are used as a spice rather than the seeds, as is often incorrectly assumed. Anise fruits are oval shaped and around three to five millimeters long (Kotanyi, 2024). Anise seeds germinate rapidly, typically within 7-14 days when conditions are just right. This quick start sets the stage for its lifecycle, which includes distinct phases: seedling, vegetative, flowering, and seed production. Anise plants grow upright, reaching heights of 2-3 feet, making them a striking addition to any garden. Initially, they develop feathery green leaves, which are soon followed by flowering stems that burst into small white clusters, usually in mid-summer. Each flower is a powerhouse of reproduction, producing multiple seeds that significantly boost the plant's chances of survival. This strategy not only enhances genetic diversity but also ensures that Anise can thrive in various environments. The combination of rapid growth and prolific seed production

makes Anise a fascinating plant to cultivate (Rankel, 2024). The lifecycle of Anise unfolds in distinct stages, each crucial for its growth and production. In the seedling stage, Anise establishes its roots and begins initial leaf growth. This foundational phase is vital for supporting the plant's future development. Next comes the vegetative stage, where rapid growth takes center stage. During this time, Anise develops lush foliage, preparing for the flowering period ahead. Typically, the flowering period occurs 60-90 days after planting. Small white flowers emerge, signaling that the plant is ready to reproduce. Following flowering, seed maturation takes place. Seeds are usually ready for harvest shortly after flowering, typically in late summer, marking the culmination of Anise's annual lifecycle. Different cultivars of anise can exhibit slight differences in growth patterns and flowering times. This genetic diversity allows gardeners to select varieties that best suit their specific conditions (Rankel, 2024). The plant reaches up to 0.75 metre tall. The leaves near the base are long-stalked and simple, whereas the leaves along the stem are compound with shorter stalks. Its small yellowish white flowers form loose umbels. The fruit is a schizocarp (a dry fruit formed of multiple carpels that separate) and is nearly ovoid in shape. It is about 3.5 mm long and has five longitudinal dorsal ridges. The essential oil content is about 2.5 percent, and its principal component is anethole (Petruzzello, 2025).

Botanical Description of anise is given in Fig. 1.

		
Anise Life Cycle	Seeds	Seeds
		
Sowing	Seedlings	Plant
		
Flowers	Flowers	Flowers \

Continue ...

		
Umbel	Immature seeds	Seeds
 • Fruits	 • Fruits (aniseed)	 Green anise
 •	 •	
Close-up of fruits	Cross-section of fruit	
		
Floor	Sugar-coated anise seeds	Anise essential oil
Fig. 1. Botanical Description		

GENERTICS AND CYTOGENETICS

Anise genetics and cytogenetics research focuses on understanding the genetic diversity and chromosomal structure of anise. This includes exploring the molecular markers for genetic variation, investigating the effects of polyploidy induction, and analyzing chromosome behavior during cell division. Studies using molecular markers like RAPD and ISSR have been conducted to assess the genetic diversity of anise landraces. These markers help identify polymorphic bands, revealing variations in the genomic DNA among different anise populations. The analysis of these variations helps understand the genetic relationships between different anise varieties. Cytogenetics focuses on the structure and function of chromosomes, particularly during cell division (mitosis and meiosis). Studies on anise cytogenetics aim to understand how chromosomes behave during cell division, which can provide insights into plant breeding and evolution. Karyotyping and other cytogenetic techniques are used to analyze chromosome number, size, and structure in anise. Understanding anise genetics and cytogenetics is crucial for developing improved breeding strategies. Knowledge of genetic variation can help select desirable traits for crop improvement, such as disease resistance, yield, and quality. Cytogenetic studies can inform the development of polyploid breeding programs, potentially leading to plants with

increased size, vigor, and yield. Anise chemotypes, which are groups of plants within the same species with different chemical compositions, are also studied in relation to genetics. Research on genes involved in the biosynthesis of compounds like trans-anethole and methyl chavicol, which contribute to the flavor and aroma of anise, is ongoing. The genetic variation in anise can also influence its medicinal properties, as the plant is used for its antispasmodic, antioxidant, and antimicrobial effects.

GENETIC DIVERSITY

On the basis of a study of allozyme variation in 4 enzyme systems of the seeds (9 loci), the frequency of the various alleles is given, together with the expected and actual distribution of genotypes in cultivated populations from different regions of the USSR (northern Crimea and south of western Siberia). The proportion of polymorphic loci was 31.35-32.67% and the mean number of alleles/locus 1.22. In no case did the observed distribution of genotypes accord with that expected on the basis of the Hardy-Weinberg law. Populations from the different regions differed in the distribution of genotypes at the polymorphic Est1 locus. Ameliorative selection over 5 generations in the population introduced from the Crimean province of the Ukraine into Siberia reduced the mean populational values for genetic diversity. The populations were genetically similar (Shumskaya and Garifullina, 1990). In order to evaluation of genetic variation and comparison of 8 populations of Iranian anises, a study was conducted in the research farm of University of Zanjan in randomized complete block design during 1392 and 1393. Evaluated traits were days to flowering, days to maturity, grain filling period, plant height, number of fertile umbels, umbelet numbers per umbel, grain yield, biological yield, harvest index and grain essential oil percentage. Combined analysis of variance showed significant differences between years and between studied populations, point of all traits except grain filling period. The highest coefficients of genetic and phenotypic variation were found in traits of grain yield, biological yield and grain essential oil percentage and the highest heritability in traits of grain essential oil percentage, biological yield, grain yield, umbelet numbers per umbel and plant height, respectively. Based on cluster analysis, 8 under studied populations were divided into three groups that the first group of populations were better than others in terms of important traits such as days to flowering, days to maturity, plant height, number of fertile umbels, grain yield and biological yield. The results showed that there has been a high diversity between anise populations and yield and essential oil percentage is able to increase by selection in anise populations. Also regarding to excellency of Qazvin, Markazi and Sabzevar populations, selecting within them can be proposed to improve yield and essential oil percent (Maleki *et al.*, 2017).

The molecular diversity of 15 Turkish anise landraces collected from different regions of Turkey and four foreign landraces obtained from Cyprus, Syria and France were analyzed using randomly amplified polymorphic DNA (RAPD) and inter simple sequence repeat (ISSR) markers. The discriminatory power of these markers was assessed by calculating various marker parameters, namely percent polymorphism, polymorphism information content (PIC), resolving power (RP), and marker index (MI). The genomic DNA of 19 anise landraces was amplified with nine RAPD primers that generated 71 polymorphic bands and five ISSRs primers that produced 45 polymorphic bands. The percentage of polymorphic loci was 59.8% in RAPD profiling and 51.5% in ISSR profiling. The average PIC values obtained using RAPD and ISSR markers were 0.40 and 0.38, respectively. The mean RP (2.90 and 2.67) and MI values (1.23 and 1.05) of the RAPD assay were found to be somewhat higher than those of the ISSR assay, but ISSR was more favorable than the RAPD techniques in terms of presenting the phylogenetic relationships in anise landraces. A UPGMA cluster grouped the 19 anise landraces into two major clusters based on both markers. The RAPD and ISSR marker systems were found to be useful for determining genetic diversity in *P. anisum* L. and identifying variation among landraces (Akçali Giachino, 2020). Researchers have investigated the genetic variation of anise using molecular markers like RAPD (Random Amplified Polymorphic DNA) and ISSR (Inter-Simple Sequence Repeat). Studies using RAPD primers have shown polymorphism in anise landraces, with varying numbers of polymorphic bands generated by different primers. ISSR markers have also been used to assess genetic diversity, with studies showing polymorphism among anise landraces. Research has focused on examining the genetic variation within different anise landraces, which are local varieties adapted to specific regions. Studies have calculated genetic similarity values among anise landraces, using RAPD and ISSR data (Abouelela *et al.*, 2023). 10 half-diallel hybrids and their five parents were evaluated in both field and greenhouse lysimetric experiments under well-watered and water deficit stress conditions. The results indicated that the inheritance of grain yield is complex and affected by water deficit stress. Similar heritability and genetic architecture were detected for flowering time and percentages of photosynthate partitioned to grain (PPPG) in both well-watered and water deficit stress treatments. Significant negative genetic correlations were observed between grain yield and flowering time, root dry mass, root diameter, root volume, root number, percentages of photosynthate partitioned to shoot, and percentages of photosynthate partitioned to root. A positive significant genetic linkage between grain yield and PPPG, chlorophyll content, cell membrane stability, and leaf relative water content reveal selection for high values of these attributes is favored. These attributes could be used as surrogate selection criteria in the early segregating generations. The P₁ parent (early ripening parent) contained key genes associated with PPPG and drought escape (Mehraoui *et al.*, 2023). Studies have investigated the genetic variation within anise landraces (local varieties). Researchers have used Random Amplified Polymorphic DNA (RAPD) and Inter-Simple Sequence Repeat (ISSR) markers to analyze genetic diversity in anise. Studies have found average genetic similarity values among anise landraces. Research has focused on the biosynthesis of anethole, the key compound responsible for anise's characteristic flavor and aroma, including the identification of enzymes involved in its production (Google, 2024b).

BREEDING

Breeding Objectives

Anise breeding focuses on improving seed yield, drought resistance, and water use efficiency, with research exploring genetic variation among landraces using molecular markers like RAPD and ISSR. Anise breeding programs aim to increase the quantity and quality of seeds produced by plants. Developing anise varieties that can tolerate water scarcity is a major focus, especially in

regions with limited rainfall. Breeding for plants that utilize water more efficiently can help mitigate the impacts of drought stress. Understanding the genetic diversity within anise landraces is crucial for selecting parents for breeding programs (Google, 2024a).

