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RESEARCH ARTICLE

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

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ABSTRACT

Tamarind belongs to the family Fabaceae (Leguminosae), subfamily Detarioideae, tribe Amherstieae, genus *Tamarindus and species Tamarindus indica.* The name derives from Arabic: romanized *tamr hindi*, "Indian date". Several early medieval herbalists and physicians wrote *tamar indi*, medieval Latin use was *tamarindus*, and Marco Polo wrote of *tamarandi*. In Colombia, Nicaragua, Costa Rica, Ecuador, Cuba, the Dominican Republic, Guatemala, El Salvador, Honduras, Mexico, Peru, Puerto Rico, Venezuela, Italy, Spain, and throughout the Lusosphere, it is called *tamarindo*. In those countries it is often used to make the beverage of the same name (or *agua de tamarindo*). In the Caribbean, tamarind is sometimes called *tamón*. Countries in Southeast Asia like Indonesia call it *asam jawa* (Javanese sour fruit) or simply *asam*, and *sukaer* in Timor. While in the Philippines, it is called *sampalok* or *sampaloc* in Filipino, and *sambag* in Cebuano.Tamarind (*Tamarindus indica*) is sometimes confused with "Manila tamarind" (*Pithecellobium dulce*). While in the same taxonomic family Fabaceae, Manila tamarind is a different plant native to Mexico and known locally as *guamúchili*. Common names are Tamarind, tamarind tree (English); tamarindo (Spanish/Italian); tamarinier (French); tamarindeiro, tamarineiro, tamarineira (Portuguese); tamarinde (Afrikaans/Dutch); Tamarindenbaum (German); asam jawa (Indonesian); asem jawa (Javanese); Tsamiya (Hausa); raqay (Somali); Sampalok (Tagalog); Demirhindi (Turkish). Imli (Hindi, Punjabi), Tetul (Bengali), Amli (Gujarati), Hunise hannu (Kannada), Tamber (Kashmiri), Puli (Malayalam, Tamil), Chintha pandu (Telugu), Chinch (Marathi), Tentuli (Oriya). Odhisa, Bihar, Maharashtra, Tamil Nadu, Andhra Pradesh and Himalayan tract. Imlee, Imli, Tamarin, Tamarindo, Tamarindus indica. Tamarind scientifically known as *Tamarindus indica* derives from the Persian word Tamar e hind means 'Indian date' is a tree in the Fabaceae family. The genus *Tamarindus* is having an single species only. Tamarind tree is a very popular Indian tree & a very charming tree. It is a member of the leguminosae family and Caesalpinieae sub family. There are different names to Tamarind called in different regional languages for instance imli in Hindi, Puli in both Tamil and Malayalam, Chintapandu in Telugu and nuli or tinti in Bengali. Native to tropical Africa the tamarind grows wild throughout the Sudan. Very long ago it was introduced into India and has often been reported as indigenous there also. It is extensively cultivated in tropical areas of the world. During the 16th century it was introduced to America and today is widely grown in Mexico**.** In 1797 one of the first tamarind trees was planted in Hawaii**.** Normally the size of the tamarind tree is very large and it can reach a great age of around 200 years. The flowers of the tamarind tree are very ordinary with nice spreading branches and a canopy of bulging flora. The tree is much admired as an avenue, park or garden tree as it has very useful fruits and the timber of this tree is highly prized. It has a short but strong trunk to bear the weight of its wide and extensive top. The almost black bark is thick and some longitudinal and horizontal cracks cover it well. The tree can achieve the height of 27 metres**.** In the months of May and June, there appear some tiny, scented flowers in the tree in loose, lethal and sidewise sprays. They remain almost unremarkable amongst the mass of the plants. The pods are quite numerous. They significantly vary in size and shape on the same tree. Their appearance is of brown colour. At this stage they are called as Chintakaaya in Telugu**.** Chintakaaya pachadi is a very popular from the Andhra cuisine**.** After their maturity they turn off-white and brittle. A stringy pulp contains the **seeds** from one to ten and the pod is more or less slimmed between these seeds**.** The pulp is brown and acidic in some of the varieties of Tamarind and in others it is sweet but the one with reddish pulp is considered to be the best. The new and fresh leaves appear in the first months of the year and they appear even in September in some special occasions. The conversion of the tree is strange. The leaves of the tamarind tree are compound in its formation and usually divided into 10 to 12 pairs of leaflets. They are quite small and become even smaller at the end of the year. They are square**,** smooth and they grow diagonally**.** The fruit also called as the pod is about 12 to 15 cm in length with a hard brown shell. The fruit has fleshy**,** juicy and acidulous pulp**.** When matured it is colored brown or reddish brown**.** The tamarinds grown in Asia have longer pods containing about **6** to 12 seeds whereas in Africa and West Indies the varieties are short pods containing only about 1 to 6 seeds. The seeds too are somewhat flattened and glossy brown. A tamarind is excellent when it is sweet and sour in taste and high in acid, sugar, vitamin B and interestingly for a fruit**,** calcium. The fruit of tamarind tree has numerous usages. The pulp is used as an important ingredient in the curries**.** There are some commercial uses too. It is preserved and also sold in the markets. It is also used as a laxative in medicine. People make powder from grinding the seeds and boil it to paste with gum and make strong cement. A substitute for wheat or other flour can also be obtained from them that are used by the people. The stalks of the seeds have been employed for road surfacing as well. The scientists also discovered that the seeds could make a cheap but efficient substitute for cereal starch that is used for making the cotton yarn in proper size, for jute fabrics and for woolens. Further, the leaves and flowers of the tree are also quite useful. An infusion from the leaves can make a fine yellow dye that is used to give a green colour to silks. Though hard and very difficult to work on, the timber of the tree is of high value. People widely use this wood for making wheels**,** mallets, furniture**,** oil and sugar mills**.** Tamarind is harvested by pulling the pod from its stalk. A mature tree may be capable of producing up to 175 kg of fruit per year. Globally, it is most abundant in South Asia**,** where it is widely distributed and has a long history of human cultivation. Many South Asian regional languages have their own unique name for the tamarind fruit**.** It is called the tetul in Bangla; tintidi in Sanskrit, tentuli in Oriya**,** Imli in Hindi**,** amli in Gujarati**,** chinch in Marathi and Konkani, hunase in Kannada**,** chintachettu (tamaraind tree) and chintapandu (tamarind fruit) in Telugu and vaalanpuli in Malayalam**.** It is known as siyambala in Sinhala language in Sri Lanka**.** There are tamarind that taste sweet and sour but normally the taste of tamarind is very sour especially its pulp

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INTRODUCTION

Tamarind belongs to the family Fabaceae (Leguminosae), subfamily Detarioideae, tribe Amherstieae, genus *Tamarindus and species Tamarindus indica* (Wikidoc, 2025; Wikipedia, 2025). The name derives from Arabic: *hindi*, "Indian date". Several early medieval herbalists and physicians wrote *tamar indi*, medieval Latin use was *tamarindus*, and Marco Polo wrote of *tamarandi*. In Colombia, Nicaragua, Costa Rica, Ecuador, Cuba, the Dominican Republic, Guatemala, El Salvador, Honduras, Mexico, Peru, Puerto Rico, Venezuela, Italy, Spain, and throughout the Lusosphere, it is called *tamarindo*. In those countries it is often used to make the beverage of the same name (or *agua de tamarindo*). In the Caribbean, tamarind is sometimes called *tamón*. Countries in Southeast Asia like Indonesia call it *asam jawa* (Javanese sour fruit) or simply *asam*, and *sukaer* in Timor. While in the Philippines, it is called *sampalok* or *sampaloc* in Filipino, and *sambag* in Cebuano. Tamarind (*Tamarindus indica*) is sometimes confused with "Manila tamarind" (*Pithecellobium dulce*). While in the same taxonomic family Fabaceae, Manila tamarind is a different plant native to Mexico and known locally as *guamúchili* (Wikiwand, 2025). Common names are Tamarind, tamarind tree (English); tamarindo (Spanish/Italian); tamarinier (French); tamarindeiro, tamarineiro, tamarineira (Portuguese); tamarinde (Afrikaans/Dutch); Tamarindenbaum (German); asam jawa (Indonesian); asem jawa (Javanese); Tsamiya (Hausa); raqay (Somali); Sampalok (Tagalog); Demirhindi (Turkish) (Heuzé and Tran, 2015).

International Common Names (Rojas-Sandoval, 2018)

English: Indian tamarind, kilytree, tamarind
Spanish: tamarindo
French: tamarin, amarindier, tamarinier
Chinese: suan dou
Portuguese: tamarindeiro, tambarina
German: Tamarinde, Tamarindenbaum
India: amali, ambali, ambli, amilam, amli, amlika, anbli, andbli, chichi, chinch, chinta, chintachettu, chitz, huli, hunase, hunase-mara, hunse, Imli, konya, koya, nuli, puli, pulia-maram, shintachettu, tamrulhindi, tenthuli, tentili, tentul, tentuli, tetai, tetul, tetuli, tintiri, tintul

Vernacular names

Ttali (Assamese), *Tentul* (Bengali), *Ambla, Amli* (Gujarati), *Imli* (Hindi), *Hunashe*, *Hannu*, *Hunasemara* (Kannada), *Chinch* (Konkani), *Puli* (Malayalam), *Chicha*, *Chinch*, *Chincha* (Marathi), *Telul*, *Tentuli* (Oriya), *Imbli*, *Imlii* (Punjabi), *Puli* (Tamil), *Chintapandu* (Telugu) (Muraga Raja., *et al*., 2022). Imli (Hindi, Punjabi), Tetul (Bengali), Amli (Gujarati), Hunise hannu (Kannada), Tamber (Kashmiri), Puli (Malayalam, Tamil), Chintha pandu (Telugu), Chinch (Marathi), Tentuli (Oriya) (Krishihelpline, 2025). Odhisa, Bihar, Maharashtra, Tamil Nadu, Andhra Pradesh and Himalayan tract (Krishihelpline, 2025). Imlee, Imli, Tamarin, Tamarindo, Tamarindus indica (Webmd, 2025).

Common Names (Indiabiodiversity, 2025)

Assamese	Teteli
Eng	Tamarind
English	Tamarind tree Indian date Sampalok Tamarind
Hin	Imli
Hindi	Imli
Irula	Sullamaram Puliyamaram
Kannada	Hunse
Malayalam	Amlam Balapuli Kolpuli Puli Valampuli
Tami	Puli Puliyamaram

Tamarind is a multipurpose tree species, with versatile uses. It is used for various household, medicinal, and industrial purposes. The exceptional flavor, taste (sweet/sour) of the pulp is well known for cooking a variety of dishes and drinks (Hemshekhar *et al.,* 2011). The bark, root, leaves, fruit, and wood (every part of the tree) contribute to the subsistence of rural people. Some commercial applications are also well recognized in industrial uses and there is great potential for further development in different purposes (Hemshekhar *et al.,* 2011). Tamarind is familiar for its delicious appetizing fruit because of its sticky, soft, succulent, and sweet/sour tasty brown pulp usually used in various dishes and drinks (Hemshekhar *et al.,* 2011). he immature pods (green) are frequently used by the females as snacks (dipped in salt) in some Asian countries (Hemshekhar *et al*., 2011). The brown mature pulp is used for many purposes in households as a constituent in chutnies, pickles, curries, and beverages. Juice, candy, jam, and syrup are also prepared from it (Hemshekhar *et al*., 2011). Tamarind pulp is also used in cooking to detoxify poisonous yams in

some African countries (Hemshekhar *et al.,* 2011). The juice is used to preserved fish in some rural areas of Sri Lanka and some other South Asian countries (Hemshekhar *et al*., 2011). Tamarind juice is also used as traditional drink in many Asian, African and South American countries. For example, "Jugo" and "fresco de tamarindo" are popular traditional drinks made with tamarind in South America (Hemshekhar *et al.,* 2011). The seeds are consumed by the rural people after boiling or roasting in some places of India. Sometimes they prepare tamarind flour for bread making, or Indian chapattis/cake making (Hemshekhar *et al*., 2011). The seedlings, immature leaves, flowers, and pods are used as vegetables, salads, and soups in many countries. "Chindar" is a popular dish made of tamarind leaves in some parts of India (Hemshekhar *et al.,* 2011). The wood is used as charcoal and fuel woods for household utilization by the rural people. It is also used for brick burning purposes due to high calorific value of 4850 kcal/kg (Hemshekhar *et al.,* 2011). Tamarind wood is also used for making household furniture, wheels, rice pounders, mortars, tent pegs, cart shafts/axles, boats, toys, tools, and printing blocks (Hemshekhar *et al.,* 2011). *T. indica* has fantastic medicinal properties. Lots of rural people use different parts of this species for folk treatments of different ailments. A lot of medicines/drugs have already been produced by using different parts of this species (Hemshekhar *et al.,* 2011). Tamarind is a very good as blood sugar decreasing medicines. It is very popular for cardiac diseases (Hemshekhar *et al.,* 2011). The fruit is used to cure intestinal ailments, reduce fever, and is efficient against scurvy. Tamarind is also used to assist for the treatment of malarial fever (Hemshekhar *et al.,* 2011). Tamarind seed powder is commonly used for dysentery, chronic diarrhea, jaundice eye diseases, and ulcers in some Asian countries (Hemshekhar *et al*., 2011). The pulp is used for the treatment of sunstroke, effects of alcohol and "ganja" (*Cannabis sativa* L.) and Datura poisoning (Hemshekhar *et al.,* 2011). Tamarind pulp is a very good medicine for paralyzed people to restore sensation. It is also used for treatment of painful and wounded throats (Hemshekhar *et al.,* 2011). The leaves and pulp are used for softening the skin. Both of them are regarded as a diaphoretic and purgative in some Latin American countries (Hemshekhar *et al.,* 2011). The pulp is also used for the treatment of leprosy. It is also used as an ointment for rheumatism in some southeast Asian countries (Hemshekhar *et al.,* 2011). Tamarind seeds mixed with lime juice is used for prevention of pimples formation on face and seed oil is applied for hairdressing in some countries like Indonesia (Hemshekhar *et al.,* 2011). The pulp and leaves are very useful for liver ailments, cholagogue, urinary troubles, habitual constipation, and throat infections (Hemshekhar *et al.,* 2011). The bark is also used for the treatment of urinary discharges and gonorrhoea (Hemshekhar *et al.,* 2011). Flowers are used for conjunctivitis and also for the treatment of jaundice and piles (Hemshekhar *et al*., 2011). Tamarind has antioxidant, antifungal, antimicrobial, antibacterial, antiinflammatory, antidiabetic and antisnake venom properties (Hemshekhar *et al.,* 2011). Tamarind is already used as a raw material for the production of several industrial products like tamarind juice concentrate, tamarind pulp powder, tamarind kernel powder (TKP), pectin, tartaric acid, tartarates, and alcohol (Hemshekhar *et al.,* 2011). The chief industrial use of the seeds is the production of TKP. It is used as preservatives, paper adhesive, textile sizing, textile printing, and weaving and manufacture of jute products (Hemshekhar *et al.,* 2011). Tamarind seed is also used as adhesive filler in the plywood industry. It is also used as a stabilizer for brick industries that combine sawdust briquettes and as a thickener for a number of explosives (Hemshekhar *et al*., 2011). Tamarind gum (stiff gel) is commercially accessible for the improvement of texture and viscosity processed foods which are used for thickening, gelling and stabilizing in food and vegetable processing industries (Hemshekhar *et al.,* 2011). TKP up to 15% is allowed in bread and biscuits factories. TKP reduces springiness and particular volumes in bread (Hemshekhar *et al*., 2011). A mixture of TKP and low cost jelly could be used as an alternative to expensive pectin for making jams, jellies, and marmalades. Tamarind polysaccharides obtained from seed kernels can produce gels over a wide range of pH and can be used as an alternative to fruit pectin (Hemshekhar *et al*., 2011). Tamarind is a well-known fodder species. The leaves and seeds are used to feed domestic animals (cattle and goats). In general, leaves contain higher crude protein than seeds, and required almost no preparation for feeding (Hemshekhar *et al.,* 2011). Sometimes trees grown in woodland are browsed by wild elephants in Zambia (Hemshekhar *et al.,* 2011). This species is considered as a component of agroforestry because of its potential nitrogen fixing ability, tolerance of infertile soil, and erosion control (Hemshekhar *et al*., 2011). Tamarind is used in farming systems (intercropping) due to its multipurpose uses in many tropical countries. Farmers integrate many species including livestock and agricultural crops with tamarind trees in India to reduce the uncertainty of crop failure (Hemshekhar *et al*., 2011). It is a very good ornamental tree usually planted along roadsides, avenues, river banks, and in parks (Hemshekhar *et al.*, 2011). It is also used as shade tree, shelter belt, and wind breaks due to its resistance to storms (Hemshekhar *et al.,* 2011). In some countries tamarind is used as firebreak as grasses cannot grow under heavy shade of this tree (Hemshekhar *et al*., 2011). A certain portion of the rural folk and tribes living in the forest have beliefs that tamarind is a highly worshipped and sacred tree (Hemshekhar *et al.,* 2011). Tamarind is familiar for its delicious appetizing fruit because of its sticky, soft, succulent, and sweet/sour tasty brown pulp usually used in various dishes and drinks (Hemshekhar *et al.,* 2011). The immature pods (green) are frequently used by the females as snacks (dipped in salt) in some Asian countries (Hemshekhar *et al*., 2011). 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Tamarindus indica L., commonly known as the tamarind tree, is one of the most important leguminous tree species (Saideswara Rao and Mary Mathew, 2012). The tamarind tree originates from Madagascar (Saideswara Rao and Mary Mathew, 2012). The most valuable and commonly used part is the fruit. The pulp constitutes 30–50 % of the ripe fruit, the shell and fi bre account for 11–30 % and the seed about 25–40 % (Saideswara Rao and Mary Mathew, 2012). Tamarind is commonly used as a health remedy throughout Asia, Africa and the Americas (Saideswara Rao and Mary Mathew, 2012). Tamarind products, leaves, fruits and seeds have been extensively used in Indian Ayurvedic medicine and traditional African medicine (Saideswara Rao and Mary Mathew, 2012). Tamarind is reported to have been adulterated with foreign matter which is both organic and inorganic in nature, due to poor post-harvest management practices including processing (Saideswara Rao and Mary Mathew, 2012). Tamarind (*Tamarindus indica* L.) is one of the most widespread trees of the Indian subcontinent (Saideswara Rao and Mary Mathew, 2012). It is a large evergreen tree with an exceptionally beautiful spreading crown, and is cultivated throughout the whole of India, except in the Himalayas and western dry regions (Saideswara Rao and Mary Mathew, 2012). Tamarind is a multipurpose plant. The pulp of the fruit has been used as a spice in Asian cuisine, especially in the southern part of India, for a long time. Almost all parts of the tree fi nd a use in the food, chemical, pharmaceutical or textile industries, or as fodder, timber and Fuel (Saideswara Rao and Mary Mathew, 2012). Tamarind (*Tamarindus indica* L.) is one of the most widespread trees of the Indian subcontinent (Azad, 2018). It is a large evergreen tree with an exceptionally beautiful spreading crown, and is cultivated throughout the whole of India, except in the Himalayas and western dry regions (Azad, 2018). Tamarind is a multipurpose plant. The pulp of the fruit has been used as a spice in Asian cuisine, especially in the southern part of India, for a long time. Almost all parts of the tree find a use in the food, chemical, pharmaceutical or textile industries, or as fodder, timber and fuel (Azad, 2018). Tamarind is a well-known fodder species. The leaves and seeds are used to feed domestic animals (cattle and goats). In general, leaves contain higher crude protein than seeds, and required almost no preparation for feeding (Azad, 2018). Sometimes trees grown in woodland are browsed by wild elephants in Zambia (Azad, 2018). This species is considered as a component of agroforestry because of its potential nitrogen fixing ability, tolerance of infertile soil, and erosion control (Azad, 2018). Tamarind is used in farming systems (intercropping) due to its multipurpose uses in many tropical countries. Farmers integrate many species including livestock and agricultural crops with tamarind trees in India to reduce the uncertainty of crop failure (Azad, 2018). It is a very good ornamental tree usually planted along roadsides, avenues, river banks, and in parks (Azad, 2018). It is also used as shade tree, shelter belt, and wind breaks due to its resistance to storms (Azad, 2018). In some countries tamarind is used as firebreak as grasses cannot grow under heavy shade of this tree (Azad, 2018). A certain portion of the rural folk and tribes living in the forest have beliefs that tamarind is a highly worshipped and sacred tree (Azad, 2018).