Breeding Strategies

RAPD (Random Amplified Polymorphic DNA) and ISSR (Inter-Simple Sequence Repeat) markers are used to assess genetic diversity and identify useful traits for breeding. Genetic variation among anise landraces can be used to select parents for crossing, generating populations with desired traits. Colchicine treatment can induce tetraploidy (doubling the chromosome number), which can lead to improved seed yield and other traits. For plant regeneration and breeding, indirect regeneration of callus from petiole explants is considered more suitable than direct regeneration (Google, 2024a).

Methods for Breeding

Anise plants are typically propagated through seeds. They do not transplant well once established, so seeds should be sown directly into the garden. Anise plants prefer well-drained soil and require a long, warm growing season.

Improved varieties

Ajmer-Anise-1, this variety developed at National Research Centre on Seed Spices and released by AICRP on spices. Flower colour of this variety is white with green sepals. The stamens are longer than petals and sit above them. It is a high yielding variety bears attractive seeds. Plant is medium height and suitable for intercrop with other crops. This variety bears 3.2 percent volatile oil. Variety is suitable for cultivation in semi-arid regions under irrigated conditions. The average yield of this variety is 733 kg ha⁻¹. However, yield potential of this variety 1150 kg ha⁻¹ in semiarid conditions with suitable irrigation facility. In the semiarid conditions, it comes up well only in winter season when temperature went down. It can be grown in summer season also in the Himalayan regions at high altitude. Prolong of winter period enhances the crop yield (Aishwath *et al.*, 2021).

Uses

Fruits, which are often termed seeds, though this is not botanically correct (Katzer, 1998). Anise is one of the oldest species, used by ancient Greeks, Romans, and Arabs. It was also recommended by notable personalities, including Pliny, Pythagoras, and Hippocrates. The fruits from this species were also used as currency in the Middle Ages. Anise has morphological similarities to another species from the family Apiaceae, resulting sometimes in serious problems. For example, misidentification can occur between *Pimpinella anisum* and *Conium maculatum*, causing intoxication and/or death (Rocha and Fernandes, 2003). Aniseed and its essential oil have been used in folk medicine for a wide range of therapeutic uses, such as a diuretic, mild expectorant, tranquilizer, stomachic, antifungal, antibacterial, anticonvulsant, carminative, milk secretion inducer, antispasmodic, expectorant, and intestinal purifier, among others. This species and the parameters of quality control for the herb are described in many official compendiums around the world, such as the British Pharmacopoeia, United States Pharmacopoeia, and Brazilian Pharmacopoeia. Moreover, its use is regulated in Europe; aniseed is also listed as generally regarded as safe (GRAS). The use of aniseed in folk medicine encouraged many researchers to investigate the medical properties of essential oil from this species, including its strong antimicrobial activity. Moreover, many studies of this essential oil include elucidation of the mechanism of action. For example, aniseed essential oil was able to induce bronchodilatory effects, which may be explained by the inhibition of muscarinic receptors. Despite the remarkable advantages and potential uses of essential oils, in the case of aniseed indicated that patients suffering from epilepsy should use products that contain essential oil from aniseed with caution due to its capacity to induce hyperexcitability (Rocha and Fernandes, 2003). Therapeutic: Antibacterial, antiseptic, antispasmodic, carminative, digestant, diuretic, expectorant, insecticide, stimulant, tonic. Medicinal: Internal - Anxiety, asthma, difficult breathing, bronchial spasm, colic, dry cough, flatulence, fluid retention, indigestion, migraine nausea, tension vomiting. External - Asthma, bronchial congestion, coughs, exhaustion, headache, insect bites, sinus problems, stress. Industry & Household uses: Pharmaceutical uses in cough mixtures, lozenges, to mask odours and flavours in drugs; soft drinks, food flavouring, soaps toothpaste, cosmetics and perfumes. Anise is used by many fishermen to mask the smell of the human body. It helps the fish to bite better. Hunter's use anise oil to hide the smell of the human scent too. Blends with: Rose lavender, orange, pine and other spice oils (Aishwath *et al.*, 2021). Aniseed is used externally as an insecticide against small insects such as lice, mites and vermin. It also has fungicidal properties. The seeds are used to flavour curries, sweets, cakes, cookies and biscuits. Anise oil is employed in medicine as an aromatic carminative to relieve flatulence. Being a mild expectorant, it is used as an ingredient of beverages and liqueurs. It is a popular flavouring agent for dental preparations and mouth washes. Constituents in plant volatile oils are known to be useful in pest control. Various authors have reported that vapours of essential oils extracted from anise were found to be toxic to two greenhouse pests, *viz.* the carmine spider mite, *Tetranychus cinnabarinus* and cotton aphid, *Aphis gossypii*. It indicated that the essential oil of anise had a high residual toxicity to adults of *Tribolium confusum*, and was the most repellent to *Sitophilus oryzae* adults in food preference tests (Aishwath *et al.*, 2021).

Used to flavor food, candy, and alcoholic drinks, especially around the Mediterranean. Used in baked goods like Italian biscotti and pizzelles, German springerle, and pfeffernüss. Commonly used in liqueurs like absinthe, anisette, pastis, sambuca, Pernod, arak, raki, and ouzo (Google, 2024). Historically used for digestive problems and other ailments. Some traditional uses include expectorant, antispasmodic, carminative, and parasitocidal properties (Google, 2024). Anise oil is used in perfumery, soaps, toothpastes, mouthwashes, and skin creams. Anise can be made into a liquid scent and is used for both hunting and fishing

(Google, 2024). Anise is used as a spice, a flavoring agent, and in traditional medicine. Anise breeding focuses on improving seed yield, drought resistance, and water use efficiency, with research exploring genetic variation among landraces using molecular markers like RAPD and ISSR (Google, 2024a). The seeds are used as a flavor in candy, confections, dried figs, cakes, breads, curries, cheese spreads, applesauce, soups, herb tea blends (and by itself), and livestock feed. Seeds and oil of anise are used commercially in flavoring liqueurs. Anise oil can also be found in pharmaceutical products, and in tobacco products, cosmetics, toiletries, and perfumery. Fresh anise leaves are used in herb salads and in other vegetable salads and sauces (especially apple) and teas. It has been said that aniseed tea, when cooled and applied to the face, helps to lighten the skin (Herbbee, 2024). Virtually no other spice is as versatile as anise. It gives soups, compote, vegetable, lentil and meat dishes a spicy sweet note, while breads, cakes, cookies and other baked goods also benefit from its characteristic flavor. Anise really shines when combined with caraway, fennel or coriander. Anise can quickly become the dominant spice in dishes, so be careful how much you add — a small quantity will usually suffice. Before adding the fruits to a dish, briefly toast them in a dry pan before crushing them with a pestle and mortar to unlock the most flavor. For some baking recipes, anise is soaked in wine and then strained out. This is what helps to give sweet treats like traditional Austrian Easter bread their delicious flavour (Kotanyi, 2024). This shrub is an annual of a foot high with a family resemblance to their spice world cousins, dill, fennel, cumin, and caraway that produces seeds with a licorice and fennel-like flavor. In fact it is the oil distilled from the plant is what gives the distinctive flavor to licorice candy. The seeds are dried and have a greenish brown tone. It was once thought to be a charm against bad dreams and the evil eye. Known as a digestive aid it is popular in drinks, liqueurs and candies. The French use it to sweeten their *éclairs* and the Italians use it in their *Biscotti*. It is volatile when bought in ground form and quickly loses its flavour (Fooduniversity, 2024). Anise was given the nickname, *Solamen intestinorum*, the comforter of the bowels. The Romans often served spiced cakes at the close of 'rich entertainment' to avoid indigestion and flatulence. It was quite common for these cakes, known as *mustaceoe*, to be served at the end of a marriage feast. We found two slightly different recipes for *mustaceoe*. One included meal, anise, cumin and other aromatics. The other recipe included anise seeds, cumin, fat, grated bay bark, new wine and cheese. The tradition of wedding cake stems from this early use of spiced cake made with aniseed. Gerard, author of *Herball or Historie of Plants* (1597), a work that borrows its information liberally from Dr. Priest's earlier work *Pemptades* (1583), says of anise: "The Aniseed helpeth the yeoxing, or hicket (hiccough), and should be given to young children to eat which are like to have the falling sickness, or to such as have it by patrimony or succession." Germans believed so strongly in the medicinal value of anise that during the 1800s they often flavored their household bread with whole aniseed (Ourherbgarden, 2024). Aniseed is widely used to flavor pastries; it is the characteristic ingredient of a German bread called *anisbrod*, Aniseed is also widely used in meat and vegetables throughout the Mediterranean and Asia. It is widely used as an herbal tea and has been used medicinally since ancient times. Absinthe, anisette, and Pernod liqueurs are flavored with the essential oil. The leaves are used as an alcohol flavour in drinks like *raki*. Salads can also contain leaves (Plantvillage, 2024). It is used mainly as a flavourant, culinary, household, cosmetic and medicinal. The fruit of anise, commercially called aniseed is widely used for flavouring curries, bread, soups, baked goods, dried figs, deserts, cream cheese, pickles, egg dishes, non-alcoholic and alcoholic beverages. The essential oil is valuable in perfumery. The oil is used for production of anethole and sometimes as sensitizer for bleaching colours in photography. The other functional properties are anti-bacterial, anti-fungal, anti-oxidant, stimulant, carminative and expectorant (Indianspices, 2024).

Anise can be made into a liquid scent and is used for both hunting and fishing. Anise smells similar to liquorice and is put on fishing lures to attract fish. Anethole, the principal component of anise oil is a precursor that can eventually produce 2,5-dimethoxybenzaldehyde which is used in the clandestine synthesis of psychedelic drugs such as 2C-B, 2C-I and DOB. Anise is also the main flavor of Absinthe as well as being used as a flavoring for pastis, ouzo, pernod, sambuca, *raki*, *Becherovka*, anise tutone, Chartreuse and other liqueurs. Anise has a particular effect on some dogs that parallels the effect of catnip on house cats. Some cats as well seem attracted to anise. Anise is perfectly safe for cats and dogs alike to ingest. However, like anything, not in excess (Wikidoc, 2024). In aromatherapy, aniseed essential oil is used to treat colds and flu. According to Pliny the Elder, anise was used as a cure for sleeplessness, chewed with alexanders and a little honey in the morning to freshen the breath, and when mixed with wine as a remedy for scorpion stings. In the Mediterranean, aniseed is used in producing alcoholic beverages, such as Arak (Morocco), Ouzo (Greece) and *Raki* in Turkey. In Indian cuisine, no distinction is made between anise and fennel. Therefore, the same name (*saunf*) is usually given to both of them. Some use the term *patli* (thin) *saunf* or *velayati* (foreign) *saunf* to distinguish anise from fennel. In Thailand it is used to flavor tea. In Egypt boiling water is poured over about a tablespoon of aniseed in a teacup to make a hot tea. Builders of steam locomotives in Britain incorporated capsules of aniseed oil into white metal bearings, so that the distinctive smell would give warning in case of overheating (Bionity, 2024). Anise can be made into a liquid scent and is used for both hunting and fishing. Anise smells similar to liquorice and is put on fishing lures to attract fish. Anethole, the principal component of anise oil is a precursor that can eventually produce 2,5-dimethoxybenzaldehyde which is used in the clandestine synthesis of psychedelic drugs such as 2C-B, 2C-I and DOB. Anise is also the main flavor of Absinthe as well as being used as a flavoring for pastis, ouzo, pernod, sambuca, *raki*, *Becherovka*, anise tutone, Chartreuse and other liqueurs. Anise has a particular effect on some dogs that parallels the effect of catnip on house cats. Some cats as well seem attracted to anise. Anise is perfectly safe for cats and dogs alike to ingest (Bionity, 2024). The name 'anise' is believed to derive from the Greek word 'anison', reflecting its ancient origins. In traditional medicine across various cultures, anise has been used to aid digestion, relieve flatulence, and as a mild expectorant. Its sweet, licorice-like flavor has made it a popular ingredient in cooking, baking, and herbal preparations for thousands of years (Fullle, 2024).

Anise seed is primarily used to flavor baked goods such as Italian *biscotti*, pies, and candies, but it is also used to season savory foods like Italian sausage. Occasionally, anise seed extract or anise liqueur is added to drinks to lend depth and a biting licorice flavor. Anise seed pairs well with pork, duck, fish, fruit, and chocolate and is often combined with clove, mace, tarragon, and caraway. Commercially, anise seed is used to scent soaps, skin creams, candles, and mouth fresheners among other things (Aman, 2024). The fruit, or so-called seeds. When threshed out, the seeds may be easily dried in trays, in a current of air in half-shade, out-

of-doors, or by moderate heat. When dry, they are greyish brown, ovate, hairy, about one-fifth of an inch long, with ten crenate ribs and often have the stalk attached. They should be free from earthy matter. The taste is sweet and spicy, and the odour aromatic and agreeable. The commercial varieties differ considerably in size, but the larger varieties alone are official. The Spanish Anise, sold as Alicante Anise, are the largest and the best adapted for pharmaceutical use, yielding about 3 per cent. of oil. Russian and German fruits are smaller and darker and are the variety generally used for distillation of the volatile oil. Italian Anise is frequently adulterated with Hemlock fruit (Botanical, 2024). Dried fruits of anise (*Pimpinella anisum*) are known as aniseed. Aniseed is widely used to flavour pastries; it is the characteristic ingredient of a German bread called *anisbrod*. In the Mediterranean region and in Asia, aniseed is commonly used in meat and vegetable dishes. It makes a soothing herbal tea and has been used medicinally from prehistoric times. The essential oil is used to flavour absinthe, anisette, and Pernod liqueurs (Petruzzello, 2025).

Ethnobotanical uses

Anise has a history of use as a spice and fragrance. It has been cultivated in Egypt for at least 4,000 years. Recordings of its diuretic use and treatment of digestive problems and toothache are seen in medical texts from this era. In ancient Greek history, writings explain how anise helps breathing, relieves pain, provokes urine, and eases thirst. The oil has been used commercially since the 1800s. The fragrance is used in food, soap, creams, and perfumes. Anise often is added to licorice candy or used as a "licorice" flavor substitute. It is a fragrant component of anisette liqueur. Anise is used widely as a flavoring in all food categories including alcohols, liqueurs, dairy products, gelatins, puddings, meats, and candies. It is sold as a spice, and the seeds are used as a breath freshener. The essential oil is used medicinally as well as in perfume, soaps, and sachets (Drugs, 2024).

Anise Seed Tea

Anise Seed Tea is a naturally caffeine-free beverage, making it an excellent choice for those looking to reduce their caffeine intake or seeking a relaxing drink that won't disturb their sleep patterns. Its absence of caffeine allows it to be enjoyed at any time of the day or night, providing the soothing benefits of anise seed without the stimulant effects commonly found in other teas and coffees. This makes Anise Seed Tea ideal for evening relaxation rituals or for those sensitive to caffeine. Anise Seed Tea offers a unique taste profile, marked by its pronounced sweet licorice flavor that is both refreshing and slightly spicy. The tea exudes a comforting warmth, with an aroma that is rich and aromatic, inviting a sense of relaxation with each sip. Its inherent sweetness often eliminates the need for additional sweeteners, allowing the natural, full-bodied flavor of the anise seed to shine through. This tea is perfect for those who appreciate a distinctive taste experience, one that lingers pleasantly and provides a soothing, flavorful escape (Fullle, 2024).

The fruit of the anise plant, often referred to as aniseed, can be used in various forms (Ontosight, 2024):

Whole fruit: Used in baking and cooking.

Essential oil (Anise oil): Extracted from the seeds for use in medicine, cosmetics, and as a flavoring agent.

Fruit extract: Used in herbal medicine and as a dietary supplement.

Homeopathic medicine: Prepared in different potencies, such as 30c liq, for homeopathic applications.

Nutritional value

The aroma of the essential oil (up to 3% in the fruits) is dominated by *trans*-anethole (max. 90%). Additional aroma components are estragol (*iso*-anethol, 2%), anise aldehyde (less than 1%), anise alcohol, *p*-methoxy-acetophenone, pinene, limonene, γ -himachalene (2%). An unusual compound is the phenol ester 4-methoxy-2-(1-propene-yl)-phenol-2-methyl-butyrate, which is characteristic for anise (5%). Older books (*e.g.*, Melchior and Kastner) mention that anise, especially of Italian origin, may contain small amounts of highly toxic hemlock fruits. This warning seems now to be obsolete; you'll probably not share Sokrates' fate just after enjoying one anise biscuit (Katzner, 1998). Volatile oil (1% to 4%) (mainly *trans*-anethole (70% to 90%), and also dianethole and photoanethole), coumarins (such as bergapten, umbelliferone, scopoletin), flavonoids (including rutin, isovitexin, quercetin, luteolin, apigenin glycosides), phenylpropanoids, lipids, fatty acids, sterols, proteins, carbohydrates, sugars, malic acid, iron, sodium (Herbal Academy, 2020). The aniseed oil is colourless or pale yellow liquid and yield varied from 1.9 to 3.1%. Seed contains starch, protein, fatty acids and crude fibbers. It has also been reported higher values of oil upto 6% from Syrian type of aniseed. Anethole (70-80%) is the main constituent of aniseed oil. The other constituents are α -pinene (0.17%), camphene (0.07%), β -pinene (0.01%), sabinene (0.01%), myrcene (0.02%), d-3-carene (trace), α -phellandrene (0.09%), α -terpinene (0.025%), β -phellandrene, 1, 8-cineole (0.06%), *cis* ocimene (0.02), *trans*-ocimene + gamaterpinene (0.01 %), para-cymene (0.05%), terpinolene (trace), linalool (0.8%), terpinene -4-ol (trace), α -terpineol (0.12%), methyl chavicol (1.22%), *trans*- β -farnesol (trace), *cis* anethol (2.29%), saffrol (0.58%), anisaldehyde (0.9%) and anisole (0.4%) (Aishwath *et al.*, 2021).

By the development of technology and increase in the importance of time, people have started to consume more processed foods. As a result health problems have increased. Today, there is no universally accepted definition for the word "nutraceutical" and it is mainly used as a marketing term and not for regulatory purposes. Health Canada defines a nutraceutical as a "product isolated or purified from foods that is generally sold in medicinal forms not usually associated with food. A nutraceutical is demonstrated to have a physiological benefit or provide protection against chronic disease". For example, when flax is ground up and put into pill form it would be classified as a nutraceutical, whereas flax seed or flour incorporated into breads, pastries would be classified as a functional food. A nutraceutical is any substance that is a food or a part of a food and provides medical or health benefits, including the prevention and treatment of disease. Such products may range from isolated nutrients, dietary supplements and

specific diets to genetically engineered designer foods, herbal products, and processed foods such as cereals, soups, and beverages. It is important to note that this definition applies to all categories of food and parts of food, ranging from dietary supplements such as folic acid, used for the prevention of spina bifida, to chicken soup, taken to lessen the discomfort of the common cold. This definition also includes a bio-engineered designer vegetable food, rich in antioxidant ingredients, and a stimulant functional food or pharmafood (Aishwath *et al.*, 2021). Cautions: Use in moderation as this oil can slow down circulation. Any essential oils - ingested in large amounts can be fatal. Keep out of reach of children (Aishwath *et al.*, 2021). Anise contains a range of bioactive compounds, with anethole being the primary component responsible for its medicinal properties. Anethole has been shown to have antimicrobial, anti-inflammatory, and antioxidant effects. These properties contribute to the herb's traditional uses, including relieving digestive issues and coughs (Ontosight, 2024). Anise fruit yields on distillation from 2.5 to 3.5 per cent. of a fragrant, syrupy, volatile oil, of which *anethol*, present to about 90 per cent., is the principal aromatic constituent. It has a strong Anise odour and separates in the form of shining white crystalline scales on cooling the oil. Other constituents of the fruit are a fixed oil, choline, sugar and mucilage. Oil of Anise, distilled in Europe from the fruits of *Pimpinella anisum*, Anise is colourless, or very pale yellow, with taste and odour like the fruit. The oils obtainable from these two fruits are identical in composition, and nearly the same in most of their characters, but that from Star Anise fruit congeals at a lower temperature (Botanical, 2024). As with all spices, the composition of anise varies considerably with origin and cultivation method. These are typical values for the main constituents: Moisture: 9–13%; Protein: 18%; Fatty oil: 8–23%; Essential oil: 2–7% Starch: 5%; N-free extract: 22–28%; Crude fibre: 12–25%. In particular, the anise seeds products should also contain more than 0.2 ml volatile oil per 100 grams of spice (Wikipedia, 2024).