Tamarind (*Tamarindus indica* Linn.) commonly called *imli* in Hindi is an important tree of semi-arid tropical conditions suited for Dry Land Horticulture. Every part of the plant is used for different purposes. The ripe fruit (pod) on an average comprises about 55% tamarind pulp, 33% seeds and about 12% fibre (Admin, 2021). The pulp is a carminative, laxative, appetizing warming, tonic to the heart, anthelmentic, given as a infusion in bilousness and febrile conditions and cures *vata, pitta* and *kapha* and wounds and fractures. A gargle of tamarind water is recommended in sore-throat (Admin, 2021). Because of the anti-scorbutic properties the pulp is used by sailors in place of lime or lemon juice (Admin, 2021). The tamarind kernel powder (TKP) is used as a sizing material in textile and leather industry (Admin, 2021). The polysaccharide, jellose, present in TKP forms jells with sugar concentrates and is an excellent substitute for fruit pectins (Admin, 2021). The seeds are used as a source of carbohydrates for paper and jute products (Admin, 2021). The seeds yield a fatty oil which is used in paints and varnishes (Admin, 2021). Tamarind wood is used for making agricultural implements, tool handles, wheels, mallets and rice pounders. The leaves, flowers, unripe fruits and bark also have many medicinal uses. The plant acts as a good wind-break (Admin, 2021). Tamarind is a tropical fruit with a complex, sweet-tart flavour. It is typically made into a paste or a concentrate and used to enhance the flavour of both sweet and savoury dishes (Lovers, 2021). The tamarind tree is a member of the pea family, and grows large, bumpy pods containing seeds, along with the sticky, pulpy flesh that we use in cooking (Lovers, 2021). Most of the tamarind you can buy from the store is in paste form, but if you want to make your own paste, fresh tamarind is typically available in three different forms (Lovers, 2021). Raw Pods are unprocessed, with the fruit still inside the shell. This is the freshest tamarind available (Lovers, 2021). Pressed tamarind is fruit that has been removed from the shell and condensed into a single block. If you can't find any raw pods, this is the next best thing (Lovers, 2021). Oiled tamarind has been cooked to improve shelf life, and may also contain preservatives. This is not as fresh as the other two options, but will keep for longer. Check the label and avoid anything with too many additives (Lovers, 2021). Tamarind is actually indigenous to Africa, but has long been associated with Indian cuisine, with it's name deriving from the Arabic *tamar Hindi,* meaning 'Indian date' (Lovers, 2021). It is also popular in Middle Eastern cuisine, and will likely be familiar to Ottolenghi fans. This well-travelled fruit was introduced to Mexico and Central America by Spanish and Portuguese colonists in the 16th century, where it also went on to become a staple part of the cuisine (Lovers, 2021). Tamarind has a unique, sweet-sour flavour that makes it popular in sweet and savoury dishes alike (Lovers, 2021). Its flavour has been compared to tangy lemon or lime balanced by sweet caramel notes, or a cross between lemon, apricot and dates (Lovers, 2021). Some varieties of tamarind are sweeter than others, and all become sweeter as they ripen (Lovers, 2021). Half a cup of tamarind contains 143 calories, which is moderately high for a fruit. It is fat-free, but contains 34 grams of sugar, with 3 grams of fibre and 2 grams of protein. Tamarind is a good source of several nutrients, with the same half-cup serving providing at least 10% of your daily value for vitamins B1 and B3, as well as potassium, magnesium, phosphorus and iron (Lovers, 2021). Tamarind is rich in antioxidants, beneficial plant compounds that help prevent cell damage caused by particles called oxidants. Oxidative cell damage can cause premature ageing and various chronic diseases, so it's important to protect against it by including plenty of antioxidants in your diet (Lovers, 2021). Tamarind is a good source of amino acids, including all but one of the 'essential' amino acids, which your body cannot produce by itself. Amino acids are the building blocks of protein, and are vital for building and repairing tissue. There is some concern that the amino acids found in tamarind may be difficult for the body to absorb, however, so it is important to include other amino-rich foods in your diet too (Lovers, 2021). There are several B vitamins to be found in tamarind, which play an important role in brain function and the nervous system. It also provides a good source of magnesium and

calcium, both of which help maintain healthy bones and protect against fractures and osteoporosis (Lovers, 2021). Tamarind is a great source of vitamins, minerals and antioxidants, but like many foods, it may also have potential side effects. As a particularly acidic food, it may cause acid reflux, have a laxative effect, or erode tooth enamel, so avoid eating it in excessive amounts, and be sure to clean your teeth well afterwards (Lovers, 2021). Like many high-carbohydrate foods, tamarind can cause problems for diabetics, and has been known to lead to hypoglycemia. It can also interact negatively with certain types of medication, so always check with your doctor when prescribed with a new medicine. Tamarind is best avoided if you are taking medication with the potential to cause bleeding, anything designed to constrict the blood vessels, as well as certain ophthalmic antibiotics (Lovers, 2021). Tamarind is eaten in a variety of different ways around the world. In India it is used to flavour curries and rice, and can be made into chutneys for eating with samosas and pakoras. It is also made into a lollipop known as *Chigali,* used to flavour *rasam* soup and included in some varieties of masala chai tea (Lovers, 2021). In the Middle East it is used alongside dried fruit to add a sweet-sour flavour to meat stews, and several different countries make it into a drink, known variously as *tamarindo* in Latin and Central America, *Nam Ma Kham Wan* in Thailand and *Poha Beer* in Ghana. In the West, it is a key ingredient in UK favourites *Worcestershire Sauce* and *HP Sauce* (Lovers, 2021). If you want to cook with tamarind at home, it tastes great in Indian or Thai curries and in simple chutney recipes. Its acidity makes it the perfect marinade for meat, but it's great in sweet recipes too. Try mixing a little tamarind paste with water and sugar to make tamarind balls, a simple and tasty Caribbean dessert (Lovers, 2021).

All products featured on Bon Appétit are independently selected by our editors. However, we may receive compensation from retailers and/or from purchases of products through these links (Sankari, 2021). The food of my childhood is incomplete without the flavor of tamarind: Cycling to school meant sucking on one of the tamarind candies stuffed in my pockets. Meeting friends for paani puri, a crispy fried dough filled with a medley of chutneys, including the ubiquitous tamarind chutney, was a weekly affair. And on the long train journey from Pune in western India to my hometown in Tamil Nadu, I eagerly dug into the South Indian dish puliyodharai, tamarind rice wrapped in a banana leaf parcel (Sankari, 2021). In Indian cuisine, tangy tamarind plays many roles. It acts as a preservative, a cooling agent, and a remedy—its paste relieves the itchy mouthfeel that comes from eating tubers like yam and taro. It's also sour and sharp; as Saee Koranne-Khandekar explains in her book *Pangat, a Feast*, tamarind plays a crucial part in balancing flavors. When added to the lentil vegetable stew sambar and to other curries like puli kuzhambu, which consists of vegetables like moringa pods, eggplant, or okra cooked in a tamarind base, its sharpness contrasts with the spices (Sankari, 2021). Get the best Prime Day kitchen deals delivered directly to your inbox (Sankari, 2021). By signing up, you agree to our user agreement (including class action waiver and arbitration provisions), and acknowledge our privacy policy (Sankari, 2021). Because tamarind comes in so many forms and is consumed in countless ways, below, I'll walk you through its wide usage in Indian cuisine as well as its excellent benefits (tamarind is also an important ingredient in Southeast Asian and Central and South American cuisine) (Sankari, 2021). Widely used in India, tamarind is a plump pod-like fruit with a sweet, tangy flavor that is indigenous to tropical Africa. The word *tamarind* itself is derived from the Arabic *tamar hind*, meaning "Indian date." When the fruit is mature, the pods are opened and seeded to reveal the dark chocolate flesh, a staple in Indian cuisine (Sankari, 2021). But every part of the tree is useful: The leaves are used as an anti-inflammatory in home remedies; the wood is harvested for carpentry; and the seeds are pieces in playing traditional Indian board games (Sankari, 2021). Unripe green fresh fruit: Super tart and sour, it's chopped for pickles and chutneys without being seeded (Sankari, 2021). Brown ripened fruit or pulp: Tamarind comes in whole pods but is also commonly sold in Asian shops as blocks. The fruit serves as an excellent marinade for meats and seafood. Before pan-frying fish, I'll glaze it with a paste made from a small piece of ripened tamarind, green chiles, chili powder, turmeric, and onions. The ripe fruit is also added to a wide range of chutneys (Sankari, 2021). Paste, concentrate, or extract: Ripe fruit in a more user-friendly form, these can be bought from the store or made at home. To do it yourself, soak the tamarind pulp in hot water, remove the fibers and seeds, and squeeze to extract the dark, smooth paste. It has a long shelf life when refrigerated and acts as a souring agent in meat and vegetarian curries and as a natural coolant for the body (Sankari, 2021). Chutney: Store-bought tamarind chutney or sauce should not be confused with paste or concentrate as it comes already sweetened and seasoned (Sankari, 2021). Powder: When added to candies, beverages, and snacks, this dehydrated form of the fruit gives a much-appreciated extra punch (Sankari, 2021).

Currently, the paradigm shift of folklore medicine is obvious among the public and researchers. Study based on traditional medicine around the world has become prominent with the addition of pharmacological studies to scientifically prove the effectiveness of the concerned medicine (Muraga Raja., *et al*., 2022). Tamarind alone or with a combination of other herbs has been proved to be effective for treating many ailments such as arthritis, dysuria, dental diseases, ulcer, sexual dysfunction (Muraga Raja., *et al*., 2022). It also exhibits pharmacological actions such as antimicrobial, anti-dysentery, anti-coagulant, hepatoprotective, anti-asthmatic, and anti-diabetic. The pharmacological effect of the fruit or the pulp, leaves, flowers, kernel, and inner bark has been studied (Muraga Raja., *et al*., 2022). Human beings and plants share an age-old relationship. The use of plants as medicine goes back to the period of early man. India has an ancient heritage of traditional medicine and a rich tradition of plant-based knowledge in healthcare (Muraga Raja., *et al*., 2022). Plants have formed the basis of sophisticated traditional medicinal practices that have been used for thousands of years by people in China, India, and the rest of the other countries (Muraga Raja., *et al*., 2022). The earliest record of the use of plants for the treatment of various ailments can be found in the oldest Hindu scripture, the Rig Veda which dates back from 3500 B.C. to 1800 B.C. (Muraga Raja., *et al*., 2022). Practices of traditional medicine vary greatly from country to country, and from region to region, as they are influenced by factors (Muraga Raja., *et al*., 2022).

You'll find tamarind in curries, pad thai, and (surprise!). But maybe you've only ever seen it in the form of tamarind sauce on an Indian restaurant menu. Here's what you need to know about eating this underrated ingredient (Lagroue, 2022). The tamarind tree is native to Asia and Africa, but it also grows in tropical climates around the world. It produces pods of fruit that taste sweet and sour when ripe and even more sour when unripe or dried (Lagroue, 2022). India and Thailand produce the most tamarind, and it holds a prominent place in their cooking. But it's a staple ingredient in other Asian cuisines, too. You'll also find it in African and

Middle Eastern cooking (Lagroue, 2022). Tamarind trees grow in the Western Hemisphere, as well, with Mexico being the biggest producer. Tamarind candies and *agua de tamarindo*, or tamarind water, are popular in Mexico (Lagroue, 2022). To approximate the sweetness and tang tamarind brings to recipes, cooks sometimes substitute equal parts brown sugar and lime or lemon juice. But there's more to its flavor: Notes of caramel and molasses give tamarind more complexity, and its acidity is somewhat milder than that of lemon and lime and lacks the hints of bitterness found in citrus (Lagroue, 2022). Tamarind can take savory or sweet recipes up a notch. If you're new to cooking with this tangy fruit, our Tamarind Sauce Fish Curry and Tamarind Agua Fresca show off its flavor. Authentic Pad Thai is also a nice introduction that calls for just a couple of tablespoons of tamarind paste (Lagroue, 2022). You can find tamarind at Asian, Latin, and Middle Eastern markets. The fruit comes in several forms: powder, paste, concentrate, and in a plastic-wrapped block. Sometimes, tamarind paste and concentrate refer to the same product. Concentrates, however, tend to be more watered down than pastes. A block (aka tamarind pulp) takes more TLC than ready-to-use powder and paste because you have to soak, mash, and strain the portion you're cooking with first. Once you've done that, you're left with a paste-like product (Lagroue, 2022). Tamarind is a fruit that contains a nutrient-rich, fibrous pulp (Jennings, 2023). Its nutrients may have antioxidant, anti-fungal, anti-bacterial, and anti-viral effects, among other benefits (Jennings, 2023). Tamarind is a type of tropical fruit used in many dishes around the world (Jennings, 2023). It may even have medicinal properties (Jennings, 2023). Tamarind is a hardwood tree, known scientifically as *Tamarindus indica* (Jennings, 2023). It's native to Africa but also grows in India, Pakistan, and many other tropical regions (Jennings, 2023). The tree produces bean-like pods filled with seeds surrounded by a fibrous pulp (Jennings, 2023). The pulp of the young fruit is green and sour. As it ripens, the juicy pulp becomes paste-like and more sweet-sour (Jennings, 2023). Interestingly, tamarind is sometimes referred to as the "date of India." (Jennings, 2023). Tamarind is a tropical tree that grows in several regions around the world. It produces pods filled with paste-like, sweet-sour fruit (Jennings, 2023). This fruit has many uses, including cooking, health, and household purposes (Jennings, 2023).