How to Include Anise Seed in Your Daily Diet

Now that one knows the health benefits of eating anise seeds, he/she must also know how to include them in his/her daily diet. Anise seeds have an aromatic, sweet flavour. Here are a few other ways one can include it in their daily diet. One can use anise seeds as a flavouring base in a variety of bread, biscuits, cookies, cakes, and confectionery. Anise seeds and oil are popular, and individuals use them to prepare several sweet dishes in Asian countries. One can start their day with a glass of water and overnight soaked anise seeds. This claims to improve digestion and reduce symptoms of stomach ulcers. One can include anise seeds to prepare popular flavoured drinks like French pastis, prenod, Spanish ojen. Individuals can also include anise seeds as a flavouring base to prepare a herbal tea known as anisette. Besides, star anise is one of the most dominant flavours in Chinese cuisine, along with cinnamon, ground fennel seeds, Hua jiao and cloves (Ahmadinia and Heidari, 2023).

Health Benefits

Anise is also known as *Pimpinella anisum* or aniseeds. Anise is a spice used by maximum households to treat everything, from stomach problems to coughs and colds. Here are the benefits of eating anise seeds that one can derive (Ahmadinia and Heidari, 2023):

1. **Improves Digestive Health:** Egyptians initially used anise herb in their cooking, and Romans anise seed cakes after any meal to improve digestion. This herb is extremely useful for the digestive system and prevents digestive issues. Researchers confirm that taking a combination of anise, elderberry, senna, and fennel can help ease constipation. It also works as an appetite stimulant. Anise seeds are also helpful in the prevention of stomach ulcers. Although medication is necessary to decrease the production of stomach acid, anise seeds can reduce symptoms. Anise seeds are also helpful in reducing symptoms like burning sensations in one's chest and nausea.
2. **Supports Healthy Menstrual Cycle:** Anise seeds relieve menstrual pain and help manage the menstruation cycle and support healthy reproductive health in women. According to a study, combining anise, celery seed, and saffron helps alleviate the pain. Apart from that, anise tea is suggested if one faces a delay in his/her monthly period due to hormonal changes or stress. Anise seed powder is an effective treatment for menstrual disorders. It also effectively reduces symptoms of a hot flash, dry skin and fatigue when a woman goes through menopause. These seeds are known to mimic the effects of oestrogen in one's body, thereby reducing symptoms of menopause.
3. **Works as Anti-hysteric and Anti-epileptic:** Essential oil made with anise includes sedative effects and narcotics. This essential oil might help relax epileptic and hysterical assaults by reducing nervous response, respiration and blood circulation. It is really efficient at sedating hyper responses, convulsions and nervous conditions. However, it should be used cautiously as it might cause serious side effects in kids.
4. **Maintains Oral Hygiene:** Anise seeds have anti-bacterial and anti-microbial properties. Thus, they are used as a primary ingredient in mouthwash. It helps maintain oral hygiene by battling bad breath problems and oral swelling issues.
5. **Keeps Your Heart Healthy:** Using anise oil is beneficial for maintaining a healthy heart. This oil keeps the blood pressure in check and reduces pressure on the heart. Moreover, it keeps the heart balanced and healthy and enhances blood flow as it is detoxifying in nature. However, individuals who have low blood pressure levels should avoid using this oil as it can lead to an additional drop in blood pressure levels.
6. **Improves Lactation:** Anise herb can be used to improve lactation in breastfeeding mothers. This herb consists of photoantheole and diantheole, which have gentle estrogenic properties in it to improve lactation. Additionally, star anise is used to boost libido and deal with signs of premenstrual syndrome or PMS due to its estrogenic effects. However, before using this herb, lactating mothers should seek advice from their physicians.
7. **Treats Insomnia:** Individuals suffering from sleep disorders can take the help of aniseed tea. One can take it before going to sleep or after meals. However, one should not boil aniseed for too long as it might end up vaporising the essential oil in it. It can also lose many of its therapeutic qualities.

8. **Prevents Fungal and Microbial Growth:** According to some studies, anise can slow down the growth of a few infection-producing fungi. Anise oil contains trans-anethole properties, which exhibit antifungal properties. One such fungus is the yeast *Candida albicans* which causes thrush and vaginal yeast infections. Other fungal species from which it prevents include *Candida parapsilosis*, *Candida krusei*, and *Candida tropicalis*. Anise can also prevent cholera because it is effective against *Vibrio cholera* O1E1.
9. **Prevents Anaemia:** Anise contains a substantial amount of iron, which is an important component of haemoglobin. If haemoglobin does not contain enough iron in it, it won't be able to do its function of transporting oxygen to one's body tissues properly. This lack of iron can lead to developing anaemia. Thus, consuming iron-rich foods like anise seeds can lower the chances of developing anaemia.
10. **Respiratory Health:** Anise seeds are beneficial for respiratory health, helping to clear mucus and ease coughs. Their expectorant properties can provide relief from respiratory conditions like bronchitis and asthma. The seeds also soothe irritated airways, improving breathing. This makes them a helpful remedy for respiratory discomfort.
11. **Hormonal Balance:** Anise seeds contain compounds that can mimic estrogen, which helps regulate menstrual cycles and alleviate symptoms of PMS. They may also support menopausal health by balancing hormone levels. Their effect on hormonal regulation contributes to reproductive health. This makes them a valuable addition to a balanced diet.
12. **Blood Sugar Control:** Anise seeds may help regulate blood sugar levels by improving insulin sensitivity. This can be beneficial for individuals with diabetes or those at risk of developing the condition. By supporting stable blood sugar levels, they contribute to metabolic health. Their effect on glucose metabolism is a key benefit.
13. **Improved Sleep Quality:** The calming effects of anise seeds can promote better sleep and help manage insomnia. Their natural sedative properties can relax the nervous system and induce sleepiness. Consuming anise seeds before bedtime can enhance sleep quality. This contributes to overall well-being and restfulness.
14. **Skin Health:** Anise seeds can benefit skin health through their antioxidant and antimicrobial properties. They help protect the skin from damage caused by free radicals and harmful bacteria. Their anti-inflammatory effects can also soothe skin irritations and conditions. This promotes a clear and healthy complexion.
15. **Detoxification:** Anise seeds assist in detoxifying the body by promoting the elimination of toxins. They stimulate liver function, which helps in filtering out harmful substances. Their diuretic properties also aid in flushing out excess waste through urine. This supports overall detoxification and health.
16. **Cognitive Function:** The nutrients in anise seeds may support cognitive function and mental clarity. They can enhance memory and concentration by promoting healthy brain function. Their antioxidant properties also protect brain cells from oxidative damage. This contributes to overall cognitive health and performance.
17. **Pain Relief:** Anise seeds have analgesic properties that can help alleviate various types of pain. They are particularly effective in soothing abdominal and menstrual cramps. Their anti-inflammatory effects also contribute to pain relief. This makes them a natural remedy for discomfort and pain management.
18. **Anti-Cancer Potential:** Some studies suggest that anise seeds may have anti-cancer properties due to their antioxidant and anti-inflammatory compounds. They can help reduce the risk of certain cancers by preventing oxidative damage to cells. Their role in cancer prevention is still being researched. They contribute to overall health with potential anti-cancer benefits.

Traditional medicine

The main use of anise in traditional European herbal medicine was for its carminative effect (reducing flatulence), as noted by John Gerard in his *Great Herball*, an early encyclopedia of herbal medicine:

The seed wasteth and consumeth winde, and is good against belchings and upbraidings of the stomach, alaieth gripings of the belly, provoketh urine gently, maketh abundance of milke, and stirreth up bodily lust: it staieth the laske (diarrhea), and also the white flux (leukorrhea) in women. According to Pliny the Elder, anise was used as a cure for sleeplessness, chewed with alexanders and a little honey in the morning to freshen the breath, and, when mixed with wine, as a remedy for asp bites. In 19th-century medicine, anise was prepared as *aqua anisi* ("Water of Anise") in doses of an ounce or more and as *spiritus anisi* ("Spirit of Anise") in doses of 5–20 minims. In Turkish folk medicine, its seeds have been used as an appetite stimulant, tranquilizer or diuretic (Wikipedia, 2024).

Precautions and Considerations

While anise is generally safe for consumption, it's important to be mindful of a few considerations (Ispicefoods, 2023):

Allergies: Some individuals may have allergies or sensitivities to anise. If you experience any adverse reactions after consuming anise, discontinue use and seek medical advice.

Medication Interactions: Anise, particularly in concentrated forms or large quantities, may interact with certain medications. If you are taking any medications, consult your healthcare provider before consuming significant amounts of anise or anise supplements.

Pregnancy and Lactation: Pregnant and breastfeeding women should exercise moderation in consuming anise. While culinary amounts are generally safe, it's advisable to consult a healthcare professional for individualized guidance.

Side effects

Although there are numerous nutritional benefits of eating anise seeds, it also includes certain side effects. Here is a list of side effects that anise seeds can cause (Ahmadinia and Heidari, 2023)”:

Allergies: Individuals who are allergic to plants similar to anises like celery, cumin, fennel, and asparagus should avoid it.

Diabetes: Individuals suffering from diabetes should avoid anise as it might lower blood sugar levels.

Surgery: Since anise might lower blood sugar levels, individuals should stop consuming it 2 weeks before surgery. Individuals must also avoid it during or after surgery to keep blood sugar levels intact.

Pregnancy: For pregnant women, it would be safer to consult with a doctor before using anise.

People with Hormone-Sensitive Conditions: Anise seeds can mimic estrogen in the body, which might affect conditions such as breast cancer or endometriosis.

Those on Certain Medications: Anise seeds can interact with certain medications, including those that affect hormone levels or blood sugar.

Individuals with Liver Disorders: Although rare, excessive consumption of anise seeds may affect liver function.

Children: Due to the potential risks of high doses and sensitivity, anise seeds should be used cautiously in children's diets.

Besides, individuals should remember that anise acts like oestrogen. Thus anyone with hormone-sensitive conditions such as uterine, ovarian, breast, or endometriosis should remember that it can worsen these conditions.

Side Effects of Overeating Anise Seed: Consumption of excessive anise seeds can cause seizures, nausea, vomiting and pulmonary oedema. A chemical compound in star anise is slightly toxic and can act as an irritant if one consumes it in large proportions. Excessive consumption can sometimes lead to skin irritations or rashes due to the potential for allergic responses or sensitivity to certain compounds in the seeds. Consuming anise seeds in large amounts can lead to gastrointestinal discomfort, including bloating, gas, and diarrhoea. This might lead to symptoms such as irregular menstrual cycles or exacerbation of hormone-sensitive conditions. In very high doses, anise seeds may cause neurological effects such as headaches or dizziness. Large quantities of anise seeds may interfere with the effectiveness of certain medications, including those that manage blood sugar or hormone levels. Excessive consumption can sometimes lead to skin irritations or rashes due to the potential for allergic responses or sensitivity to certain compounds in the seeds (Ahmadinia and Heidari, 2023).

CULTIVATION

Propagation

Anise is typically propagated by sowing seeds directly into the garden, as seedlings are sensitive to transplanting (Google, 2024a).

Cultivation

It is cultivated widely in Bulgaria, Cyprus, Germany, Italy, Mexico, Syria, South America, Turkey, Russia and India. In India, it is grown in smaller areas in Rajasthan, Punjab, U.P., Orissa, M.P. and Delhi as a Rabi crop. However, large-scale commercial cultivation has not been taken up. The crop prefers moderately cool weather. In temperate areas, it is grown as summer crop and in subtropical North Indian plains as winter crop (Aishwath *et al.*, 2021). The Important cultural practices for successful cultivation of Anise are described as under. Anise can be cultivated in temperate, subtropical and Mediterranean type of climate and can well grow up to 20-28°C temperatures. However, life zone for better anise production requires 8 to 23°C temperature with 0.4 to 1.7 metres of precipitation. Anise requires a warm and long frost-free growing season of 120 days. A fairly warm weather during sowing is desirable in temperate regions. It requires warmer and sunny weather during seed formation and development stage (Aishwath *et al.*, 2021). The plant needs a slightly hot summer for ripening seeds. Frost in early stage also kills the growing seedlings and higher temperature at the time of seed setting is harmful. To attain the higher seed germination percentage, optimum soil temperature should be 18-21°C. High wind velocity at the time of maturity can cause shattering and hot winds at flowering reduce seed setting. If anise planted too late and hot weather sets in, the plants will be lanky and small, and will forced blooming takes place and produce seeds too quickly. Besides that high wind velocity adversely affect the flowering and after irrigation causes heavy loss by lodging. Cloudy weather during full growth stage invites sucking pests like aphid and disease like powdery mildew. Therefore, climatic conditions are very important for getting good yield and quality of crop (Aishwath *et al.*, 2021). The crop is grown on a wide range of soils, ranging from sandy loam to clay loam having pH of 6.0 - 8.5 and of moderate fertility. However, well drained medium textured soil ideal having pH range of 6.3 to 7.3. Anise develops best in deep, rich, well-drained, sandy and calcareous soils. Cold, loamy and moist soils are unsuitable for the cultivation of anise. For high seed yields have been achieved over heavier moderately rich black cotton soil of Malwa region which has a capacity to retain moisture and therefore, protect the crop in dry periods. In such conditions, a poor drainage of land as well as stagnating water damages the crop stand and reduces its yield. For both, higher yield and quality slightly acidic soils are more preferable than neutral to alkaline soil with prolong winter season mainly for the recently developed varieties in India. It can survive under temporary flood conditions, not

more than a week. During germination anise tolerates salinity up to $160\mu\text{ m Na Cl}$. However, recent study reveals that salinity tolerance for germination depends on crop cultivars and it varies from 6.0 to 14.0 EC dSm⁻¹ having SAR (Sodium Adsorption Ratio), Magnesium: Calcium ratio and Chloride: Sulfate ration 12.5 (± 0.1), 2.0 (± 0.02) and 1.5(± 0.1), respectively (Aishwath *et al.*, 2021).

Anise is an annual herb in the parsley family. Its fragrant white flowers attract important pollinators and makes anise a wonderful companion plant in vegetable gardens. Anise doesn't transplant well so it is best to plant seeds where you want to grow it for the season. Choose a sunny spot with well-draining soil so it can get a full day of sunlight. Plant seeds in spring when all danger of frost has passed. Sow anise seed directly in an outdoor garden when the soil temperature is 65-70°. Plant seeds at a depth of 1/4". Space plants 9 to 12 inches apart. Anise seeds will germinate around 14 days. Keep young plants moist but not waterlogged. Soil should drain well. Once the roots are established, water only when the soil is dry. The scent of anise can be a pest repellent, so usually, aphids are the only ones to watch out for (De and De, 2022). Anise seeds are planted directly in the garden in spring. Although seeds can be started indoors, the plants are notoriously difficult to transplant. Although anise grows in a wide range of climates, it requires at least 120 frost-free days in order to produce fully ripe seeds. For this reason, anise is often grown as an annual. Anise requires well-drained, alkaline soil with a pH of about 6.0. Full sunlight is critical for growing anise, as the plant tends to be spindly in shade. Regular watering is necessary during hot, dry weather. However, fertilizer is rarely needed unless the soil is very poor. According to Penn State Extension, anise seeds germinate more effectively when companion planted with coriander. Coriander also improves the development of anise seeds, which are harvested when the umbels are filled with brown, ripe seeds (Dyer, 2022).

The essential oil of anise is present at about 1.5 - 3.5% level. The major constituent in oil of anise is anethole. Methyl chavicol, anisaldehyde and para-methoxyphenylacetone are also present, but in lesser relative amounts.

The reported life zone for anise production is 8 to 23°C with 400 to 1700 mm of precipitation and a soil pH of 6.3 to 7.3. Seeds should be planted early in spring in rows 60 to 90 cm feet apart and at the rate of a dozen to 30 cm. The surface of the soil should be made smooth and the seeds covered to a depth of 2cm. The stand should be thinned to three or four plants to 30 cm. Only light cultivation is needed for weed control. Anise develops very well in deep, friable soils and appears to respond favorably to nitrogen fertilization by yielding a greater quantity of high-quality fruit. The small white flowers bloom in midsummer, and seed maturation usually occurs one month after pollination, when the oil content in the dried fruit is about 2.5%. The fruiting umbels should be harvested when the seeds turn brown, which take place late in fall. The fresh leaves possess a flavour similar to that of the seeds and may be used as needed during the season. As they are clipped from the plants the umbels should be thoroughly dried either in shade or under the sun and the seeds separated, cleaned and stored for later use (KSSDB, 2024).

The plant requires a warm sunny location and long frost-free growing season of 120 days. Anise plants grow best in light, fertile, well drained soil and appear to respond well to nitrogen fertilization by yielding a greater quantity of high-quality fruit. Anise seeds should be planted as soon as the ground warms up in spring. Because the plants have a taproot, they do not transplant well after being established, so they should be started either in their final location or transplanted while the seedlings are still small (Herbco, 2024). Basic prerequisites Temperatures between 6 and 24°C and 12 to 18°C are ideal for anise growth in temperate and subtropical climates. Frost won't be tolerated by the plants. Anise can be grown successfully in a range of soil types, although it thrives best in soils with a pH of 5.0 to 8.0. The plants grow poorly in sandy or heavy clay-based soils and thrive best in well-draining loam. Since they are sensitive to transplanting, seedlings grow best when planted directly outside. The seeds benefit from being soaked overnight before planting to speed up germination, and they should only be sown after all threat of frost has passed. Before planting the seeds, the planting area should be ready by tilling the soil to a fine tilth. If multiple plants are being grown, allow 2.5-15 cm between individuals within the row and a further 15-90 cm between rows. The seeds should be sown between 1 and 3 cm deep. Keep the seedbed moist as the seeds germinate by not letting the soil entirely dry out. Anise seeds should be planted in a sunny, wind-free location in the garden. Due to its thin stems, this herb may require staking if the wind picks up. Finding the ideal location in your garden for anise may need some trial and error because it is usually very sensitive to the hot sun and chilly northern winds. For a sweet licorice aroma just feet from the kitchen, you may also grow anise in pots right outside your back door. Try planting anise alongside coriander in a colorful collection of pots with other herbs that have similar growing requirements (Plantvillage, 2024). The anise plant is sensitive to cold weather. Plant anise outdoors in warm climates with a long growing season after the final spring frost and after the soil has warmed up. Anise seeds should be sown indoors in biodegradable pots eight weeks prior to transferring the seedlings outside once all threat of frost has gone in colder locations with a shorter growing season. Anise seeds take a while to sprout. In actuality, it could take up to four weeks until the first seedlings poke their heads from the soil. Anise seeds should be sown at a depth of 1/4 inch; germination takes 20 days or so. Plant spacing should be between 6 and 18 inches. Plants should be spaced at least 18 inches apart once they are 6 weeks old. Grow six anise plants for fresh leaves and cooking, and twelve for seeds and preservation (Plantvillage, 2024).