Tamarind paste is made from a sour, dark, sticky fruit that grows in a pod on a tamarind tree. While some cuisines use tamarind paste to make desserts and even candy, in Thai cooking it is used mostly in savory dishes (Schmidt, 2024). Thai sauce is made with tamarind, as are some Thai curries and seafood dishes (Schmidt, 2024). Indian curries also call for tamarind. It is also a common ingredient in Indian and Mexican cuisines, as well as Vietnamese, Latin, and Caribbean cooking (Schmidt, 2024). It is also a key ingredient in Worcestershire sauce, contributing to the distinctive tang (Schmidt, 2024). Tamarind paste is from the fruit—or pods—of the tamarind tree, specifically the pulp that surrounds the seeds within the pod. The tamarind tree is a common hardwood fruit tree that is native to Africa but now grows all over Asia and Mexico. It bears large brown pods that contain the tamarind fruit. The dark reddish-brown fruit is removed from the pods and must be separated from the seeds to become a ready-to-use cooking paste. You can make it yourself or buy it premade, but it's not expensive, and it keeps for an extensive amount of time (Schmidt, 2024). Tamarind paste is easy to use straight from the container. Because of its sour taste, whatever recipe you are making will need sugar or some kind of sweetener; when combined with sugar, tamarind gives dishes a beautiful but subtle, sweet-sour flavor. The thickness and strength of tamarind paste vary widely depending on which brand you use. If the paste is runny, you will need to add more to achieve the right flavor. Taste-test your recipe to achieve the right sweet-sour balance, adding more paste or more sweetener until the desired flavor is reached (Schmidt, 2024). Tamarind paste tastes very sour, with a somewhat citrusy taste. It does have notes of smoke and caramel as well, making for a complex flavor profile. It is thick, sticky, and resembles molasses (Schmidt, 2024). Tamarind paste is used in many Asian dishes, including noodle recipes, curries, sauces, and soups. It can also be mixed into uncooked dips and chutneys. It is ideal in a marinade since its acidic quality helps to tenderize the meat. Tamarind paste is also found in recipes for desserts, candies, cocktails, and other beverages, such as the very common and well-loved agua fresca de tamarindo, in Mexico (Schmidt, 2024). Tamarind paste is sold in a jar or plastic container. Since the paste is strong and condensed, one jar will last a long time. Tamarind paste can be found in some Asian food stores, but you might have more luck buying tamarind paste in Indian grocers. It can also be purchased online fairly easily (Schmidt, 2024). If you'd like to make your own, it's not hard. Dried pods can be easily acquired in Asian stores and even some supermarkets. Open them up and remove the fruit. Simmer them with about 1/4 cup of water in a saucepan for 10 to 15 minutes. Remove the pan from the heat, and use the back of a spoon to gently mash the fruit against the bottom and sides of the pan. Strain the brown liquid out, and press the fruit through a fine-mesh sieve to extract as much pulp as possible, while straining out the seeds. Your tamarind paste is now ready to use (Schmidt, 2024). Although one might balk at the idea of substituting something for tamarind paste, sometimes you can't find an ingredient, or the urge to make a dish with it strikes when a grocery store isn't open. There are two common substitutes for tamarind paste—one is a combination of vinegar and sugar and the other is fresh lime juice. The vinegar-sugar mix works well in dishes like pad Thai chicken. If your recipe calls for 1 tablespoon tamarind paste, substitute with 1 tablespoon vinegar mixed with 1 tablespoon brown sugar. If using fresh lime juice, substitute 2 tablespoons of lime juice for every 1 tablespoon of tamarind paste (Schmidt, 2024). Both substitutes work best when the amount of tamarind paste is 2 tablespoons or less. Neither substitute works well if the recipe you wish to make is based on tamarind as the main ingredient, such as in a recipe for Thai tamarind fish (Schmidt, 2024). Most jars and containers of tamarind paste say to store in a cool, dry place, which means your spice cabinet will do just fine. You will find, however, that cooks who use tamarind often recommend storing in the refrigerator to ensure longer shelf life and freshness. You may have to stir the contents before using or dilute it a bit with water, as it tends to thicken. It will last for months if it's properly sealed (Schmidt, 2024).

Tamarind's uniquely tangy-sweet taste enlivens the cooking of many of the world's cuisines. Here's a guide to its most common forms (Vaughn and Dunn, 2024). Tamarind is a staple in many tropical regions of the world, including Southeast Asia, South America, the Caribbean, and the Indian subcontinent (Vaughn and Dunn, 2024). Intensely tangy and fruity-sweet, tamarind is extremely versatile, starring in savory dishes, desserts, and drinks alike. The fruit's acid balances sugar, rich peanuts, and salty fermented seafood both in Thailand's pad Thai and Indonesia's gado gado (Vaughn and Dunn, 2024). In West Africa, the whole pods brighten up thiéboudienne, the nation's signature fish and rice dish. And in Mexico, the fruit is combined with sugar and water to make punchy, refreshing agua de tamarindo (Vaughn and Dunn, 2024). Before you dive into the diverse world of

tamarind recipes, it's important to know that the fruit is available to purchase in several forms. Here's your guide to the most common tamarind products you'll find, plus an overview of how to cook with each (Vaughn and Dunn, 2024). Tamarind is a fruit tree indigenous to Africa that now grows in tropical regions worldwide. The tree produces hard-shelled fruit pods that contain a bracing, dark brownish-red pulp with a date-like texture (Vaughn and Dunn, 2024). Tamarind is fruity, punchy, and nuanced (Vaughn and Dunn, 2024). The fruit varies a bit in flavor depending on when the pods are harvested. The sourest pulp comes from greenish, unripe pods; the pulp becomes more mild as the fruit ripens and the pods darken (Vaughn and Dunn, 2024). Tamarind pods are the whole form of the fruit. They feature a brittle, brown exterior and a bronze, edible sour pulp inside. Seeds, which are discarded, are nestled inside the pulp (Vaughn and Dunn, 2024). If you'd like to cook with whole tamarind pods, they can be found both ripe and unripe at specialty supermarkets, East Asian and Indian grocers, and online (Vaughn and Dunn, 2024). When shopping for whole tamarind pods, you may also come across pods of a sweet variety of tamarind, which is grown primarily in Thailand (they're usually labeled "sweet tamarind"). These pods can be enjoyed out of hand as a snack—simply pop the pod open to expose the pulp, strip away any large fibers, and eat the sweet-tart pulp, avoiding or spitting out any seeds (Vaughn and Dunn, 2024). Tamarind powder, made from dehydrated and ground tamarind, is frequently used in Indian cuisine as a souring agent in rice dishes, dals, curries, and chutneys Tamarind powder, made from dehydrated and ground tamarind, is frequently used in Indian cuisine as a souring agent in rice dishes, dals, curries, and chutneys Tamarind powder, made from dehydrated and ground tamarind, is frequently used in Indian cuisine as a souring agent in rice dishes, dals, curries, and chutneys Tamarind powder, made from dehydrated and ground tamarind, is frequently used in Indian cuisine as a souring agent in rice dishes, dals, curries, and chutneys (Vaughn and Dunn, 2024). It is also used in spice mixes and rubs and is particularly well-suited for candy making, where the added moisture imparted by tamarind pulp or paste could be problematic (Vaughn and Dunn, 2024). It is also used in spice mixes and rubs and is particularly well-suited for candy making, where the added moisture imparted by tamarind pulp or paste could be problematic (Vaughn and Dunn, 2024).

If you want to broaden your culinary knowledge, it may be time to get acquainted with the tamarind. Tamarinds are a versatile fruit featured in all kinds of global cuisines. By utilizing the distinctively sweet and tangy flavor of these fruits, you can bring new life to your favorite savory and aromatic dishes (Mucci, 2024). As great as tamarinds are, many people know very little about the tasty fruit. To help, we've put together an easy guide on what tamarind fruit is and how you can incorporate it into your cooking (Mucci, 2024). Tamarinds are little fruits that come in pods and are grown on a tamarind tree. Originating in Africa, the tamarind tree produces a somewhat sour fruit that is used in various dishes. You can find a prevalent use of tamarinds in cuisines around the world, including Asia, Africa and the Middle East. Tamarind fruits also make an appearance in British cuisine, where they are often used when making Worcestershire sauce (Mucci, 2024). Generally speaking, tamarinds grow in a tropical climate, as the plant is originally from tropical Africa — more specifically, the island of Madagascar. However, tamarinds are now cultivated in several regions, most dominantly in India and Thailand, as well as countries in South America (Mucci, 2024). Tamarinds usually don't grow successfully in the United States due to the plant's need for a tropical climate. If the temperature is too cold, tamarind plants will struggle to survive. However, you could grow tamarinds in a climate-controlled greenhouse environment, as long as they get enough sunlight and the indoor temperature stays warm (Mucci, 2024). Tamarind paste is a common way to store tamarinds and use it in recipes. Tamarind paste is extremely simple and is essentially the soft, ripe tamarind fruit with the seeds removed. This paste is dark and sticky and has a sour taste (Mucci, 2024). A jar of tamarind paste is a preferable way to store the fruit because it keeps for a long time and it's easy to use in recipes; all you need to do is scoop out some of the paste and add it to whatever sauce or mixture you're making (Mucci, 2024). Tamarind sauce is not the same as tamarind paste. While tamarind paste is made of pure tamarind, tamarind sauce contains several ingredients. Tamarind sauce consists of watered-down tamarind paste and other flavorful ingredients that balance out the sourness of the paste. Typical ingredients for a tamarind sauce include brown sugar, ginger, chili pepper and soy sauce (Mucci, 2024). Unlike the thick, sticky texture of tamarind paste, tamarind sauce is thinner, usually like a syrup. Those who make tamarind sauce at home usually mix a concentrated tamarind paste with water to create the tamarind portion of the sauce, but you can also use regular tamarind paste with slightly less water to get a similar result (Mucci, 2024). Tamarind is most certainly a fruit. Tamarinds contain seeds and grow on a flowering plant, which, by the botanical definition, makes them a fruit. But it's worth noting that in addition to being a fruit, a tamarind tree is leguminous, meaning that a tamarind fruit is a type of legume. Examples of other legumes include peanuts, soybeans and chickpeas (Mucci, 2024). So, what do tamarinds taste like? In short, don't bite into a tamarind expecting a sweet flavor. Although tamarinds get a little sweeter as they ripen, they generally have a pretty tart flavor profile (Mucci, 2024). Tamarinds aren't very acidic, so they don't necessarily have a "fruity" taste that you might associate with citrus fruits. Some might find that tamarinds taste a little like sour cherries, although tamarinds still distinguish themselves by having a heavy flavor note that's similar to molasses (Mucci, 2024). So, with all those tamarind fun facts in mind, what is tamarind good for? Tamarind pops up as an ingredient in a lot of dishes. You can use tamarind when you make all kinds of curries, chutneys and other sauces. Tamarind also has a sweeter side and can be used in tamarind candy, which is a mix of tamarinds, sugar and chili powder, sometimes with the addition of other fruits like mango (Mucci, 2024). If you want to learn more about preparing dishes with tamarind fruit, look for cooking classes near you. Alternatively, if none of the classes in your area specialize in cuisines that use tamarinds, you can also search for online cooking classes. With the right course, you'll soon be making everything from basic tamarind sauces to yummy chicken massaman curry (Mucci, 2024). While tamarind is mostly used in cooked dishes, you can also eat tamarind raw if you want to try out how it tastes. To eat raw tamarinds, you can simply break open a pod and nibble at the pulp — just be careful to avoid the seeds. Or, if you have tamarind paste on hand, you can take a little on a spoon and try it out. Just remember that tamarinds are pretty sour, so you might not enjoy that raw flavor on its own (Mucci, 2024). Although you can buy tamarind paste at the store, you can also try making tamarind paste from scratch at home. To do so, start with a dried block of concentrated tamarind pulp (sometimes sold as concentrated tamarind paste). Take a piece from the tamarind block and put it in a bowl with boiling water, allowing it to sit for about half an hour (Mucci, 2024). Then, blend the mixture a bit, making sure all the fibers are broken down. You can use a spoon or masher, but your hands are actually the easiest way to do this. Strain the paste to get rid of the seeds, and store it in a jar until

you're ready to use it. You can also try making tamarind paste with fresh tamarinds removed from the pod, using the same process (Mucci, 2024). Tamarind juice is another tasty treat you can make with tamarinds. To make tamarind juice, all you need is tamarind paste, water and sugar. Stir some tamarind paste into hot water. After the water is cooled, strain out any pulp remaining from the paste (Mucci, 2024). Then, add some cool water and sugar. You can leave the juice as-is, or add an extra ingredient for more flavor, such as bitters. Be sure to keep the tamarind juice in the fridge and serve it over ice (Mucci, 2024). Tamarinds are an excellent flavor to incorporate into your recipes, but is tamarind good for you? If you enjoy eating tamarinds, you'll be happy to hear that there are many health benefits of tamarind (Mucci, 2024). From a nutritional perspective, tamarind contains several beneficial nutrients, such as vitamins A and C, iron, protein, calcium and potassium. Tamarind also has antioxidants and anti-inflammatory properties. A study in the Asian Pacific Journal of Tropical Biomedicine even finds that tamarinds can help promote healthy cholesterol (Mucci, 2024). Overall, tamarinds, like any food, have both benefits and drawbacks. While the fruit should be fine for anyone to consume in moderation, always consult a medical professional if you'd like to eat tamarind to address a specific health concern (Mucci, 2024). For all of those with celiac disease or another form of gluten restriction, don't worry; tamarind is completely gluten-free. If you're buying a tamarind product that contains other additive ingredients, you may want to check the label to confirm that it is still gluten-free (Mucci, 2024). If you'd like to purchase tamarind, you should have no issue finding it. Many mainstream grocery stores now sell tamarind, either in fresh pods or paste form. Look for the pods in the produce section and the paste in the international food aisle (Mucci, 2024). If you can't find it at your regular grocery store, look for it at a specialty store, such as an Asian market. And if you're struggling to find a tamarind product in person, you can always shop online at an independent store or on Amazon and get it delivered (Mucci, 2024). Depending on the recipe, if it calls for tamarind paste and you don't have any, you could get away with using a substitute. To recreate the flavor of tamarind, try to find something that has a sweet and sour flavor. The simplest tamarind substitute is a combination of lemon or lime juice and brown sugar. White wine vinegar mixed with brown sugar can also work (Mucci, 2024). Tamarind is a versatile and unique fruit. Once you understand its flavor profile and how to use it in cooking, all kinds of delicious culinary delights will become available to you. While the thick texture and tart taste might seem intimidating at first, you'll soon find that tamarind is one of the best ingredients to keep on hand for your cooking adventures (Mucci, 2024).

With a sweet, tangy flavor, this tropical fruit is super versatile and high in antioxidants (Health, 2024). Around the world, tamarind fruit is a key ingredient in popular and culturally significant dishes both savory and sweet (Health, 2024). It's one of the key ingredients in sinigang, a savory Filipino stew, and imli or saunth chutney, a sweet chutney that complements fried snacks in India and Pakistan. It's also used in beverages like agua fresca, which abounds in Mexico and parts of Latin America, and sharbat, a chilled cordial often served during Ramadan (Health, 2024). But tamarind comes from a tree that can only survive in tropical and subtropical climates, so depending on where you live, you may not be as familiar with it as you are with other fruits (Health, 2024). Registered dietitian Devon Peart, RD, MHSc, explains what tamarind is and what health benefits it may provide so you can start incorporating this versatile fruit into your diet (Health, 2024). Tamarind fruit is a pod-like legume from the tamarind tree (*Tamarindus indica*). Its hard shell looks like a long peanut shell or a brown edamame (soybean) pod, but inside is a fleshy pulp with a texture kind of like a date (Health, 2024). "Tamarind is both sweet and tangy," Peart says. "It's sweeter or sourer depending on how ripe it is. The riper the fruit, the sweeter the taste." (Health, 2024). Tamarind trees are native to tropical areas of Africa, but they now grow in other warm climates, too, including South Asia, Mexico and parts of Central America (Health, 2024). If you've been buying ready-made tamarind paste (a.k.a "tamarind concentrate") for cooking, let me tell you why I stopped using them and what I do now (Chongchitnant, 2024). Growing up in Thailand we always made our own tamarind paste for cooking, but when I arrived in Canada I was delighted by the convenient jars from the store! (Chongchitnant, 2024). But after years of using it, I don't know if the products became worse or my standards became higher, but I eventually I became more and more dissatisfied with the quality of premade pastes (Chongchitnant, 2024). They started to taste bland and diluted to me (Chongchitnant, 2024). And while this isn't the case with all brands, all the time, it was inconsistent enough, even within the same brand, to warrant another solution (Chongchitnant, 2024). Tamarind pulp can be turned into homemade jars of delicious tamarind paste, used in many Thai recipes (Chongchitnant, 2024). Simply put, tamarind is a fruit. Its sticky brown flesh ranges from being very sweet to very sour, depending on the variety. The sweet ones are for eating fresh, and the sour ones are for turning into a paste for cooking (Chongchitnant, 2024). The tamarind liquid that is used for Thai cooking is sometimes referred to as "tamarind water," and some brands of premade ones are labeled "tamarind concentrate." I used to call it "tamarind juice," but I have switched to "tamarind paste" to avoid confusion with tamarind beverages (Chongchitnant, 2024). *If you find whole tamarind fruit pods at the store, those are the sweet ones for eating as snacks not for cooking.* Do not make this mistake as many people have done! (Chongchitnant, 2024). Cooking tamarind comes either in ready-to-use liquid in a tub or jar, or in a brown block which is what you'll need to make your own tamarind paste at home (Chongchitnant, 2024). The brown block is simply compacted tamarind fruit pulp. The pulp is seedless, but it has lots of fibers that need to be strained out (Chongchitnant, 2024). Tamarind pulp commonly sold at Asian markets. It is seedless, but still contains a lot of fibers that need to be strained out (Chongchitnant, 2024). Here's an overview of the process, but be sure to read the recipe card and watch the video tutorial because this is one of those things that's much better understood once you see it in action (Chongchitnant, 2024). The tamarind paste you make is ready to use right away, but for the rest, you will want to cook it before storing to maximize its shelf life. When cooking tamarind, because it's thick, it'll bubble and look like it's boiling before the entire mixture has reached boiling temperature. So it's important to let it bubble for about 5 minutes to allow it to thoroughly heat through (Chongchitnant, 2024). If you cook the paste and store it in a mason jar while hot as per my instructions, it will last up to 6 months, unopened in the fridge. Once it's opened, it has lasted me at least 2 months, but always use clean utensils to scoop from the jar (Chongchitnant, 2024). Because of this, I recommend you putting it in small jars, no larger than 1 cup per jar, to maximize its shelf life. You can also water-bath can the tamarind, like you would with jam, to make it shelf-stable, though I have not personally done this (Chongchitnant, 2024). You can also freeze tamarind paste. Many of my patreon members report freezing tamarind paste into ice cubes which make it easy to use. It'll also help for you to know the volume of the ice cube so you can take out the appropriate amount the recipe calls for (Chongchitnant, 2024). Understanding Thai ingredients is

incredibly important in helping you cook Thai food successfully (Chongchitnant, 2024). Now that you've got delicious homemade tamarind paste, try using it in these recipes! (Chongchitnant, 2024).