Anise grows rapidly from seed. Plant after all danger of frost has passed. If planted in rows, thin to 6 to 8 inches apart in rows 2 feet apart (Extension, 2024). Anise, an annual sun-loving plant, grows to a height of 24" to 30", with a 6" spread. Anise is not considered cold hardy and requires at least 120 days of frost-free weather. Direct seed after last expected frost in sandy soil that is well-worked and well-drained, planting seeds 1/4" deep in rows 12" apart. (Anise does not transplant well.) Location should be protected from prevailing winds. Thin plants to 8" apart when seedlings reach 2" high. Soil's pH should be between 6.0 to 7.5. Fertilizing is usually not necessary. Watering should be done regularly when temperatures are hot and dry. Anise is a companion plant to Coriander, where its functions in the garden include repelling aphids and cabbage worms. The flowers of anise, which show up in late summer, are attractive to parasitic wasps (Herbbee, 2024).

Cultural practices

Preparation of land: It is essential to prepare good seedbeds and to create a good contact between the planted seed and the soil because the seeds are small and have low germination percentage (70%). Therefore, field should be ploughed and harrowed 2-3 times to bring it to fine tilth. Pre sowing irrigation may be given to bring the soil in working condition ensuring better germination of seed. First ploughing should be done by soil turning plough and afterward 2-3 ploughing should be done with harrow. The ploughed field should be made fine and levelled by planking. In order to manage problem of termite Endosulfan 4% or Quinalphos 1.5% or Methyl Parathion 2% dust, @ 25.0 kg/ha may be applied in soil before sowing. In the semi-arid conditions, ants take away the seed from seed bed before germination can also be control by bordering the field using Methyl Parathion dust (Aishwath *et al.*, 2021).

Sowing time: Optimum soil temperature for germination is 18-21°C. The optimum sowing time in north Indian plains is mid October to early November and March-April in temperate areas in hills for better yield. In temperate regions, planting begins when the soil in the beds is warmed. Ripe-fruits seeds germinate relatively quickly. The germination time is 7-14 days. Only seeds from the previous year's harvest germinate well. Long storage quickly reduces germination vigour and seeds stored for five years will no longer germinate. It is reported that Seeds are directly sown at 1 cm depth in late October (Malwa region) to early November (Delhi and western UP) for better crop growth and yield (Aishwath *et al.*, 2021).

Spacing and sowing method: Without knowing the fertility of soil, length of winter season and plant type (biparous/prostrate), spacing recommendations are meaningless. Therefore, seeds should be sown at a line x plant spacing of 45 cm x 20 cm or 30 cm x 20 cm at one cm depth based on the soil fertility and length winter of season of the growing areas. Seeds can be drilled directly in rows at a distance of 45 cm by dibbling method and transplanting is also possible in anise. Seeds start germinating after seven days and are over in 10 days. Studies made at Indore (M.P. State) showed that the broadcasting of seed has an edge over line sowing but this causes crowding and uneven distribution of plant resultant difficulty in inter-cultural operations. Comparative performance of in-situ direct seeding crop and transplanted crop reported a loss of 55.17 per cent in seed yield from transplanted crop (Aishwath *et al.*, 2021).

Seed rate: About 8 - 20 kg of seed is required for planting in one hectare on the basis of soil fertility, plant type and climatic conditions. Low fertile soil with small span of winter season and small spreading type of cultivar require more seed rate than high fertile soil with long span of winter season area. Light irrigation is given after sowing and optimum moisture should be maintained till germination (Aishwath *et al.*, 2021).

Seed treatment: Soaking the seed for 8-10 hours in water before sowing improves germination. To check the incidence of seed and soil born diseases, the seed should be treated with carbendazim or captan or thiram @ 2.5 g per kg of seed before sowing. For the better yield and utilization of water and nutrients, seed treatment with VAM and other biofertilizers is also needed (Aishwath *et al.*, 2021).

Manures and fertilizer: The crop is moderate for its requirement of manure and fertilizer. Under north Indian plains 15-20 tons of well rotten farmyard manure should be applied before sowing. A total of 80 kg of nitrogen, 30 kg of phosphorus and 20 kg of potash is required to raise good crop. At the time of sowing 40 kg nitrogen, 20 kg of phosphorus and 20 kg of potash should be applied as basal dose on lower to medium fertile soils. The remaining nitrogen dose of 40 kg should be given in two splits at an interval of 25-30 days after sowing western plains of India. The micronutrients, magnesium, iron and zinc, have been found useful in increasing the yield and quality under. In northern plains, nitrogen requires 60 kg ha⁻¹ in sandy loam soil and in heavy soils of Malwa regions needs 40 kg N in two three splits along with 20-30 kg each of K₂O potassium and P₂O₅ ha⁻¹ under both the situations. Anise is also responds well to use of certain micro-nutrients have reported beneficial results on use of sulphur, manganese, iron and zinc at the rate of 18.6, 1.2, 2.0 and 5.6 kg/ha. Amongst these, the effect of Fe, Zn and Mn was more pronounced than sulphur in terms of seed and oil yield. Under the integrated nutrient management, 50-75% nutrient supplied through recommended dose fertilizers and 25-50% supplied through organic manures and biofertilizers (Azotobacter, Azospirillum, VAM, PSB) for sustainable crop production and better soil health. It is recommended to apply fertilizers at a rate of 80-100 kg K₂O and 50-75 kg P₂O₅ per hectare in temperate regions. About 50 - 100 kg/ha N is normally enough in these temperate regions. With nitrogen, it is important to be careful, since excessive nitrogen fertilization results in luxuriant vegetative growth with reduced seed yields, and increased vulnerability to lodging. It is reported that application of N, P and K fertilizers do not affect oil content or its quality (Aishwath *et al.*, 2021).

Irrigation: Keeping in view of the soil and climatic conditions the frequency of irrigation varies. Averages of 4-6 irrigations are required up to full vegetative growth to seed formation. Flowering and grain filling are the crucial stages requiring irrigation. In general a pre-sowing irrigation is recommended if the soil does not have sufficient moisture for germination. The second irrigation is given at 30 days when the seedlings have established. The third irrigation is given at 50 days, and fourth and fifth irrigation are given at flowering and grain filling stage (Aishwath *et al.*, 2021).

Intercultural operations: The plant develops slowly after germination and for the following few weeks it is necessary to control weeds closely. The field should be kept free from weeds during the initial period of growth. It requires 2-3 weeding and hoeing at an interval of 20-30 days after sowing. Initially two weeding are very crucial and should be done in time. Therefore, first inter-culture operation is done at 25-30 days, just before the irrigation and a second at 45-50 days age; thereafter the crop grows fast and covers the ground. Under integrated weed management, there are some chemicals can be use effectively as pre-emergence

application of oxadiargyl @ 75 g ha⁻¹ or pendimethalin @ 1.0 kg ha⁻¹ or oxyflurofen @150g ha⁻¹ along with a mechanical or hand weeding (Aishwath *et al.*, 2021).

Crop rotations and Cropping systems: Generally this crop is cultivated after harvesting of kharif crops like bajra, maize, sorghum and pulses in northern plains and central India. Growing anise in prevailed and sustainable cropping system is the best way to enhance resources use efficiency includes land, water, nutrients and time. Some medicinal plant based crop rotations were tried using anise in the system. It has been found that the sacred basil (in kharif) and anise (rabi) or senna-anise combination produced better return than any other rotation. In senna based crop rotation, anise equally performs with methi and with sacred basil also. Its performance is comparable to other seed spices (Aishwath *et al.*, 2021).

Production of anise oil

Anise oil is steam distilled from the crushed seeds. Steam distillation is the most widely accepted process for the production of essential oils on a large scale. Steam is introduced at the base of the still filled with crushed anise seeds and volatile elements evaporate with the steam. A condensation process turns this vapour-mix into a liquid form of water and essential oil. The essential oil floats on top of the water and is separated off. The essential oil of aniseed is a colourless to faintly yellow oil which solidifies upon cooling to about 1519°C due to the crystallization of anethole. Oleoresin anise is a yellowish-green to orange-brown fluid oleoresin. Volatile oil content of oleoresin anise is 1518%. The presence of a large quantity of fixed oil in this product limits its shelf-life and the addition of a permitted antioxidant is advised. Anise and anise oil are widely used as flavouring ingredients in all major categories of foods and alcoholic beverages. The highest average permissible levels for anise oil are about 0.06% (570 ppm) in alcoholic beverages and 0.07% (681 ppm) in sweets (Aishwath *et al.*, 2021). The anise fruits are prepared as an infusion, usually after being ground in a mortar. They are also used to manufacture schnapps and liqueurs and as a condiment in baked goods (Avogel, 2024). Anise essential oil can be obtained from the fruits by either steam distillation or extraction using supercritical carbon dioxide. The yield of essential oil is influenced by the growing conditions and extraction process, with supercritical extraction being more efficient. Regardless of the method of isolation the main component of the oil is anethole (80–90%), with minor components including 4-anisaldehyde, estragole and pseudoisoeugenyl-2-methylbutyrates amongst others. (Alternately found by Orav *et al.* 2008 to be 2–6% extracted oil by weight of raw seed material, 74–94% being *trans*-anethole and the remaining fraction estragole (methylchavicol), anisaldehyde and γ -himachalene.). Anethole is responsible for anise's characteristic odor and flavour (Wikipedia, 2024).