You may not be familiar with this tropical fruit, but tamarind has become increasingly available in many grocery stores and online in the United States. Considering its popularity in numerous regions across the world, you may want to give it a try (Welch and Kayli Anderson, 2024). Here's what to know about this versatile, antioxidant-rich staple of many international cuisines (Welch and Kayli Anderson, 2024). Tamarind is a type of tropical fruit that grows on an evergreen tree by the same name. It's native to Africa, but is also widely cultivated in other tropical and subtropical regions of the world, which include countries such as India, Bangladesh, Thailand, Mexico, and Costa Rica (Welch and Kayli Anderson, 2024). Tamarind fruit is brown in color and encased in irregularly shaped pods that are about 3 to 8 inches long. When the fruit first begins to grow, its pulp is juicy and acidic, but as it matures, the pulp turns brown and dehydrates to a sticky paste, according to the Culinary Institute of America. Once fully ripe, the pod shells can easily be broken, allowing easy access to the fruit inside, which contain seeds that are also edible (Welch and Kayli Anderson, 2024). Depending on how ripe tamarind is, it may taste sour or sweet. Unripe tamarind has a taste that's tart, acidic, and sour. You can eat tamarind at any ripeness, but most people prefer to wait until it has matured and becomes sweet and less acidic (Welch and Kayli Anderson, 2024). While tamarind can be eaten raw, the fruit is commonly used to make sauces, chutneys, and even beverages. It's available in a number of forms, including paste, powder, dried block, liquid concentrate, and fresh pods (Welch and Kayli Anderson, 2024). Various cultures use tamarind in different ways. In Mexico and Latin America, for example, it's typically mixed with sugar and water to produce a cooling drink, as well as sweet and sour candies. In Southeast Asia, it's commonly used in sauces, soups, and noodle dishes. Throughout the world, tamarind pulp is also used in desserts, to flavor preserves and chutney, and even to pickle fish. In the U.S., it's one of the main ingredients in Worcestershire sauce (Welch and Kayli Anderson, 2024). Tamarind is packed with nutrients, and research indicates that it may provide a number of health benefits. It's also been used in traditional medicine for centuries to treat a wide array of conditions from constipation to diabetes (Welch and Kayli Anderson, 2024). Tamarind is high in fiber and is a good source of magnesium, potassium, and iron. It's also rich in antioxidants (Welch and Kayli Anderson, 2024). The use of tamarind to aid in weight loss is currently being studied. While tamarind appears to have some anti-obesity effects in animal studies, it's yet to be proven in humans. In fact, a randomized clinical control trial of 40 overweight or obese adults determined that eating 20 grams of tamarind daily had no significant effect on weight (Welch and Kayli Anderson, 2024). Still, experts say tamarind has the potential to indirectly help with weight loss as part of a healthy diet (Welch and Kayli Anderson, 2024). "Tamarind is an excellent source of fiber providing 6 grams per cup, which is 21 percent of the daily value," says Melanie Marcus, a registered dietitian and chef based in Concord, North Carolina. "Consuming adequate fiber during meals and snacks is important for overall health, including weight loss because it keeps us feeling fuller for longer." (Welch and Kayli Anderson, 2024). Before heading to your local grocery store or going online to shop for tamarind, there are a few things to keep in mind in terms of selection and storage (Welch and Kayli Anderson, 2024). When purchasing fresh tamarind, you'll want to consider the fruit's ripeness, which impacts taste. The riper the fruit is, the sweeter it will be (Welch and Kayli Anderson, 2024). "As tamarind pods age, the skin turns brown and brittle, while its pulp turns reddish-brown and sticky," Marcus says. "If you see whole tamarind pods in the store, you'll know they are fully ripe when the shells will look brittle, even broken. This is normal and should be expected." (Welch and Kayli Anderson, 2024). When buying products made from tamarind, check the nutrition label and be mindful of the amount of sugars added. "Use caution when eating tamarind in candy or soda form because its health benefits will be outweighed by the added sugar in these foods (Welch and Kayli Anderson, 2024). Fresh tamarind can be stored in the fridge, says registered dietitian nutritionist Roxana Ehsani, who is based in Miami (Welch and Kayli Anderson, 2024). The paste form of tamarind can be stored in a cool, dry place. "When stored properly in airtight containers, processed forms of tamarind are thought to last indefinitely (Welch and Kayli Anderson, 2024). You can enjoy tamarind in a variety of forms. "You can eat the fruit raw, straight from the pods, which is probably the most nutritious way to enjoy it." Using tamarind as a rub for fish or meat before cooking. "In Indian cuisine, tamarind is used similarly to how we use lemon or lime in the United States." "Adding it to meals can provide a much needed pop of acid to curry, marinades, and pickles." (Welch and Kayli Anderson, 2024). When using tamarind this way, you'll likely opt for the block or paste. "Block tamarind is used by soaking a small piece equivalent to 1 tablespoon in hot water for 10 minutes to loosen the pulp." "Then squeeze, and drain the liquid to remove any seeds before using." (Welch and Kayli Anderson, 2024). Tamarind pairs well with lentils, chili, coriander, garlic, and ginger as well as proteins such as chicken, lamb, and fish (Welch and Kayli Anderson, 2024).

Tamarind is one of the ingredients that are being used in Indian curries, Chuthneys, Sauces and soups for sweet and sour taste (Krishihelpline, 2025). Tamarind is sweetish and its pulp has laxative properties (Krishihelpline, 2025). Tender leaves, flowers and seeds are used as vegetables in India; tamarind kernel powder is also used in sizing material in leather and textile industry (Krishihelpline, 2025). Tamarind seeds yield fatty oil which is being used in paints and varnishes (Krishihelpline, 2025). Tamarind wood also used for multi-purpose like in tool handles, agricultural tools (Krishihelpline, 2025). In India, Tamarind is grown is most of the states, but highly producing states are Bihar, Odhisa, Maharashtra, Tamil Nadu and Andhra Pradesh (Krishihelpline, 2025). The Tamarind (*Tamarindus indica*) (hindi = Indian date) is in the family Fabaceae. The genus *Tamarindus* is monotypic (having only a single species). It is a tropical tree, native to tropical Africa, including Sudan and parts of the Madagascar dry deciduous forests (Wikidoc, 2025). It was introduced into India so long ago that it has often been reported as indigenous there, and it was apparently from India that it reached the Persians and the Arabs who called it "tamar hindi" (Indian date, from the date-like appearance of the dried pulp), giving rise to both its common and generic names (Wikidoc, 2025). Unfortunately, the specific name, "indica", also perpetuates the illusion of Indian origin. The fruit was well known to the ancient Egyptians and to the Greeks in the 4th Century B.C. (Wikidoc, 2025). The tree has long been naturalized in the East Indies and the islands of the Pacific. One of the first tamarind trees in Hawaii was planted in 1797. The tamarind was certainly introduced into tropical America, Bermuda, the Bahamas, and the West Indies much earlier (Wikidoc, 2025). In all tropical and near-tropical areas, including South Florida, it is grown as a shade and fruit tree, along roadsides and in dooryards and parks. There are commercial plantings in Mexico, Belize

and other Central American countries and in northern Brazil (Wikidoc, 2025). In India there are extensive tamarind orchards producing 275,500 tons (250,000 MT) annually. The pulp is marketed in northern Malaya and to some extent wherever the tree is found even if there are no plantations (Wikidoc, 2025). The tree can grow up to 20 m in height, and stays evergreen in regions without a dry season. Tamarind timber consists of hard, dark red heartwood and softer, yellowish sapwood. The leaves consist of 10–40 leaflets. The flowers are produced in racemes. The fruit is a brown pod-like legume, which contains a soft acidic pulp and many hard-coated seeds. The seeds can be scarified to enhance germination (Wikidoc, 2025). Alternative names include Indian date, translation of *tamr hindī*. In Malaysia it is called *asam* in Malay and *swee boey* in Hokkien (Min Nan). In Indonesia it is called *asem* (or *asam*) *Jawa* (means *Javanese asam*) in Indonesian. In the Philippines it is called *sampaloc* in Tagalog and *sambag* in Cebuano. In Oriya it is called *tentuli*. In Hindi it is called *imli*. In Marathi it is called *chinch*. In Bangla, the term is *tẽtul*. In Sinhala the name is *siyambala*, in Telugu it is called chintachettu (tree) and chintapandu (fruit extract) and in Tamil and Malayalam it is *puli.* In Kannada it is called *hunase*. In Malagasy it is called *voamadilo*. The Vietnamese term is *me*. In Puerto Rico it is called "tamarindo". The tamarind is the provincial tree of the Phetchabun province of Thailand (in Thailand it is called *ma-kham*). In Taiwan it is called *loan-tz* (Wikidoc, 2025). Tamarind (*Tamarindus indica*) is a leguminous tree bearing edible fruit that is indigenous to tropical Africa and naturalized in Asia. The genus *Tamarindus* is monotypic, meaning that it contains only this species. It belongs to the family Fabaceae (Wikiwand, 2025). The tamarind tree produces brown, pod-like fruits that contain a sweet, tangy pulp, which is used in cuisines around the world (Wikiwand, 2025). The pulp is also used in traditional medicine and as a metal polish (Wikiwand, 2025). The tree's wood can be used for woodworking and tamarind seed oil can be extracted from the seeds (Wikiwand, 2025). Tamarind's tender young leaves are used in Indian and Filipino cuisine (Wikiwand, 2025). Because tamarind has multiple uses, it is cultivated around the world in tropical and subtropical zones (Wikiwand, 2025).

Tamarind, scientifically known as *Tamarindus indica*, is a tropical fruit celebrated for its unique sweet and tangy flavour (Soni, 2025). Encased in a brown, pod-like shell, tamarind pulp is a versatile ingredient extensively used in culinary traditions across the globe (Soni, 2025). Beyond its delightful taste, tamarind offers numerous health benefits and is rich in essential nutrients, making it a valuable addition to diets worldwide (Soni, 2025). Its sweet, pungent flavor enhances everything from chutney, rice, and marinades to baked goods and candy (Gollin, 2025). Tamarind is a beguiling tropical fruit shaped like a winged bean pod, which makes perfect sense when you consider that it's also a legume (Gollin, 2025). Its unique taste veers from sweet to sour, and also defies easy categorization (Gollin, 2025). Native to tropical Africa, and cultivated in India, Pakistan, Thailand, Africa, the Caribbean, and other tropical and subtropical areas, tamarind is the edible plant of a hardwood tree (*Tamarindus indica*). It's sometimes referred to as the "date of India," and, in fact, tamarind pods are filled with sticky, fibrous, seed-stippled pulp with a date-like consistency (Gollin, 2025). Like peanuts and soybeans, tamarind straddles the fruit-legume divide. Since the pod grows from the flower of a plant and has seeds, it's a fruit. The tamarind tree, however, is part of the legume family (*Fabaceae*), which makes it a kind of legume, or seed-bearing fruit (Gollin, 2025). The pods transform from green to brown with maturity, and look similar to lima beans or green beans, notes Arvinder Vilkhu, president and co-executive chef of Saffron, an upscale Indian restaurant in New Orleans (Gollin, 2025). Even if you consider yourself a tamarind rookie, newsflash: if you've tasted packaged Worcestershire sauce, you've experienced the sweet, sour, and savory wonders of tamarind, a key ingredient in this cooking staple (Gollin, 2025). As to the raw pulp, the taste and texture ricochet, depending on the variety and its maturation stage (Gollin, 2025). Underripe: "The flavor profile varies as per ripeness," points out Rutul Joshi, director of produce merchandising for FreshDirect, an online grocer. "When underripe, it tastes sour, like sour cherries." The flesh is green and hard (Gollin, 2025). Fully ripe: "When it's ripe, its taste is mildly acidic, combined with caramel or dates with lemon," Joshi notes. With time, the pulp becomes reddish-brown, juicy, and paste-like. "It's sweet and tangy, with a chocolatey texture," adds Vilkhu (Gollin, 2025). Tamarind, scientifically known as *Tamarindus indica*, is a fruit-bearing tree native to tropical Africa but widely cultivated across the world including India (Greenverz, 2025). It is a leguminous tree that is well-known for its tangy, sour, and slightly sweet pulp used in various culinary preparations (Greenverz, 2025). The tamarind tree is not just known for its edible fruit but also has a host of medicinal and ecological benefits (Greenverz, 2025). The tamarind tree can grow up to a height of 30-40 meters with a wide and shady canopy. It has a relatively short, crooked trunk with rough, dark gray bark. The leaves are compound, pinnate, and feathery with about 10-12 pairs of leaflets. The tree produces clusters of small yellowish flowers that are followed by brown, pod-like fruits that are about 10-15cm long and contain hard, brownish-black seeds (Greenverz, 2025). The tamarind tree is an important component of the tropical ecosystem as it provides shade, helps prevent soil erosion, and improves soil fertility by fixing atmospheric nitrogen. The tree also serves as a host for various species of birds, insects, and animals (Greenverz, 2025). The tamarind tree is an important source of food for various species of birds, including parrots and pigeons, as well as small animals like squirrels and monkeys. The flowers of the tamarind tree attract various pollinators like bees and butterflies (Greenverz, 2025). The tamarind tree can grow in a wide range of soils but prefers well-drained sandy or loamy soils with a pH range of 5.5-7.5 (Greenverz, 2025). The tamarind tree is well adapted to tropical and subtropical climates and can withstand temperatures ranging from 5°C to 45°C. It requires a warm and humid climate with an annual rainfall of 800-2500 mm (Greenverz, 2025). Tamarind is found naturally in various states of India, including Andhra Pradesh, Telangana, Tamil Nadu, Karnataka, Kerala, Maharashtra, Gujarat, and Rajasthan (Greenverz, 2025). Tamarind is propagated by seeds or vegetative means like grafting or budding. The tree is commonly grown in home gardens, orchards, and as an agroforestry crop. The fruit is harvested manually, and the pulp is extracted and processed for various culinary and medicinal uses (Greenverz, 2025). The tamarind tree takes about 5-7 years to bear fruit, and the yield increases with the age of the tree. The tree can continue to produce fruit for up to 50 years, and the fruiting season typically starts from November and continues till February (Greenverz, 2025). Tamarind is an important agroforestry crop that can provide a regular source of income to farmers. The tree can be intercropped with various crops like vegetables, cereals, and pulses, and can help in soil conservation, nutrient cycling, and microclimate regulation. The fruits of the tamarind tree are in high demand in the market and can fetch a good price (Greenverz, 2025). The fruit is harvested manually by plucking the pods from the tree. The pods are then sun-dried, and the pulp is extracted by breaking the

shell. The pulp is then processed into various products like tamarind paste, tamarind concentrate, and tamarind powder (Greenverz, 2025).