Harvesting

The fruits of *P. anisum* ripen about a month after flowering, around August or September, and the seeds are harvested when they are hard and change from green to gray-brown in color. If harvested too early, the seeds may not reach their peak aromatic capacity. For drying, cut the stalks a few inches from the base of the plant and hang upside down inside of a paper bag to catch falling seeds. Any remaining seeds on the seed head can be hand-picked once thoroughly dried. Store in an airtight and sealed container (Herbal Academy, 2020). Umbels become ready for harvest in March in northern plains of India. The terminal umbels mature first and lateral ones 15 to 20 days later. When 80-90% fruits begin to turn greyish green in colour, the tops of the plants are cut along with the branches and are tied in bundles. The bundles are stacked in a central place up to two-meter height, keeping the fruiting heads towards the centre. It should be allowed to cure for 4-5 days and then threshed by beating. Seeds are cleaned, dried in shade and stored in gunny bags (Aishwath *et al.*, 2021).

There is a need to popularize the knowledge about the anise among farmers for growing right species, traders for marketing right product and consumers for using right product so as to get the right benefits of nutraceutical, food and beverage, flavouring and medicine for realizing actual satisfaction of anise rather use of alternatives. This way whole chain will get the benefit from this crop (Aishwath *et al.*, 2021). Whether you're picking anise when it's ripe or not, there's no need to collect the tiny seeds one at a time. Instead, snip the stems below the flower heads. If the seeds are still green, tie the flowers together into a bundle and hang them upside down in a cool, airy place. Make sure to put a container or a cloth beneath them to catch the seeds, which should ripen and dry out naturally. If you've waited until the seeds are already dry, gently shake the flowers upside down over a container, or inside a paper bag. If they're ripe, the seeds ought to fall right off. After picking anise seeds, it's important to store them correctly. Make sure the seeds are completely dry, then place them in an airtight container or jar. Avoid adding any cloth or paper towels, as this will just consolidate moisture and lead to problems. Store your container in a cool, dark place, and enjoy your homegrown anise seeds all year long (Baessler, 2023). Anise flowers are white and wispy and very similar in appearance to Queen Anne's lace. It takes them quite a while to develop seeds, and about 100 frost-free days of growth are required before anise seed harvest can take place. In late summer or early autumn, you should notice the flowers developing small, green seeds. Some gardeners insist that you should leave the plants alone until the seeds dry out and turn a muddy brown color. Others hold that you should harvest them when they're still green and let them ripen and dry indoors. Both are viable options, but considering how long it takes the seeds to form, most gardeners would benefit from getting them indoors when they're still green, before the autumn frost hits (Baessler, 2023).

Yield

Average yield of 700-800 kg per hectare can be obtained. The thousand seeds weight of the part-fruits amounts to 1.5 to 3.0 g and should have a minimum purity of 90% and a minimum germination of 70%. The small white flowers bloom in midsummer, and

seed maturity usually occurs one month after pollination in temperate regions (Aishwath *et al.*, 2021). In India, it is grown as a rabi crop in an estimated area of about 2000 ha with production of 550 metric tones. The major exporting countries are USSR, Poland and Spain (Aishwath *et al.*, 2021). Western cuisines have long used anise to flavor dishes, drinks, and candies. The word is used for both the species of herb and its licorice-like flavor. The most powerful flavor component of the essential oil of anise, anethole, is found in both anise and an unrelated spice indigenous to South China called star anise (*Illicium verum*) widely used in South Asian, Southeast Asian and East Asian dishes. Star anise is considerably less expensive to produce and has gradually displaced *P. anisum* in Western markets. While formerly produced in larger quantities, by 1999 world production of the essential oil of anise was only 8 tons, compared to 400 tons of star anise (Wikipedia, 2024).

Cleaning, packaging and storage

After threshing crop, peduncle remains intact with seed require to remove before packaging and storage otherwise it lowers the marketability of anise. This peduncle can be removed by using debearder (an attachment of cleaning and grading machine). Vacuum gravity separator can be used for cleaning of anise. Seeds are stored at 7-8% moisture or lower. Anise has to be stored away from daylight and kept in a dry place in cool conditions. The average loss of the content of the volatile oil has been calculated at 1% of the original content per month. The content of trans-anethole decreases from 89% to 73% during a storage of six weeks with the influence of sunlight, while the content of cis-anethole increases from 0.8 to 4.5% and the content of anisaldehyde from 0.8 to 7.0%. Because of the sensitivity to light and oxidation it is recommended that the volatile oil of anise is stored in well filled and well closed containers (glass or tin, but not plastic) protected against daylight. Moreover, ideal storage demands a temperatures below 25°C. The small packaging may be 25-100g and big packaging in 20-25 kg capacity lined seed bag is recommended before storage for sale (Aishwath *et al.*, 2021).

Products

Aniseed has strong flavour and aroma and hydro-distillation yields the “oil of anise”, which has now replaced the fruit for medicinal and flavouring purposes. The oil content in the dried fruits is about 2.5%. Anethole is the major component of aniseed oil. Aniseed is used for flavouring food, confectionery, bakery products, chewing gums and tobacco. It is also used in flavouring alcoholic beverages “aniseed” and “pernod”; is used for flavouring soups, mouthwashes and toothpastes. Aniseed oil also possesses insecticide properties. In medicine, it is used in cough syrups, lozenges and as a carminative. It is used in the preparation of gripe water. The distillate i.e. arak (water of the anise) is sold in Indian market as arak badian and arak saunf and are used in medicine. Fresh leaves can also be used for garnishing and flavouring of salad (Aishwath *et al.*, 2021).

Tips for Buying and Storing Anise

When purchasing anise, look for whole seeds or ground powder from reputable sources. Whole anise seeds should be plump, aromatic, and free from moisture or signs of damage. Store anise seeds or ground powder in a cool, dry place, away from direct sunlight. Whole anise seeds retain their flavor for a longer period, while ground anise powder should be used within six months for optimal taste (Ispicefoods, 2023). Whole or ground anise seed should be stored in a cool, dark place for the best shelf life. The whole seeds will be of the best quality for three to four years. Ground anise seed will lose its potency faster but still be good to use (Alfaro, 2023).

Store Anise

Since storage instructions may vary for different natural products, carefully read the directions and packaging label on the container. Keep your medications tightly closed and out of the sight and reach of children and pets, ideally locked in a cabinet or closet. Store in a cool and dry place, and discard after one year or as indicated on the packaging. Avoid putting unused and expired medicines down the drain or in the toilet. Visit the FDA's website to know where and how to discard all unused and expired medicines. You can also find disposal boxes in your area (Phan, 2024).

Anise and the Animal World

Anise oil destroys lice and other biting, itch-inducing insects. It was once mixed with lard or spermaceti (whale oil) and used as an ointment for the treatment of skin irritations. Anise oil used alone or in combination with cheese has the reputation of being an excellent bait for mousetraps. In one historical work on beekeeping, it was suggested that anise oil was the quickest way to attract bees when there are no flowers to be found. The author mentioned touching the cork from a bottle of anise oil to his bee boxes to encourage their return from half a mile or more. In veterinary science, anise is often mentioned for the treatment of a variety of intestinal issues in animals including dogs and horses (Ourherbgarden, 2024).

Cooking

Anise seed (whole or ground) can be added to the dough for baked goods, fruit fillings for pies, and ground meat before baking. Anise extract can be used in baked goods and to flavor drinks such as coffee or hot chocolate. The seeds can also be used to brew a licorice-flavored tea. Anise seed is the flavoring for a number of alcoholic beverages, including anisette, ouzo, sambuca, and absinthe. The slight candy-like flavor has made them popular as after dinner or dessert drinks. They can also be used to add flavor to coffee (Alfaro, 2023). Fresh leaves may be used in salads, especially apple; seeds in cookies and candies. While the entire plant is fragrant, it is the fruit of anise, commercially called anise seed, that has been highly valued since antiquity. The delicate fragrance is widely used for flavouring curries, breads, soups, cakes, candies, desserts, non-alcoholic beverages, and such liqueurs

as anisette and arak. Aniseed is widely used to flavour pastries; it is the characteristic ingredient of a German bread called Anisbrod. In the Mediterranean region and in Asia, aniseed is commonly used in meat and vegetable dishes (KSSDB, 2024).

Sensory quality

Sweet and very aromatic. See cicerone for other spices with a similar fragrance. For an overview on sweet spices, see licorice (Katzner, 1998).

Preserving and Storing Anise: Dry anise seeds on trays of paper for several warm days outdoors. After drying, pasteurize the seeds in the oven at 100°F for 15 minutes. Storing: Store leaves and seeds in an airtight container (Plantvillage, 2024).

Safety and Regulations: Anise and its derivatives are generally recognized as safe (GRAS) by regulatory agencies, such as the US FDA. However, high doses or prolonged use can cause adverse effects due to the herb's estrogenic activity. Pregnant and breastfeeding women should consult healthcare professionals before using anise products (Ontosight, 2024).

Toxicology

Ingestion of the oil may result in pulmonary edema, vomiting, and seizures (Drugs, 2024).

REFERENCES

- Aboulela, M.B., *et al.*, 2023. Mini review: Anise (*Pimpinella anisum* L.): Phytochemical and Pharmacological Activities. Egyptian Russian University Research Journal, 2(4): 723 – 733
- Ahmadinia, H. and Heidari, P. 2023. Effects of polyploidy induction on the performance of anise (*Pimpinella anisum* L.). JPMB, 11(2): 17-30
- Ahmadinia, H. and Heidari, P. 2024. Effects of polyploidy induction on the performance of anise (*Pimpinella Anisum* L.). Journal of Plant Molecular Breeding, 11 (2): 17-30.
- Aishwath, O.P., *et al.*, 2021. Advance Production Technology of Anise. ICAR-National Research Centre on Seed Spices, Tabiji-305 206, Ajmer, Rajasthan
- Akçali Giachino, R.R. 2020. Investigation of the genetic variation of anise (*Pimpinella anisum* L.) using RAPD and ISSR markers. Genet Resour Crop Evol., 67: 763–780
- Alfaro, D. 2023. What Is Anise Seed?. <https://www.thespruceeats.com/what-is-anise-995562>
- Aman, M. 2024. Star Anise vs. Anise Seed: How Are They Different?. <https://www.bhg.com/star-anise-vs-anise-seed-7104634>
- Anonymus. 2024. Taxonomy of anise genera.
- Avogel. 2024. *Pimpinella anisum* L. (Anise). Vogel plant encyclopaedia. https://www.avogel.ch/en/plant-encyclopaedia/pimpinella_anisum.php
- Baessler, L. 2023. Harvesting Anise Seed – When and How to Pick Anise Seeds. <https://www.gardeningknowhow.com/edible/herbs/anise/harvesting-anise-seed.htm>
- Bailey, N. 2022. Star Anise Vs. Anise: What's The Difference?. <https://www.tastingtable.com/1119272/star-anise-vs-anise-whats-the-difference/>
- Bionity. 2024. Anise. https://www.bionity.com/en/encyclopedia/Anise.html#google_vignette
- Boroughmarket . 2024. The spice series: anise, star anise, liquorice & fennel seed. <https://boroughmarket.org.uk/market-blog/the-spice-series-anise-star-anise-liquorice-fennel-seed/>
- Botanical. 2024. Anise. <https://www.botanical.com/botanical/mgmh/a/anise040.html>
- Davidvanille. 2024. Green Anise Seeds. <https://www.davidvanille.com/en/spices-and-seasoning/332-4907-green-anise-seeds.html#267-packaging-25g>
- De, A.K. and De, M. 2022. Functional and therapeutic applications of some general and rare spices. In: Functional Foods and Nutraceuticals in Metabolic and Non-Communicable Diseases. Pages 411-420
- Drugs. 2024. Anise. <https://www.drugs.com/npc/anise.html>
- Dyer, M.H. 2022. Learn About Anise Herb History. <https://www.gardeningknowhow.com/tbt/learn-anise-herb-history>
- Etymonline. 2024. Anise. <https://www.etymonline.com/word/aniseed>
- Extension. 2024. Anise (*Pimpinella anisum*). <https://extension.umd.edu/resource/anise/>
- FLTC. 2025. Your Complete Guide to Anise Seed. <https://fullleafteacompany.com/pages/what-is-anise-seed-history-benefits-and-more?srsId=AfmBOoq77Ju6cu7i6x>
- Fooduniversity. 2024. Anise *Pimpinella anisum*. http://www.fooduniversity.com/foodu/produce_c/producereference/Resources/Spices/Anise/AniseN.h
- Fullle. 2024. Your Complete Guide to Anise Seed. <https://fullleafteacompany.com/pages/what-is-anise-seed-history-benefits-and-more?srsId=AfmBOorNE6MRVqZ6>
- Gardens. 2024. 'Anise' *Pimpinella anisum*. https://www.rogersgardens.com/pages/anise?srsId=AfmBOoo_ur56Fdjp_l6Oyh5DIHxczbVwooh7QqABAJ7U
- Google. 2024. AI Overview. <https://www.google.com/search?client=firefox-b-d&q=Introduction+of+anise+> Google. 2024a. AI Overview. <https://www.google.com/search?client=firefox-b-d&q=Anise+breeding+focuses+on+improving+seed+yield+%252C+>

- Google. 2024b. AI Overview. <https://www.google.com/search?client=firefox-b-d&q=Anise+genetics>
- Google. 2024c. Genertics and Cytogenetics of anise. https://www.google.com/search?client=firefox-b-d&sca_esv=16fb234a3036915d&sxsrf=AHTn8zpNMXIb6tchs0rwoVL0eTUAORixWQ:1744530650606&q=GENERTICS+AND+CYTOGENETICS+of+anise&nfr=1&sa=X&ved=2ahUKEwiFquqNw9SMAxUo4zgGHVZXKYwQvgUoAXoECA0QAg&biw=1076&bih=544
- Herbal Academy. 2020. Anise Monograph: *Pimpinella Anisum*. <https://theherbalacademy.com/blog/anise-monograph-pimpinella-anisum/?srsltid=AfmBOor8INiSHQCqFbAfCCcZ-XL7X22YPiQJyqrmwk05TwJ4RBc6F3d>
- Herbco. 2024. Wholesale Anise. *Pimpinella anisum* plant overview. <https://www.herbco.com/c-104-anise.aspx?srsltid=AfmBOop2S0g7dklVon2Ma3trkACiJdIxxnz4eBWWeYz3fgMR4PMd7-nB>
- Herbbee. 2024. Anise. <https://www.herbbee.com/herb-profiles/anise/>
- Indianspices. 2024. Aniseed. <https://www.indianspices.com/spice-catalog/aniseed.html>
- Ispicefoods. 2023. Anise: The Aromatic Spice That Delights the Senses and Nurtures Well-Being. <https://ispicefoods.com/anise-the-aromatic-spice-that-delights-the-senses-and-nurtures-well-being/>
- Ispiceyou, 2024. Anise. https://www.ispiceyou.com/blogs/spices/anise?srsltid=AfmBOordA1BZNf9K_kNBoK58LlcDOmtpGQ0YSKlrfbSI-
- Katzer, G. 1998. Anise (*Pimpinella anisum* L.). http://gernot-katzers-spice-pages.com/engl/Pimp_ani.html
- Kılıç, C.S. 2024. *Pimpinella anisum* L. (Anise, Aniseed). In: Science of Spices and Culinary Herbs - Latest Laboratory, Pre-clinical, and Clinical Studies, Volume: 6. Pp: 1-55 (55)
- Kotanyi. 2024. Anise. <https://www.kotanyi.com/en/spices/anise/>
- Maleki, A., et al., 2017. Evaluation of genetic variation and comparison of Iranain anise (*Pimpinella anisum* L.) populations. Iranian Journal of Field Crop Science, 47(4): 661-670
- McCann, D. 2021. What Is Anise and How Do I Use It?. <https://www.allrecipes.com/article/what-is-anise/>
- Mehravi, S, Hanifei, M, Gholizadeh, A. and Khodadadi, M. 2023. Exploring the quantitative genetics of traits associated with drought tolerance and yield in *Pimpinella anisum* L. under different water regimes. Planta, 257(6):102. doi: 10.1007/s00425-023-04128-w. PMID: 37093410.
- NG. 2025. Anise (*Pimpinella anisum*). Nutritional Geography. <https://nutritionalgeography.faculty.ucdavis.edu/spices/anise/>
- Ontosight. 2024. Introduction to Anise Plant. https://ontosight.ai/glossary/term/introduction-to-anise-plant--67a175d1_6c35_93987a577bc3
- Ourherbgarden. 2024. Anise. http://www.ourherbgarden.com/herb-history/anise.html#google_vignette
- Öztekin, A. 2024. Anise. <https://www.paperandtea.com/blogs/glossary/anise>
- Petruzzello, M. 2025. Anise. The Editors of Encyclopaedia Britannica. <https://www.britannica.com/plant/anise#ref83252>
- Phan, R. 2024. Anise: Uses, Side Effects, & More. <https://www.verywellhealth.com/the-benefits-of-anise-88608>
- Plantvillage. 2024. Anise. <https://plantvillage.psu.edu/topics/anise/infos>
- Rankel, K. 2024. Anise: An Annual Plant. <https://greg.app/anise-annual/>
- Rocha, L. and Fernandes, C.P. 2003. Aniseed (*Pimpinella anisum*, Apiaceae) Oils. In: Essential Oils in Food Preservation, Flavor and Safety (pp.209-213)
- Sanlier, N. and Gencer, F. 2020. Role of spices in the treatment of diabetes mellitus: A minireview. Trends in Food Science & Technology, 99: 441-449
- Shumskaya, I.A. and Garifullina, F.S. 1990. Study of genetic variation in anise (*Pimpinella anisum* L., *Apiaceae* Linde, *Umbelliferae* Juss.). *Genetika Moskva*, 26(10): 1852-1857
- Singletary and Keith, W. 2022. Anise. Nutrition Today, 57(2): 96-109
- Sobrin, M. 2024. Anise. <https://tenochtitlan.omeka.net/exhibits/show/molepoblano/anise>
- Sun, W., Shahrajabian, M.H. and Cheng, Q. 2019. Anise (*Pimpinella anisum* L.), a dominant spice and traditional medicinal herb for both food and medicinal purposes. Cogent Biology, 5: 1673688
- Ullah, H., Mahmood, A. and Honermeier, B. 2014. Essential Oil and Composition of Anise (*Pimpinella anisum* L.) With Varying Seed Rates and Row Spacing. Pak. J. Bot., 46(5): 1859-1864
- VHBG. 2024. VHB Group - Exchanging Excellence's post. <https://www.facebook.com/vihaba/posts+ue-t/846277540846713/>
- WebMD. 2024. Health Benefits of Anise. <https://www.webmd.com/diet/health-benefits-anise>
- Wikidoc. 2024. Anise. <https://www.wikidoc.org/index.php/Anise>
- Wikipedia. 2024. Ani seed. <https://en.wikipedia.org/wiki/Anise>
- Wiktionary. 2024. Anise. <https://en.wiktionary.org/wiki/anise>
- Wilson, L. 2016. Spices and Flavoring Crops: Fruits and Seeds. https://2024.sci-hub.se/7133/4_2a4b406ad1_99a4a_5e5bc3c49aa41e1d/wilson2016.pdf