Tamarind (*Tamarindus indica*) is a tree found in tropical Africa and southern Asia. The fruit pulp is widely used in Asian culture (Webmd, 2025). Tamarind contains ingredients that might have laxative effects and fight against certain fungi and bacteria. It also contains a chemical that is similar to mucin found in the eye. Mucin helps protect and wet the surface of the cornea (Webmd, 2025). People use tamarind for dry eye, constipation, parasite infections, early orgasm (premature ejaculation), and many other conditions, but there is no good scientific evidence to support most of these uses (Webmd, 2025). Tamarind is a seed pod with a unique sweet and sour flavour. Find out how to prepare tamarind blocks, slices or concentrate and which dishes it can be used in (BBC, 2025). A seed pod from the tamarind tree that is used extensively in South-East Asian and Indian cooking to flavour curries, chutneys and bean dishes. Tamarind has a unique sweet and sour flavour and comes in seeded and paste form and most commonly in a block form (BBC, 2025). To prepare compresses block tamarind, tear off the equivalent of 15ml and soak it in 150ml warm water for 10 mins. Mix it together and strain through a fine sieve. Throw away the pulp and use the liquid (BBC, 2025). To use tamarind slices, soak them in 150ml warm water for about 30 mins. Squeeze and strain the juice (BBC, 2025). To use tamarind concentrate, mix 15ml of tamarind with 4-6 tbsp warm water (BBC, 2025). Tamarind tree (Tamarindus indica) is a tropical tree that is native to Africa but is widely cultivated throughout the world in tropical regions (Greenverz, 2025). It is a large, slow-growing tree that can grow up to 20-30 meters tall (Greenverz, 2025). The tree is well-known for its edible fruit, which is used in a variety of culinary dishes, especially in Indian cuisine (Greenverz, 2025). The tamarind fruit is sour and tangy in taste and is commonly used in chutneys, sauces, and curries (Greenverz, 2025). The tree also has medicinal properties and is used in traditional medicine to treat various ailments (Greenverz, 2025). An African evergreen tree (*Tamarindus indica*) of the legume family that is widely grown in tropical regions and has hard yellowish wood, pinnate leaves, red-striped yellow flowers, and an edible fruit (Merriam, 2025). The fruit of the tamarind tree consisting of an oblong brown pod containing 1 to 12 flat seeds embedded in a brownish, sticky, acidic pulp which is used especially in preserves and pastes and to flavor foods and beverages (Merriam, 2025). Tamarind scientifically known as Tamarindus indica derives from the Persian word Tamar e hind means 'Indian date' is a tree in the Fabaceae family. The genus *Tamarindus* is having an single species only. Tamarind tree is a very popular Indian tree & a very charming tree (Aarevah, 2025). It is a member of the leguminosae family and Caesalpinieae sub family. There are different names to Tamarind called in different regional languages for instance imli in Hindi, Puli in both Tamil and Malayalam, Chintapandu in Telugu and nuli or tinti in Bengali (Aarevah, 2025). Native to tropical Africa the tamarind grows wild throughout the Sudan. Very long ago it was introduced into India and has often been reported as indigenous there also. It is extensively cultivated in tropical areas of the world. During the 16th century it was introduced to America and today is widely grown in Mexico. In 1797 one of the first tamarind trees was planted in Hawaii. Normally the size of the tamarind tree is very large and it can reach a great age of around 200 years (Aarevah, 2025). The flowers of the tamarind tree are very ordinary with nice spreading branches and a canopy of bulging flora. The tree is much admired as an avenue, park or garden tree as it has very useful fruits and the timber of this tree is highly prized. It has a short but strong trunk to bear the weight of its wide and extensive top (Aarevah, 2025). The almost black bark is thick and some longitudinal and horizontal cracks cover it well. The tree can achieve the height of 27 metres. In the months of May and June, there appear some tiny, scented flowers in the tree in loose, lethal and sidewise sprays. They remain almost unremarkable amongst the mass of the plants (Aarevah, 2025). The pods are quite numerous. They significantly vary in size and shape on the same tree. Their appearance is of brown colour. At this stage they are called as Chintakaaya in Telugu. Chintakaaya pachadi is a very popular from the Andhra cuisine. After their maturity they turn off-white and brittle. A stringy pulp contains the seeds from one to ten and the pod is more or less slimmed between these seeds. The pulp is brown and acidic in some of the varieties of Tamarind and in others it is sweet but the one with reddish pulp is considered to be the best (Aarevah, 2025). The new and fresh leaves appear in the first months of the year and they appear even in September in some special occasions. The conversion of the tree is strange. The leaves of the tamarind tree are compound in its formation and usually divided into 10 to 12 pairs of leaflets. They are quite small and become even smaller at the end of the year. They are square, smooth and they grow diagonally. The fruit also called as the pod is about 12 to 15 cm in length with a hard brown shell. The fruit has fleshy, juicy and acidulous pulp (Aarevah, 2025). When matured it is colored brown or reddish brown. The tamarinds grown in Asia have longer pods containing about 6 to 12 seeds whereas in Africa and West Indies the varieties are short pods containing only about 1 to 6 seeds. The seeds too are somewhat flattened and glossy brown (Aarevah, 2025). A tamarind is excellent when it is sweet and sour in taste and high in acid, sugar, vitamin B and interestingly for a fruit, calcium. The fruit of tamarind tree has numerous usages. The pulp is used as an important ingredient in the curries. There are some commercial uses too. It is preserved and also sold in the markets. It is also used as a laxative in medicine. People make powder from grinding the seeds and boil it to paste with gum and make strong cement. A substitute for wheat or other flour can also be obtained from them that are used by the people. The stalks of the seeds have been employed for road surfacing as well (Aarevah, 2025). The scientists also discovered that the seeds could make a cheap but efficient substitute for cereal starch that is used for making the cotton yarn in proper size, for jute fabrics and for woolens. Further, the leaves and flowers of the tree are also quite useful. An infusion from the leaves can make a fine yellow dye that is used to give a green colour to silks. Though hard and very difficult to work on, the timber of the tree is of high value. People widely use this wood for making wheels, mallets, furniture, oil and sugar mills (Aarevah, 2025). Tamarind is harvested by pulling the pod from its stalk. A mature tree may be capable of producing up to 175 kg (350 lb) of fruit per year. Globally, it is most abundant in South Asia, where it is widely distributed and has a long history of human cultivation (Aarevah, 2025). Many South Asian regional languages have their own unique name for the tamarind fruit. It is called the tetul in Bangla; tintidi in Sanskrit, tentuli in Oriya, Imli in Hindi, amli in Gujarati, chinch in Marathi and Konkani, hunase in Kannada, chintachettu (tamaraind tree) and chintapandu (tamarind fruit) in Telugu and vaalanpuli in Malayalam. It is known as siyambala in Sinhala language in Sri Lanka. There are tamarind that taste sweet and sour but normally the taste of tamarind is very sour especially its pulp (Aarevah, 2025). The ripe fruit is a little less bitter, thus when sweetened can be used in a very well known sweet drink, drank by the Egyptians from a long time ago. Asians use the pulp of the fruit as a spice in many of

their dishes. Tamarind is an important ingredient in Worcestershire sauce and HP sauce (Aarevah, 2025). The Tamarind pulp concentrate is popular as a flavoring in East Indian and Middle Eastern cuisine. Tamarind is extensively used in Indian cookery and is an important ingredient in curries and chutneys, and makes delicious sauce for fish, meat products and water fowl, and in Western India is used for pickling fish. In Andhra tamarind is widely used in making the very popular dish called the Chapala pulusu (fish cooked in tamarind sauce) and pappu charu (lentil stew) being considered a great delicacy (Aarevah, 2025). Tamarind pulp adds a distinct sour taste to the hot and spicy preparations and is normally used as the substitute of tomatoes. Before using in cooking, the dry tamarind pulp is soaked in water and the juice is then added to the preparation. The South Indian delicacies that use tamarind are Pulihora rice, Sambhar (spicy lentil soup with plenty of vegetables), Rasam and various kinds of pickles and chutneys. Tamarind is also used as a marinade and a natural preservative (Aarevah, 2025). Tamarind is available in a pulp form and is used in preparing refreshments and cool drinks. The ripe tamarind is used in desserts, sweet sauces and other sweet dishes. Some people also consume the ripened tamarind pulp directly for its laxative properties. In north India, this forms an important element of the 'imli chutney - a spicy ketchup. Even the young and unripe tamarind pods and the flowers of the tree are used in preparing pickles and used as a side dish in south India (Aarevah, 2025). In southern parts of Kerala, mostly along the coastal belt, it is added to fish curry, masalas and ground coconut for flavoring. People in Thailand, prepare a delicious dish called 'Pad Thai' with tamarind and this is generally well accepted even by the Americans and Europeans. They add tamarind to this cuisine for the fruit's bitter-sweet flavor. In addition, they add lime juice to the dish to add some sourness and a fish sauce to impart saltiness to 'Pad Thai' (Aarevah, 2025). In Central Thailand, people prepare a sweet-and-sour sauce with tamarind and use it with deep-fried fish for extra zing. This is a very common and popular preparation in this part of the world. People in Malaysia and Singapore use tamarind to add a sweet-and-sour flavor to the gravy of a fish preparation known as 'asam fish' (Aarevah, 2025). The tamarind tree is considered to be a traditional food plant in the African continent.

For the Africans, this tree has a variety of uses - a food that has the potential to augment nutrition, enhance food security, promote rural development and also endorse sustainable land care (Aarevah, 2025). Tamarind is used as in Indian Ayurvedic Medicine for gastric and/or digestion problems, and in cardioprotective activity. Based on human study, tamarind intake may delay the progression of fluorosis by enhancing excretion of fluoride. However, additional research is needed to confirm these results (Aarevah, 2025). Excess consumption has been noted as a traditional laxative. Other medicinal uses include: Anthelminthic (expels worms), antimicrobial, antiseptic, antiviral, asthma, astringent, bacterial skin infections (erysipelas), boils, chest pain, cholesterol metabolism disorders, colds, colic, conjunctivitis (pink eye), constipation (chronic or acute), diabetes, diarrhea (chronic), dry eyes, dysentery (severe diarrhea), eye inflammation, fever, food preservative, food uses (coloring), gallbladder disorders, gastrointestinal disorders, gingivitis, hemorrhoids, indigestion, insecticide, jaundice, keratitis (inflammation of the cornea), leprosy, liver disorders, nausea and vomiting (pregnancy-related), paralysis, poisoning (Datura plant), rash, rheumatism, saliva production, skin disinfectant/sterilization, sore throat, sores, sprains, sunscreen, sunstroke, swelling (joints), urinary stones, wound healing (corneal epithelium) (Aarevah, 2025). In temples, especially in Buddhist Asian countries and many households in India, the fruit pulp is used to polish brass shrine furniture, brass lamps, removing dulling and the greenish patina that forms.

The wood is a bold red color. Due to its density and durability, tamarind heartwood can be used in making furniture and wood flooring. Tamarind trees are very common throughout Asia and the tropical world as both an ornamental, garden and cash crop (Aarevah, 2025). The tamarind has recently become popular in bonsai culture, frequently used in Asian countries such as Indonesia, Taiwan and the Philippines. The seeds are sometimes used by children in traditional board games such as Chinese checkers (China), Dhakon (Java), and others (Aarevah, 2025). Tamarind juice is a mild laxative, is used to treat bile disorders, lowers cholesterol, and promotes a healthy heart. Tamarind is use as a gargle for sore throats, and as a drink to bring relief from sunstroke. It is used as a diuretic remedy for bilious disorders, jaundice and catarrh. It is a good source of antioxidants that fight against cancer. Tamarind helps the body digest food. Tamarind has a variety of uses. The unripe fruit is acid in taste, whereas the pulp of the ripe fruit is both sweet and acid and is cooling, carminative, digestive and laxative (Aarevah, 2025). It is anti-bilious and anti-scorbutic. In summer elixir type syrup is prepared from it, which is very cooling and anti-bilious. Sometimes it is given to patients suffering from fever, sunstroke and inflammatory conditions. Tamarind is efficacious in preventing or curing scurvy. In short, tamarind which is widely used in cooking has numerous other and medicinal applications (Aarevah, 2025).

Tamarind, evergreen tree of the pea family (Fabaceae), native to tropical Africa (Petruzzello, 2025). It is widely cultivated in tropical and subtropical regions for its edible fruit, the sweet and sour pulp of which is extensively used in foods, beverages, and traditional medicines (Petruzzello, 2025). The plant is especially popular in the Indian subcontinent and in Central America and Mexico and is a common ingredient in the cuisine of those regions (Petruzzello, 2025). The tree is also grown as an ornamental, and the wood is used in carpentry (Petruzzello, 2025). The tree grows to about 24 metres tall and bears alternate, pinnately compound (feather-formed) leaves with leaflets that are about 2 cm long (Petruzzello, 2025). The yellow flowers are borne in small clusters. The fruit is a plump legume 7.5–24 cm long that does not split open; it contains 1 to 12 large, flat seeds embedded in a soft, brownish pulp (Petruzzello, 2025). Tamarind (*Tamarindus indica*) is a leguminous tree bearing edible fruit that is indigenous to tropical Africa and naturalized in Asia. The genus *Tamarindus* is monotypic, meaning that it contains only this species. It belongs to the family Fabaceae (Wikipedia, 2025). The tamarind tree produces brown, pod-like fruits that contain a sweet, tangy pulp, which is used in cuisines around the world. The pulp is also used in traditional medicine and as a metal polish (Wikipedia, 2025). The tree's wood can be used for woodworking and tamarind seed oil can be extracted from the seeds (Wikipedia, 2025). Tamarind's tender young leaves are used in Indian and Filipino cuisine. Because tamarind has multiple uses, it is cultivated around the world in tropical and subtropical zones (Wikipedia, 2025).

ORIGIN AND DITRIBUTION

Tamarind is native to Eastern Africa. In India, tamarind tree is grown in Madhya Pradesh (central part), Andhra Pradesh, Tamil Nadu and Karnataka (southern parts) (Muraga Raja., *et al*., 2022).

TAXONOMY

Family Fabaceae, Subfamily Faboideae, Genus Tamarindus, Species Tamarindus indica (Rojas-Sandoval, 2018). *Tamarindus* is a monospecific genus in the family Fabaceae, subfamily Caesalpinioideae. Fabaceae is one of the largest families of flowering plants. This family includes about 766 genera and 19,580 species growing in a great variety of climates and habitats. The genus *Tamarindus* is a monotypic taxon, having only a single species. *T. indica* is a tree native to tropical Africa and Madagascar but was introduced into India so long ago and it was apparently from India that it reached the Arabs and Persians who called it 'tamar hindi' or Indian date (from the date-like appearance of the dried pulp), giving rise to both its common and generic names. The specific name, 'indica', also perpetuates the illusion of Indian origin (Rojas-Sandoval, 2018). A taxonomic distinction was formerly made between tamarinds from the West Indies and those from the East Indies, trees in the West Indies producing pods three times longer than wide, containing 1-4 seeds, with those from the East Indies having a pod six times longer than wide, with 6-12 seeds (Verheij and Coronel, 1991). There are various tamarind cultivars, varying in colour and sweetness of the fruit pulp (Rojas-Sandoval, 2018). *Tamarindus indica* is probably indigenous to tropical Africa, but has been cultivated for so long on the Indian subcontinent that it is sometimes reported to be indigenous there. It grows wild in Africa. In Arabia, it is found growing wild in Oman, especially Dhofar, where it grows on the sea-facing slopes of mountains. It reached South Asia likely through human transportation and cultivation several thousand years ago. It is widely distributed throughout the tropics, from Africa to South Asia. In the 16th century, it was introduced to Mexico and Central America, and to a lesser degree to South America, by Spanish and Portuguese colonists, to the degree that it became a staple ingredient in the region's cuisine. As of 2006 India is the largest producer of tamarind. The consumption of tamarind is widespread due to its central role in the cuisines of the Indian subcontinent, Southeast Asia, and the Americas, especially Mexico (Wikiwand, 2025).

Synonyms

Tamarindus umbrosa Salisb., *Tamarindus officinalis* Hook, *Tamarindus occidentalis* Gaertn (Heuzé and Tran, 2015).
Tamarindus occidentalis Gaertn, *Tamarindus officinalis* Hook.*Tamarindus umbrosa* Salisb. (Rojas-Sandoval, 2018).
Cavaraea elegans Speg., *Tamarindus erythraeus* Mattei, *Tamarindus occidentalis* Gaertn., *Tamarindus officinalis* Hook., *Tamarindus somalensis* Matteqi, *Tamarindus umbrosa* Salisb. (Muraga Raja *et al.,* 2022).

BOTANICAL DESCRIPTION

Tamarind is a large, evergreen tree, up to 24 m in height and 7 m in girth. The morphology of the tree in detail has been described by several authors. The most useful part is the pod (also called the fruit). Pods are 7.5–20 cm long, 2.5 cm broad and 1 cm thick, more or less constricted between the seeds, slightly curved, brownish-ash coloured, scurfy. The outermost covering of the pod is fragile and easily separable (Saideswara Rao and Mary Mathew, 2012). The tamarind (*Tamarindus indica* L.) is a usually evergreen legume tree. It grows slowly, up to 25-30 m high, and can live as long as 200 years. Leaves are compound, divided in 10-18 opposite and oblong leaflets. Orange-yellow or pinkish flowers are grouped in racemes. Fruits occur 7-12 years after sowing. They are rusty-coloured pods, 10-18 cm long x 2 cm broad. The pods contain a sour pulp surrounding the seeds. They are edible and used in many culinary recipes around the world (Heuzé and Tran, 2015).

T. indica, a large evergreen tree, is widely distributed in Asia, Africa and the Neotropics. It is a valuable timber species used for making furniture, tool handles, walking sticks, oil mills and rice pounders, and for fuelwood and charcoal manufacture. The leaves are an important source of herbal medicine and the edible pulp of the fruit is used as a flavouring agent in cooking, for soups, jams. *T. indica* is ideally suited for planting as an avenue or roadside tree, particularly in dry regions. Tamarind, *Tamarindus indica*, is a subtropical, multipurpose, fruit tree, distributed throughout the tropics and warm subtropics. The tree is widely adaptable, easily managed and produces fruit (few commercial orchards exist), many valued medicines, wood and industrial products. It is also used as a shade tree in many city streets and parks. It is drought resistant and strong and performs well as a windbreak, preventing soil erosion and protecting people, crops and animals in harsh environments. Tamarind is also found in thousands of park, garden and roadside landscapes. Tamarind has many common names among which are tamarindo (Spanish), tamarindier (French), Indian date and Madeira mahogany (English), makham (Thai), imli (Hindi), mkwaju (Swahili) and wolof (Dakah) (Rojas-Sandoval, 2018). Tamarind is a long-lived, slow-growing and highly wind-resistant deciduous tree that can reach 20-30 m height with a canopy spread of 8-14 m in diameter. The tree is normally multi-stemmed, which sometimes results in a poor tree form. The bark is scaly, dark grey to brown, strongly fissured, rough and scaly. Blood-red gum exudes from the bole and branches when damaged. The tree can produce fruit for more than 50 years and live for 80-100 years. The leaves are alternate, even and pari-pinnately compound. The rachis is 7–15 cm long with six to 20 pairs of opposite leaflets. The leaves are pinnate and 8-15 cm long, with 10-20 pairs of 1.25-2.5 cm long and 5-6 mm wide, narrowly oblong, unequal and entire, rounded to almost square and slightly notched at the apex with a tuft of yellow hairs and rounded at the base, that close at night. The leaves may abscise during long dry periods. The foliage is bright green and has a feathery appearance, which in combination with the open branch structure makes this a very good shade tree (Rojas-Sandoval, 2018). Flowers occur on small drooping racemes (5-13 cm in length) that appear normally along new branches. The flowers are inconspicuous at just 2-2.5 cm in diameter. The flower buds are often pink because of the outer colour of the four sepals that are shed as the flower opens. The four sepals, up to 1.5 cm long, are unequal, ovate and pink, cream or pale yellow. Of the five petals, the posterior and lateral petals are large and showy and slightly exceed the calyx, oblong in shape. The anterior petals are reduced to bristles. The individual petals are oblong in shape and white,

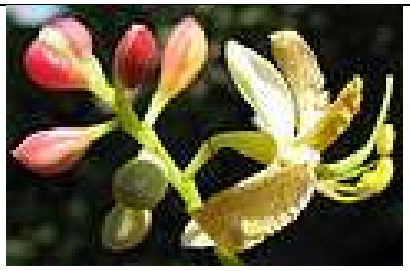
cream, pale yellow or pinkish in colour, streaked with red or orange. The flowers can be bisexual, as well as dichogamous and protogynous. Flower-bud development takes about 20 days from the first visible initiation (Rojas-Sandoval, 2018). Stigma receptivity is at its maximum on the day of flower opening. The peak of anthesis takes place at 06:00 h the next day, with peak anther dehiscence at 10:30 h. Flowers usually develop in the spring or summer, with synchronous leaf growth. In some countries, such as Sri Lanka and India, two flowering periods have been reported. As with other legume trees, bees seem to the main pollinating agents. Honeybees are frequent visitors, attracted to collect nectar and pollen. The tamarind appears to be preferentially cross-pollinated. Flowers are hermaphroditic, but the stamens are shorter than the style and the stigma is receptive 1 day before anthesis. The flowers produce nectar and are probably pollinated by insects; self-pollination results in seeded pods and poor fruit set (1% to 15%). Approximately 75% fruit set can be obtained in controlled cross-pollination studies (Rojas-Sandoval, 2018). The fruit is a pendulous indehiscent pod that can be 7-20 cm long and 1.5-3.0 cm wide. It can be straight, irregularly curved or sometimes curved in a horseshoe shape. The skin is cinnamon to greyish-brown and scaly, and normally has constrictions between the seeds. As the pod ripens it becomes brittle and can be easily broken. The pod thickens as it matures and the green pulp surrounding the seeds turns reddish-brown or brown. This pulp dehydrates to a sticky paste with a few coarse stands of the vascular fibre and separates from the brittle pod wall. The pods may contain one to 12 large reddish-brown or brown flat seeds, with an irregular obovate or rhomboid shape, that are embedded in the brown edible pulp. Indian types often have longer pods with six to 12 seeds, while shorter west Indian types contain only three to six seeds. The pods reach maturity about 7 months after fruit set, and are fully ripe and dry around 1 month later. The pod loses half of its water content during drying. In Thailand the fruiting season is December to February, in the Philippines from May to December with a peak between August and October, and in Sri Lanka from January to February (Rojas-Sandoval, 2018).

The genus *Tamarindus* is a monotypic genus containing the sole species *T. indicus* and belongs to the sub-family Caesalpinioideae of the family Fabaceae (Leguminosae). Tamarind is a large, evergreen tree, up to 24 m in height and 7 m in girth. The morphology of the tree in detail has been described by several authors. The most useful part is the pod (also called the fruit). Pods are 7.5–20 cm long, 2.5 cm broad and 1 cm thick, more or less constricted between the seeds, slightly curved, brownish-ash coloured, scurfy. The outermost covering of the pod is fragile and easily separable (Azad, 2018). *Tamarindus indica* Linn. (2n=24) of the family Caesalpinaceae is a semi evergreen tree, which grows, to a height of 24 m with a compact runded crown with drooping branches which reach to within a few feet of ground. Trunk 7 m in girth is stout, often becoming twisted with grey scaly bark. Leaves, alternate, paripinnate, 7-15 cm long with pulvinous at base of petiole; leaflets 10-20 pairs, opposite, entire, almost sessile, oblong, 1-2.5 x 0.5-1 cm, pale green beneath, with unequal rounded base and runded or emarginated apex. Tamarind is probably entomophilous (Admin, 2021).

It grows up to a height of 25–30 meters. Tamarind tree is evergreen, dome-shaped, much branched and it looks similar to an *Amla* tree (Indian gooseberry) with respect to leaves, like small pinnate compound leaves. In tamarind, leaves are smaller leaflets, broader and dark green in color. Flowers are small, 3 cm in length, aromatic, and yellow in color. Fruits are sub-cylindrical, straight or slightly curved. Pods are swollen, with rounded ends and are brown or greyish-brown in color. The sapwood of the tamarind tree is pale yellow in color and the heartwood is very hard, dark purplish-brown color, heavy, strong, durable and resistant to bugs and insects (Muraga Raja., *et al*., 2022).

The tamarind is a long-living, medium-growth tree, which attains a maximum crown height of 25 metres. The crown has an irregular, vase-shaped outline of dense foliage. The tree grows well in full sun. It prefers clay, loam, sandy, and acidic soil types, with a high resistance to drought and aerosol salt (wind-borne salt as found in coastal areas). The evergreen leaves are alternately arranged and paripinnately compound. The leaflets are bright green, elliptic-ovular, pinnately veined, and less than 5 centimetres in length. The branches droop from a single, central trunk as the tree matures, and are often pruned in agriculture to optimize tree density and ease of fruit harvest. At night, the leaflets close up. As a tropical species, it is frost-sensitive. The pinnate leaves with opposite leaflets give a billowing effect in the wind. Tamarind timber consists of hard, dark red heartwood and softer, yellowish sapwood. The tamarind flowers bloom (although inconspicuously), with red and yellow elongated flowers. Flowers are 2.5 cm wide, five-petalled, borne in small racemes, and yellow with orange or red streaks. Buds are pink as the four sepals are pink and are lost when the flower blooms. The fruit is an indehiscent legume, sometimes called a pod, 12 to 15 cm in length, with a hard, brown shell. The fruit has a fleshy, juicy, acidic pulp. It is mature when the flesh is coloured brown or reddish brown. The tamarinds of Asia have longer pods (containing six to 12 seeds), whereas African and West Indian varieties have shorter pods (containing one to six seeds). The seeds are somewhat flattened, and a glossy brown. The fruit is sweet and sour in taste (Wikipedia, 2025). Canopy compact and spreading. Trunk stout with deep furrows, Bark thick, dark brown, cracked. Leaves compound. Small flowers, yellowish with red veins in the petals. Fruit a brown curved pod, seeds enclosed in choclate brown pulp. Trees, to 20 m high, bark brown to brownish-black, rough with vertical fissures; branchlets warty, tomentose. Leaves paripinnate, alternate; stipules lateral, minute, cauducous; rachis 8-13 cm long, slender, glabrous, pulvinate; leaflets 20-34, opposite, sessile, estipellate; lamina 1.5-4 x 0.4-1.3 cm, oblong, base unequal, apex obtuse, margin entire, glabrous, chartaceous; lateral nerves 10-15 pairs, pinnate, slender, obscure, looped at the margin forming intramarginal nerve; intercostae reticulate, obscure. Flowers bisexual, 1 cm across, yellow with reddish-pink dots, in lax terminal racemes; bracts and bracteoles ovate-oblong, coloured, cauducous; pedicels upto 5 mm; calyx tube narrowly turbinate, lined by disc; lobes 4, subequal, oblong, imbricate; petals 3, outer one, 1 x 0.3 cm, rolled up, pink dotted, lateral 2, 1-1.5 x 0.7-1 cm, clawed, subequal, oblong-lanceolate, lower pair scaly; stamens 9 monadelphous, only 3 fertile, others reduced to bristle, base pubescent; anthers versatile; ovary half inferior, stipitate, adnate to the disc, ovules many; style attenuate, tomentose; stigma globose. Fruit a pod 10-15 x 1-2 cm, oblong, fruit wall crustaceous, mesocarp pulpy, endocarp septate, leathery, indehiscent; seeds 3-8 or more, obovoid-orbicular, compressed, brown (Indiabiodiversity, 2025). The tamarind is a long-living, medium-growth tree, which attains a maximum crown height of 25 metres (80 feet). The crown has an irregular, vase-shaped outline of dense foliage. The tree grows well in full sun. It prefers clay,

loam, sandy, and acidic soil types, with a high resistance to drought and aerosol salt (wind-borne salt as found in coastal areas). The evergreen leaves are alternately arranged and paripinnately compound. The leaflets are bright green, elliptic-ovular, pinnately veined, and less than 5 centimetres (2 inches) in length. The branches droop from a single, central trunk as the tree matures, and are often pruned in agriculture to optimize tree density and ease of fruit harvest. At night, the leaflets close up. As a tropical species, it is frost-sensitive. The pinnate leaves with opposite leaflets give a billowing effect in the wind. Tamarind timber consists of hard, dark red heartwood and softer, yellowish sapwood. The tamarind flowers bloom (although inconspicuously), with red and yellow elongated flowers. Flowers are 2.5 cm wide, five-petalled, borne in small racemes, and yellow with orange or red streaks. Buds are pink as the four sepals are pink and are lost when the flower blooms. The fruit is an indehiscent legume, sometimes called a pod, 12 to 15 cm in length, with a hard, brown shell. The fruit has a fleshy, juicy, acidic pulp. It is mature when the flesh is coloured brown or reddish brown. The tamarinds of Asia have longer pods (containing six to 12 seeds), whereas African and West Indian varieties have shorter pods (containing one to six seeds). The seeds are somewhat flattened, and a glossy brown. The fruit is sweet and sour in taste (Wikiwand, 2025) (Fig. 1).

		
Tree	Tree	Tree
		
Back seeds	White seeds	Seedling
		
Seedling	Leaf	Leaves
		
Flower	Flowers	Leaves and fruit pod

Tender seedpods

Seedpods

Seedpod and Fruit

Husk

Tamarind

Fig. 1. Botanical Description

Seed powder

Seed powder

Cncetarate

Tamarind balls

Fig. 2. Products

GENETICS AND CYTOGENETICS

Tamarind (*Tamarindus indica* L.) is a unique tree species of the Fabaceae family within the subfamily Caesalpiniaceae and has a chromosome number of 2n = 24. The term "tamarind" is derived from the Arabic word "Tamar-E-Hind," meaning "Date of India". Tamarind (*Tamarindus indica* L.) is a unique tree species of the Fabaceae family within the subfamily Caesalpiniaceae and has a chromosome number of 2n = 24 (Singh *et al*., 2025).

GENETIC DIVERSITY

Determination of genetic variation is important to the plant breeders for development of high yielding variety. The aim of the current study was to investigate the genetic diversity of nine tamarind cultivars, out of nine four flowering cultivars using random amplified polymorphic DNA (RAPD) markers. Ten Random amplified polymorphic DNA (RAPD) primers were used to assess the genetic diversity in four flowering cultivars and five non-flowering of tamarind trees. The average genetic similarity level

among the four flowering cultivars and five non-flowering accessions grouped into six clusters groups at 0.76%. RAPD profiles of all the tamarind were compared and a total of 58 scorable bands were produced with seven primers ranging from one for OPG-13 to twelve for OPA-R15. Genotypes which were morphological closely related were found to be unrelated at the molecular level. A sizeable amount of intrapopulation diversity recorded in the present study which can be utilized in hybridization programmes to efficiently introgress the desirable trait of interest (Kumar *et al.,* 2015). An experiment on genetic diversity in tamarind was conducted at Horticultural College and Research Institute, Periyakulam, Tamil Nadu. The objective was to examine the genetic relatedness and genetic diversity among 31 tamarind genotypes. Significant differences were recorded among the 31 tamarind genotypes with regard to different morphological characters. Thirty one genotypes of tamarind were grouped into eight clusters by following the Tocher's method of clustering analysis utilizing data on a set of eleven traits related to yield, vegetative characters and quality characters. TI-23 (cluster VIII) and TI-12 (VII) formed individual clusters and had the maximum genetic divergence. Whereas Cluster II had the maximum of nine genotypes grouped together while cluster I had the seven genotypes and cluster IV had five genotypes. The intra and inter cluster genetic distance values ranged from 9.205 (cluster V) to 16.039 (cluster I). The maximum inter cluster distance was observed between cluster III (9.770) and cluster VIII (32.285). Cluster VII (550.33) showed the highest mean performance among 31 tamarind genotypes in five out of seven traits followed by cluster V and cluster II. Contribution of individual characters towards divergence recorded that maximum contribution to total divergence was recorded in acidity and number of fruits per tree; whereas the lowest contribution noticed in the traits such as tree circumference, fibre weight, pulp weight, pod width, pod length and tree height. The highest frequency was recorded on acidity, number of fruits per tree, fruit weight and shell weight. The lowest frequency exhibited in tree height, pod length, pod width, tree circumference, number of seeds per pod and fibre weight (Rajamanickam *et al.,* 2023).

There is scanty information on tamarind's genetic diversity in Easter Kenya. The objective of this study was to determine the genetic diversity of 64 tamarind accessions from Eastern Kenya using 12 Inter Simple Sequence Repeat (ISSR) markers. DNA was extracted from the young apical leaves using modified CTAB method and amplified using standard PCR. The data collected were scored as presence (1) or absence (0) of bands then compared to the 100bp ladder and analyzed using GeneAlex and R softwares. Only seven primers produced reproducible bands. A total of 46 alleles were produced for the 7 loci with an average of 6.6 per loci. Polymorphic information content (PIC) varied from 0.72 to 0.89 and genetic diversity varied from 0.74 to 0.9. The ISSR markers revealed effective polymorphism of 40.87 to 99.46% and the band sizes varied from 100 to 1000 bp. Analysis of Molecular Variance (AMOVA) depicted high variation within the tamarind populations at 90% and the least variation of 10% among the population. The first 3 components of Principal coordinate analysis (PCoA) contributed 40.83% of the total variation. Hierarchical cluster analysis grouped the tamarind accessions into seven major distinct groups. Tamarind accessions were different within counties with minimal variations among counties, proving that genetic diversity exists among the tamarind accessions in the Eastern region of Kenya. High genetic diversity was evident among Embu accessions and least among Masinga accessions. Diversity in tamarind can be utilized in marker-assisted breeding and primer ISSR17899A and ISSRHB11 can be explored in studying genes that code for various traits in tamarind accessions (Kidaha, 2023). The genetic diversity and variability of *Tamarindus indica* L., a valuable multipurpose tree species, was investigated through a comprehensive study conducted in the Bilaspur region. This research aimed to assess the morphological variations and growth responses of *T. indica* under contrasting environments, specifically agroforestry and natural forest systems. The study employed a rigorous scientific approach, encompassing field surveys, statistical analyses, and morphological assessments. The results indicated pronounced morphological differences between *T. indica* trees in the agroforestry and natural forest systems. *T. indica* trees in the natural forest exhibited significantly greater average height and diameter at the breast height (DBH) compared to those in agroforestry settings, highlighting the influence of the environment on growth parameters. Here, the crown diameter displayed homogeneity across both environments, suggesting a potential level of adaptability in this trait. The findings show the importance of considering environmental conditions when assessing the growth and development of *T. indica*, providing valuable insights for both scientific research and practical applications in agroforestry and conservation efforts (Ojha *et al.,* 2024).

This study characterizes a collection of 30 tamarind genotypes based on a range of qualitative and quantitative traits to assess phenotypic diversity. The analysis revealed wide variation across most of the traits, indicating their potential for distinguishing germplasm diversity. High phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were observed for tree height (24.34 and 21.26), stem girth (26.63 and 23.72), tree spread E-W (23.50 and 21.68), tree spread N-S (27.46 and 24.38), pod yield kg/tree (29.98 and 27.56), pod length (25.29 and 24.51), pod breadth (22.08 and 21.92), pulp weight (30.49 and 28.58), and pod weight 31.03 and 29.74), which indicates these traits display high variation, suggesting significant potential for selection. High heritability coupled with high genetic advance were observed for the most of traits which were influenced by additive or fixable genetic variation. Path coefficient analysis revealed that traits, such as stem girth and tree spread showed direct effects on pod yield, while other characters contributed indirectly. Principal component analysis (PCA) indicated that PC-1 accounted for approximately 27.648% of the total variance, followed by PC-2 (18.250%), and PC-3 (15.835%), and hierarchical clustering uncovered crucial genetic components and distinct clusters, which can be considered for targeted breeding strategies. Cluster II emerged as the most divergent cluster, due to its the highest inter-cluster distances with other clusters and the highest intra-cluster distance (Kanupriya *et al.,* 2025). This study characterizes a collection of 30 tamarind genotypes based on a range of qualitative and quantitative traits to assess phenotypic diversity. The analysis revealed wide variation across most of the traits, indicating their potential for distinguishing germplasm diversity. High phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were observed for tree height (24.34 and 21.26), stem girth (26.63 and 23.72), tree spread E-W (23.50 and 21.68), tree spread N-S (27.46 and 24.38), pod yield kg/tree (29.98 and 27.56), pod length (25.29 and 24.51), pod breadth (22.08 and 21.92), pulp weight (30.49 and 28.58), and pod weight 31.03 and 29.74), which indicates these traits display high variation, suggesting significant potential for selection. High heritability coupled with high genetic advance were observed for the most of traits which were influenced by additive or fixable genetic variation. Path coefficient analysis revealed that traits,

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BREEDING

Propagation

Tamarind seeds remain in good condition for months and germinate a week after planting. Young trees are usually grown in nurseries. Vegetative propagation of the selected varieties is also carried out due commercial prospective of tamarind products. Tamarind trees can also be grown from stem cuttings, grafting, or air-layering (Muraga Raja., *et al*., 2022).

Propagation: Seed propagation: Tamarind is traditionally grown from seed. When propagating from seed, ripe pods should be collected in March-April by shaking the branches. The pods should be dried in the sun and seeds removed from the pulp by hand-kneading or washing in water. Washed seeds are dried in the shade and stored in well-ventilated gunny bags in a cool place. The seeds retain viability for about 6 months when kept at ambient temperature in dry conditions. Viability can be extended for over a year if the seeds are well dried, mixed with sand and kept in airtight containers, and for several years if stored in airtight packs at 10°C and 7-15% moisture content. Germination rates are about 65-75%. Seed germination usually begins within 7 days and can take up to 25 days to complete. No seed pre-treatment is usually required. However, seed germination can be accelerated by soaking in 10% cow urine or cow dung solution (500 g in 10 litres) for 24 hours. Germination was seen to increase from 37% for untreated seed to 73% with cow urine and 83% with cow dung solution.

Pre-treatment of the seeds by soaking in cold water for 24 h can increase germination from 30-70% to 80% and scarifying or cutting the seed coat can increase this further to 92%. Soaking the seeds in gibberellic acid for 24 h results in taller seedlings with thicker stems at 5 months from sowing. Spraying 4-month-old seedlings with gibberellic acid results in significant gains in height and stem diameter after 4 months, but the stem diameter differences are small at 15 months. Seedling growth is rapid, with the taproot growing 30 cm or more in the first 2 months (Rojas-Sandoval, 2018). Fully-formed seeds are sown in polythene bags (medium- to large-size) when containers are used for propagation. Seed germination begins within a week and may take a month to complete. The seedlings can be field-planted after 14 months at which age they are about 30 cm tall. If growth is poor the seedlings should be retained in the nursery for another year. These seedlings are difficult to handle as the taproot may have grown into the soil. They will require root pruning and care should be exercised in transport. Transplanting should occur when the seedlings are at least 80 cm tall. Seed propagation results in significant variability due to out-crossing and can delay the time before bearing. Seedlings may take 7-8 years to bear fruit and 10-12 years to produce a good crop. Natural regeneration of *T. indica* is aided by animals such as monkeys and gazelles, which eat the fruit and disperse the seeds. However, the seedlings have to be protected from browsing animals. Germinants survive under bushes. When damaged, seedlings will coppice and produce root suckers (Rojas-Sandoval, 2018). Vegetative propagation: Vegetative propagation must be used to reduce tree-to-tree variability and ensure earlier bearing and uniformly high-quality fruit. Propagation by softwood terminal cuttings has been developed and the protocol standardized. Cuttings have showed a 94% success rate with the use of indole butyric acid. Both air- and ground-layering methods are widely practiced, but are not as successful as grafting. Air layering has been successful using peat moss as a substrate, with no significant response to the use of indole butyric acid. Cleft grafting is one of the most successful methods; veneer grafting is also popular. Patch and shield (T or inverted T) budding are also often used, although T budding is more complicated because of the characteristics of tamarind bark. Rootstocks for budding or grafting are propagated from seeds. After sowing, preferably directly into nursery bags, the seedlings should reach 0.8-1.0 cm in diameter at the base of the stem to allow grafting or budding with scions or buds from selected plants. Vegetative propagation by shield and patch budding, cleft grafting, branch cuttings and layering are reliable methods. Shield and patch budding and cleft grafting are used in the Philippines and Thailand. Patch budding and modified ring budding have achieved 96% and 94% success rates, respectively, and are reported as suitable for large-scale multiplication of *T. indica*. In the Philippines, budded or grafted trees are field-planted at the onset of the rainy season (May to June) at a spacing of 8-10 m. Fruit is produced from grafted trees in 3-4 years, while others may take over 10-12 years (Rojas-Sandoval, 2018).

Germplasm Collections: The FAO-World Information and Early Warning System on Plant Genetic Resources lists 16 institutions holding 99 germplasm accessions of tamarind. Some of the collections are in BurkinaFaso (9 wild/weedy accessions), Costa Rica (1), Ethiopia (5), France (2), Ghana (1), Honduras (1), Mexico (2), Philippines (12), Senegal (2), EI Salvador (1), Taiwan (1) and USA (10). In India, there is a wealth of tamarind variability particularly in central and southern regions. However, systematic efforts have not been made so far to collect and evaluate this germplasm (Pareek and Awasthi, 2002).

Conservation: Conservation of elite trees for commercial exploitation has, thus, been done in several countries of the world. Clonally propagated systematic plantations have also been done. Even then, concerted efforts are necessary to conserve its genetic resources. It is equally important that methods and programmes are also developed to systematically evaluate these collections. This should include description using the standard descriptors including the important economic characters besides biochemical characteristics wherever relevant () (Pareek and Awasthi, 2002).

Table 1. Tamarind germplasm conserved in field genebank

Centre	Number
State Agricultural Universities	
Belgaum, Karnataka	40
University of Agriculturel Sciences, Bangalore	19
Aurangabad, Maharashtra	351
Kovilangulam, Kamarajar, Tamil Nadu	26
Periyakulam, Tamil Nadu	85
Rahuri, Ahmednagar, Maharashtra	14
Pune, Maharashtra	118
Parbhani, Maharashtra	3
IGAU, ZARS, Jagdalpur	5
Bastar, Chattisgarh	
Forest Department, Karnataka	
Gottipura, Bangalore	40
Challekere RF, Bellary	50
Bidar	10
Yeregera, Raichur	10
Gungurgatti, Dharwad	70
Other stations in Karnataka	40
Forest Department, Tamil Nadu	
Coimbatore	40
Sesanchavady, Salem	61
Athivur, Erode	5
Varattupallum, Erode	4
Harur, Dharampuri	28
Ramanahalli, Dharampuri	23
Chengam, Tiruvaannamalai	52
Karumbapatti, Salem	77
Varinchipuram, Vellore	38

Variability in Plant Characters: Tamarind is essentially across pollinatedcrop. As a result of cross pollination, seedling and at breast height maximum diameter from 1 to 4 m. Tree longevity varies from 150 to 200 years. Phenological variations in flowering and fruit maturity have also been reported. Similarly, phenotypic variations have been observed in fruit characters such as pod weight, seed and pulp content, colour and taste of pulp, endocarp colour (Table 2). Wide range of variability in morphological and physico-chemical characters of fruit has been observed in Maharashtra, Karnataka, Andhra Pradesh and Chhattisgarh. Such variations in tamarind germplasm has been attributed to geographic isolation and gene mutation (Pareek and Awasthi, 2002).

Table 2. Varibility in morphological characters of fruit

Characters	Range
Fruit weight (g)	8.9-63.6
Fruit length (cm)	8.2-32.0
Fruit, width (cm)	2.7-5.0
Curvature in pod	Straight, Curved
Bulging in pod	Flat, Bulged, Cylindrical
Pulp content (%)	24-71
Seed number/fruit	3.3-12.0
Seed content (%)	12-48
Rag and shell content (%)	11-42
Pulp colour	Red-Brown-Yellow
Endocarp colour	Extra white, White, Yellow
Seed length (mm)	0.95-1.8
Seed width (mm)	0.60-1.2
Seed weight (g)	2.6-12.5
Fruits (kg)	15-59.0
Seeds (kg)	517-1400

Classification of tamarind types

- Primary characters *Pulp colour* (red, brown); *Endocarp colour* (white, yellow); *Pulp taste* (sweet, sub acid, acid).
- Secondary characters *Pod length* (large: > 20 cm; small: < 20 cm); *Pod width* (wide: > 5.0 cm; Narrow: < 5 cm).
- Tertiary character *Pod shape* (straight and bulged, straightand flattened, curved and bulged, curved and flattened).
- (Pareek and Awasthi, 2002).

Genetic Improvement: The objective of improvement strategy should be to select or develop high yielding types producing large and straight pods having extra white endocarp and high content of pulp with high TSS from the two variability groups of tamarind, *i.e.* sweet red and sour yellow-brown. Similarly, trees having dwarf growth habit with loose and weII-formed crown, precocious and regular bearing habit need to be identified. The following ideotype description for development of an ideal genotype is suggested (Table 3) (Pareek and Awasthi, 2002):

Table 3. Ideotype description

Character	Ideotype
Root system	Deep
Crown	Loose with profuse branching
Tree canopy	Circular
Tree height	Dwarf
Resistance to stress	Drought and frost resistance
Bearing	Precocious (from 5th year); regular
Pulp colour	Red
Endocarp colour	White
Pod length	>20 cm
Pod width	>5 cm
Pod weight	>20 g
Pod shape	Straight and bulged
Pulp:seed ratio	4:1
Pulp TSS	>80%
Acidity in pulp	Acidic type : 10-15 %; Sweet type : 6

Selection: Presence of a large natural variation both in vegetative and reproductive characters and occurrence of bud spots in tamarind offer ample chances for identifying promising genotypes. The desirable ones could be subsequently propagated by vegetative methods. Studies have shown that mid and late flowering types produce higher fruit yields. Some of the fruit characters could be used as markers for high productivity. The length of fruit was positively correlated with its weight, pulp content and seediness. The fruit thickness was negatively correlated with fibre and seed content (Pareek and Awasthi, 2002).

Hybridization: No attempts have been made to develop improved cultivars by hybridization. However, reproductive biology and breeding system have ~n studied in five tamarind clones. Controlled pollination studies indicate that tamarind is predominantly an out-crossing species with extremely low level of selfing. Open pollination fruit set is between 1 to 2%. Pollen sterility is very low. Flowers show strong entomophilous adaptations. Apomixis is absent and fruit shows colour dimorphism. Flowering in tamarind can be early, mid-season or late. The duration of fruiting is the longest in late flowering trees and shortest in early flowering trees. In mid and late flowering trees cross pollination has been observed to be more while the early flowering trees are mostly self-pollinated. In Karnataka, flowering in tamarind occurs between the last weel of March and mid June. Anthers dehisce between 9.00 and 11.00 h. In majority of trees (64%), one floral bud was observed to flower at random on every alternate day while in 33% trees there was regular flowering, *i.e.* at least one floral bud opened! day. A period of 25 days was required for flowering to complete in any infloresence. The ability of the tamarind tree to adapt to a wide range of agro-ecological conditions and high degree of usefulness of all its plant parts: fruit, seed, leaf and wood, both for domestic utilization as well as in industry merit concerted focus on exploitation of its rich genetic variability by systematic research strategies mainly on (i) Collection, characterization and conservation of genepools, (ii) Identification of provenances with desirable characteristics according to use through characterization and evaluation (Pareek and Awasthi, 2002).

Varieties (Pareek and Awasthi, 2002): PKM 1: It is a selection made at Horticulture College and Research Institute, Periyakulam. It is an early bearer. Grafts come to flowering three years after planting and give commercial yield from fifth year. Nine-year-old trees gave a mean yield of 263 kg. It is a green tamarind producing yellow pods, having 39% pulp, high acidity (17.1%) and ascorbic acid (3.9 mg/1oo g pulp).

Urigam : It is a progeny of more than 2oo-year-old tree identified near Urigam by the Department of Horticulture, Tamil Nadu, which is reported to yield 2 tonnes of fruits/year. The average length of fruit is 30 cm and width is 6.25 cm. It is a red tamarind.

Pratisthan: The variety was released from Fruit Research Station, Aurangabad. It has 61% pulp, 12% seed, 27% shell and 7-9% acidity. It is a sour-sweet and red tamarind. A 10-year-old tree yields 300 kg fruit. Its pulp can be stored for long period.

No. 263: The variety has been released from Fruit Research Station, Aurangabad. It is a regular bearing cultivar producing 6-10 quintal fruits/tree. The fruits have pinkish and light yellow pulp, and 18-19% acidity. Fruits are large. On an average 45 fruits weigh to 1 kg.

Yogeshwari: The variety has been released from Taluk Seed Farm, Ambajogai (Beed) in Maharashtra. The fruits are large and have red and sour-sweet pulp with 6-7% acidity.

DTS 1: It is a selection identified at University of Agricultural Sciences, Dharwad, College of Horticulture, Arabhavi. The pods are straight having semi-curved shape, 23.6 cm length, 3 cm width, 19.5 g weight, 51% pulp and 13.6% acidity. It is a late variety and takes 310 days from fruit set to maturity.

DTS 2: This is a selection made at University of Agricultural Sciences, Dharwad, College of Horticulture, Arabhavi. The pods are straight having semi-curved shape, 17.6 cm length, 2.6 cm width, 18 g weight, 53% pulp and 12.2% acidity. It is an early variety and the pods mature in 280 days after fruit set.

Sweet tamarind: The origin of sweet tamarind has been attributed to point mutation. It is also assumed that the rare trait of sweetness in tamarind may be governed by recessive genes. The sweet tamarind is found mostly in South-East Asia and India. One Thailand variety is known as Makham Waan. Several sweet fruited trees are found in Cavite, Laguna and Binan regions of Philippines. The pods are 7-10 cm long, 2-3 cm wide, 20-30 g in . weight and having 4 to 7 seeds/pod.

The Institute of Plant Breeding, University of the Philippines, Los Banos has identified promising trees. A variety named Manilla Sweet is reported from Florida. In India, a red fleshed tamarind having sweet pulp (TSS>85%) has been spotted in village Faraskot, Dantewada, Bastar district of Chhattisgarh.

Most tamarind cultivars that are grown vary in fruit size and degree of tartness. Producers in India mainly grow the sour types in commercial orchards. The seedlings are not identical in their genotypes. They grow very slowly, attaining full production after 12-13 years, and become very large. Some of the major tamarind-growing countries have selected improved cultivars from among the natural populations. Thailand has more than 50 sweet cultivars, which include 'Muen Chong,' 'Sri Tong,' 'Nam Pleung,' 'Jae Horn,' 'Kun Sun,' 'Kru Sen,' 'Nazi Zad' and 'Sri Chompoo.' In the Philippines, 'Cavite,' 'Batangas,' 'Bulacan,' 'Laguna' and 'Manila Sweet' are selected sweet varieties.

In India, selections such as 'Prathisthan' from Maharashtra and 'Urigam' from Tamil Nadu are well established. The most preferred cultivar is 'Periyakulam 1,' a clonal selection from Tamil Nadu (El-Siddig *et al*., 2006), a local sour variety that starts bearing in the third year after grafting (Rojas-Sandoval, 2018). The existing cultivated types of tamarind are all of seedling origin, being highly heterozygous there are a few recognized varieties based on the pulp colour of the fruit. The local varieties can be classified as 'brown sour types' and 'reddish sweet types'. The popular among the local types are Bangalore Tamarind, Tumkur Tamarind, Hosur Tamarind, Krishnagiri Tamarind, Natham Tamarind, Nagarkoil Tamarind, Villupuram Tamarind, Ranchi Tamarind (Admin, 2021).

Varieties (Admin, 2021)

PKM-1: A clonal selection from the gene bank, it is an early variety yielding 263 kg pods per tree with a pulp content of 39 per cent. It can give 26 tonne of pods per hectare if transplanted at a spacing of 10 m x 10 m. The variety is characterized by purple pigmentation in the terminal buds, stems dark brown in colour, fruits borne in clusters of 4-5 nos, they are slightly curved with brown pulp.

Urigam: This is another local type providing very long pods having fleshy sweet pulp. It bears 2-3 pods per bunch. The fruit yield is low when compared to PKM-1.

Pratisthan: This is an improved sweet pulped high yielding variety of tamarind released from Marathwada Agricultural University, Parbhani.

NTI-19 (DST –1): The variety is reported to yield well in Dharwad region of Karnataka. The pods are big and the grafted plants start yielding in 4-5 years of planting. The average yield per plant is about 3 kg at 5th year.

Red Tamarind: The variety is recommended for cultivation by the Tamil Nadu Agriculture University. The pulp is red in colour which has a great demand in Arabian countries.

GKVK-6 and GKVK-33: These two are local types released by the Division of Horticulture, UAS, Gandhi Krish Vignana Kendra, Bangalore.

There are several varieties of tamarind trees that can be planted in Indian gardens. Some of the popular varieties include Upland tamarind, Sweet tamarind, and Sour tamarind. The Sweet tamarind variety is the most commonly grown variety in India, while the Sour tamarind is preferred in some regions for its tangy flavour (Greenverz, 2025).

Varieties (Krishihelpline, 2025)

PKM1: This is an early variety which yields about 270 to 300 kg pods/tree with a pulp content of 40%. If the plants are spaced at 10 meter by 10 meter, they produce yield of 25 tones of pods/hectare

• **Urigam**: This is a local variety having sweet taste and long pods.

Uses

Tamarind fruits and other extracts from the tree have a number of reported miscellaneous applications which are still in widespread use. Tamarind pulp mixed with sea salt has been reported to polish brass, copper and silver in Sri Lanka, India, West Afric, South Africa and Somalia. In West Africa, an infusion of the whole pod is added to the dye when colouring goat hides. The fruit pulp is used as a fi xative with turmeric (*Curcuma longa*) and annatto (*Bixa orellana*) in dyeing, and it also serves to coagulate rubber latex and is used for ethanol production. The seed husk has also been found to be an effective fi sh poison. It was reported that powdered seed husks added to water, even at low dosages of 5–10 mg/L, killed several fish species, within 2 hours of its application. The treatment of salted dried fi sh by TKP was found to be the best in preserving the quality of salted fish (Saideswara Rao and Mary Mathew, 2012). The tender leaves, fl owers and the young seedlings are eaten as a vegetable and used in curries, salads, stews and soups in many countries. The leaves are reported to be rich in minerals and v itamin constituents such as calcium, magnesium, phosphorus, iron, copper, chlorine and sulphur; thiamine, ribofl avin, niacin and vitamin C. The fl owers are considered to be a good source of honey which is rich golden in colour, but has slight acidity peculiar to its fl owers. The tree also yields valuable timber and the wood is used mostly for agricultural implements, tool-handles, wheels, mallets, rice pounders and oil-mills and for turnery. It was suggested that seed coat, a by-product of the tamarind gum industries, can be used as a safe and low-cost antioxidant for increasing the shelf-life of foods by preventing lipid peroxidation. They have carried out studies on the utilization of spent (detanned) tamarind seed testa as a substrate to grow the edible mushroom *Pleurotus fl orida*. They claimed that wattle-tamarind seed testa substrate was effi cient for growing the mushroom and that the spent mixture was suitable as organic manure as well (Saideswara Rao and Mary Mathew, 2012). Tamarind products are commonly used as health remedies throughout Asia, Africa and the Americas. Tamarind products, leaves, fruits and seeds have been extensively used in Indian Ayurvedic medicine and traditional African medicine. The medicinal value of tamarind is mentioned in ancient Sanskrit literature. Tamarind fruits were well known in Europe for their medicinal properties, having been introduced by Arab traders from India. Detailed medicinal uses for tamarind in Africa which include as an anthelminthic (expels worms), antimicrobial, antiseptic, antiviral, sunscreen and astringent and to promote wound healing in the following conditions: asthma, bacterial skin infections, boils, chest pain, cholesterol metabolism disorders, colds, colic, conjunctivitis, constipation (chronic or acute), diabetes, diarrhoea, dry eyes, dysentery, eye infl ammation, fever, gallbladder disorders, gastrointestinal disorders, gingivitis, haemorrhoids, indigestion, jaundice, keratitis, leprosy, liver disorders, nausea and vomiting (pregnancyrelated), saliva production, skin disinfection/sterilization, sore throat, sores, sprains, swelling (joints) and urinary stones. It was suggested that the consumption of adequate amounts of 'poha beer' a popular tamarind fruit drink of Northern Ghana in Africa, could help reduce the prevalence of iron defi ciency anaemia. This was based on the vitamin C content in it which enhances bioavailability of non-haem iron (Saideswara Rao and Mary Mathew, 2012). Tamarind fruit is commonly used throughout Southeast Asia as a poultice applied to foreheads of fever sufferers. In traditional Thai medicine, the fruit of the tamarind is used as a digestive aid, carminative, laxative, expectorant and blood tonic. The laxative properties of the pulp and the diuretic properties of the leaf sap have been confirmed by modern medical science. Tamarind has been used in the treatment of a number of ailments, including alleviation of sunstroke, Datura poisoning and the intoxicating effects of alcohol and 'ganja' (*Cannabis sativa* L.). It is used as a gargle for sore throats, dressing of wounds and is said to aid the restoration of sensation in cases of paralysis. Tamarind is also said to aid in the cure of malarial fever. In Southeast Asia, the pulp is prescribed to counteract the ill effects of overdoses of chaulmoogra (*Hydnocarpus anthelmintica* Pierre), a leprosy medication, and in Mauritius, the pulp is used as a liniment for rheumatism. Tamarind seeds have been used in Cambodia and India, in powdered form, to treat boils and dysentery. Boiled, pounded seeds are reported to treat ulcers and bladder stones and powdered seed husks are used to treat diabetes. Several medicinal properties are claimed for preparations containing tamarind pulp, leaves, fl owers, bark and roots (Saideswara Rao and Mary Mathew, 2012). Improved bioavailability of anti-infl ammatory drugs utilizing tamarind xyloglucan was reported. Fruit extracts have been shown to enhance the bioavailability of ibuprofen in humans as well. In rats, tamarind xyloglucan has been found to show a strong antidiabetic effect. There is current medical interest in the use of purifi ed xyloglucan from tamarind in eye surgery for conjunctival cell adhesion, corneal wound healing as well. The tamarind seed polysaccharide appears to be a promising candidate as a vehicle for the topical treatment of bacterial keratitis, a serious infectious ocular disease. Other medical-related trials have shown that tamarind intake delayed the progression of fluorosis by enhancing excretion of fluoride. Apart from fruits, tamarind leaves are used to treat conjunctivitis, throat infections, coughs, fever, intestinal worms, urinary troubles and liver ailments, cardiac and blood sugar reducing medicines, in ulcers, and as external applications in boils, rheumatism and external swellings (Saideswara Rao and Mary Mathew, 2012). It was reported its use in treatment for digestive tract ailments and indigestion in Cambodia, India and the Philippines. The bark as an astringent was being used as a tonic and in lotions or poultices to relieve sores, ulcers, boils and rashes in the Philippines and Eastern Sudan. Ashes of the burnt shells of ripe fruits are used as an alkaline substance with other alkaline ashes in the preparation of medicine 'Abayalavana' in India, for curing enlarged spleen. Flowers are used in the treatment of eye diseases in the Philippines and also for jaundice and bleeding piles. The 'Irula' tribals in Tamil Nadu, India, use tamarind root bark for abortion and for prevention of pregnancies. In some countries, the bark is reported to be prescribed in asthma, amenorrhoea and as a tonic and febrifuge. A recent study revealed a decrease in plasma and bone F levels on ingestion of 100 mg tamarind water extract in rabbits (Saideswara Rao and Mary Mathew, 2012).

Pulp: Tamarind is used in India mainly in the form of pulp. The fruit pulp is the chief agent for souring curries, sauces, chutneys and certain beverages throughout the greater part of India. In India, the immature green pods are often eaten by children and adults

dipped in salt as a snack. It is also used in India to make 'tamarind fi sh', a seafood pickle, which is considered a great delicacy. Immature tender pods are used as seasoning for cooked rice, meat and fi sh and delicious sauces for duck, waterfowl and geese. Tamarind fruit is also reported to be used as a raw material for the preparation of wine-like beverages. Whilst it is found mainly in Indian regional food, the spice is used in Asian, Latin American and South African dishes extensively. A review on traditional uses of tamarind with reference to sub-saharan Africa has been published. In Sri Lanka, tamarind is widely used in cuisine as an alternative to lime and also in pickles and chutneys. In the Bahamas, fully grown but still unripe fruits are roasted in coal, the skin is then peeled back and the sizzling pulp is dipped in wood ash and eaten (Saideswara Rao and Mary Mathew, 2012). In Egypt, tamarind is used to make a sour drink during the summer period, and it is also added to a similar lemonfl avoured drink, popular in the Middle East. It is also used for this purpose in Mexico, where the drink is known as well as *agua fresca* (refreshing water) or *agua de tamrindo*, which is sometimes turned into frozen fruit ices. Mexicans also use tamarind as a snack, dried, salted or candied (e.g. Pulparindo). In the Philippines, it is also used to make sweets, but the leaves of the plant are also utilized in the recipe for the famous sinigang soup. In Guadeloupe, the fruit is used to make jam and syrup, whilst in northern Nigeria tamarind is used during breakfast, as it is added to the traditional porridge known as pap or *kunun tsamiya*. Tamarind is also widely used in sauces to give a sour fl avour, for example in the popular pad thai from Thailand, or in gravy for assam fi sh in Singapore and Malaya (Saideswara Rao and Mary Mathew, 2012).

Concentrate: Juice concentrate of tamarind is produced and marketed in India and abroad. The product is promoted as being very convenient for culinary purposes and the food industry. The CFTRI, Mysore, has developed processes for the manufacture of juice concentrate and powder of the pulp. All the water solubles were extracted from the fruit pulp by boiling with water then concentrated to about 65–70 % solids and packed in suitable containers. The fi nal product was viscous and set to a jam-like consistency on cooling. Tamarind juice concentrate was found to be more viscous than sucrose solutions. Formulae for preparing spiced sauces and beverages from the pulp have also been reported. The approximate composition of the concentrate according to a CFTRI report is as follows: total tartaric acid 13 %; invert sugars 50 %; pectin 2 %; protein 3 %; cellulosic material 2 %; and moisture 30 % (Saideswara Rao and Mary Mathew, 2012).

Seeds: Tamarind seed is the raw material used in the manufacture of (TKP), polysaccharide, adhesive, oil and tannin. Tamarind seed used to be an under-utilized by-product of the tamarind pulp industry. Tamarind seeds are reported to give amber-coloured oil, free of smell and sweet to taste, which resembles linseed il. It is reported to be useful in the preparation of paints and varnishes and for burning lamps. The oil is said to be palatable and of culinary quality. Tamarind jellose – a pectin-like substance extracted from tamarind seeds – has not been fully exploited but, due to its abundance and cheapness, jellose has great potential for replacing fruit pectins in many industries. Purifi ed tamarind seed polysaccharide, xyloglucan, has been found to have various applications in food technology, drug-delivery technology and the textile industry. It was pointed out that, even though the tamarind xyloglucan as a viscosifi er offered no chemical advantage over guar gum, a galactomannan from cluster beans, a bioprocess to upgrade the tamarind polysaccharide, might be commercially viable as the tamarind fl our is cheaper. Purifi ed, refi ned tamarind xyloglucan is produced in Japan and is permitted as a thickening, stabilizing and gelling agent in the food, cosmetic and pharmaceutical industries. It is reported to possess properties like high viscosity, broad pH tolerance and adhesivity. Tamarind xyloglucan imparted more viscous, liquid-like rheological properties and heat stability to gelatinized tapioca starch/xyloglucan mixtures. TSP is a promising polymer in the pharmaceutical industry as a novel carrier of drugs in various bioadhesive and other sustained release formulations (Saideswara Rao and Mary Mathew, 2012).

Kernel powder: TKP was extensively used in the food industry and as a sizing material in the textile industry as well. TKP used to be recommended in preparing confectionery, as a stabilizer in ice creams, mayonnaise and cheese. Use of white TKP in food products such as jellies, jams, marmalades, fortifi ed breads and biscuits was also detailed. Other than the food and textile industries it has been used in cosmetics, pharmaceutical and insecticidal preparations, adhesives, bookbinding, cardboard and plywood manufacture, and in sizing and weighing compositions in the leather industry (Saideswara Rao and Mary Mathew, 2012). Seed testa: The testa is reported to contain 40 % water solubles, 80 % of which is a mixture of tannin and colouring matter. In the production of TKP or the jellose, large quantities of testa are left as a residual by-product. The use of testa in dyeing and tanning has been suggested. The seed testa contains 23 % tannin which, when suitably blended, is used for tanning leather and imparting colour-fast shades to wool. In leather tanning tests, tamarind tannin gives a harsh and highly-coloured leather which could be used for heavy soles, suitcases. Seed coat, a by-product of the tamarind gum industries, can be used as a safe and low-cost antioxidant for increasing the shelf-life of foods by preventing lipid peroxidation. Studies carried out on the utilization of spent (detanned) tamarind seed testa as a substrate to grow the edible mushroom *Pleurotus fl orida*. They claimed that wattle-tamarind seed testa substrate was effi cient for growing the mushroom and that the spent mixture was suitable as organic manure as well (Saideswara Rao and Mary Mathew, 2012). The tender pods can be eaten as a vegetable, cooked or pickled. Unripe fruit are roasted and later eaten. Sweet-type ripe tamarind is most often consumed as a fresh or semi-processed fruit. It is marketed worldwide in sauces, syrups and processed foods. The sticky pulp, which tastes both sweet and sour, contains the richest natural source of tartaric acid (8-10%). This soft, succulent pulp is used as an item of confectionery and an ingredient in curries, chutneys, preserves, pickles, sherbets and beverages. The pulp is used to make sweetmeats, mixed with sugar, called tamarind balls. It is also used as a preservative, and in northern Sri Lanka it is used to preserve fish. *T. indica* flowers are an important food source for honey bees. When overripe, the pulp can also be used to clean brass and copper. Tamarind seeds are gaining importance as a rich source of protein, with a favourable amino acid composition. The seeds also contain pectin, which has been found to be superior to fruit pectin for making jellies, jams and marmalades. Confectionery and condiments are also made from the seeds. Sometimes they are made into flour. The seeds are eaten after removal of the testa, roasting and boiling. In India seeds are used as a source of carbohydrate, for sizing and finishing cotton, paper and jute products and in the food processing industries. Polyose obtained from the seeds is a good substitute for fruit protein (Rojas-Sandoval, 2018). The seed testa contains 23% tannin, which when suitably

blended is used for tanning leather. Seeds give an amber-coloured oil which can be made into a varnish to paint statues. The leaves are used as fodder for cattle and goats, although they are rarely used for this purpose as it affects the fruit yield. They are also fed to certain species of silkworm in India and West Africa. Leaves and flowers are good mordants in dyeing. The flowers and leaves are also used in curries, salads and soups, *e.g*. in West Africa. *T. indica* wood is hard to very hard, and very heavy, with a purplish-brown heartwood. Sapwood is liable to insect attack but the heartwood is more durable. The wood makes excellent charcoal which is valued for producing gunpowder. The wood is also used for general carpentry, sugar mills, wheels, hubs, wooden utensils, agricultural tools, mortars, boat planks, toys, panels and furniture (Rojas-Sandoval, 2018). Ripe tamarind fruit have proven medicinal value. The American pharmaceutical industry processes 100 t of tamarind pulp annually. The pulp is used for many medicinal purposes including as a laxative, for fevers and inflammation, in a gargle for sore throats and mixed with salt as a liniment for rheumatism. The pulp is also used as an astringent on skin infections. Its effectiveness against scurvy is well documented, and it is a common ingredient in blood sugar-reducing and cardiac medicines. Leaves ground into a paste with lime juice and the heartwood of *Acacia chundra* are applied to boils to prevent suppuration and inflammatory swellings. A decoction of leaves is used as fomentation on boils and abscesses. The seed testa macerated with vinegar or lime juice is used on the face to prevent formation of pimples. Internally, leaves and pulp act as cholagogue laxatives and are often used for congestion of the liver, habitual constipation and haemorrhoids. The ripe fruit is used as a refrigerant, digestive, carminative and laxative.

The flowers are used internally as remedy for jaundice. Filtered hot juice of young leaves and a poultice of the flowers are externally applied on eyes for diseases such as conjunctivitis. In Cambodia, the bark is used as an astringent for diarrhoea, and the powdered seed for dysentery and as a poultice on boils. In Indonesia, an oil extracted from the seed is used for the hair. In Mauritius, the pulp of the fruit is used as a liniment for rheumatism. In Brazil, both fruit pulp and the leaves are regarded as purgative, diaphoretic and emollient. In Madagascar, an infusion of the leaves is given as an anthelmintic and for stomach disorders. In West Africa, the powdered dry leaves are used on wounds and a decoction of the bark as a lotion to wash wounds and ulcers; in Nigeria the roots are a component in a remedy for leprosy (Rojas-Sandoval, 2018). *T. indica* wood is hard to very hard, and very heavy, with a purplish-brown heartwood. Sapwood is liable to insect attack but the heartwood is more durable. The wood is used for wheels, mallets, rice-pounders, oil presses, sugar presses, tools, furniture and turnery. The very durable heartwood is used in furniture-making and polishes well. It is regarded as a substitute for teak (*Tectona grandis*) in many applications. The wood also makes excellent charcoal which is valued for producing gunpowder. In India, *T. indica* charcoal was a major fuel for producing gas (gasogen) units for cars and trucks during World War II. *T. indica* is valued mainly for its fruit pulp. Its acidic pulp is a favourite ingredient in culinary preparations such as curries, chutneys, sauces and sherbet. The pulp is also used to make sweetmeats, mixed with sugar, called tamarind balls. It is also used as a preservative, and in northern Sri Lanka it is used to preserve fish (Rojas-Sandoval, 2018). When overripe, the pulp can also be used to clean brass and copper. The seeds are extensively used in the jam, jelly and confectionery industries and for making condiments.

The seeds are eaten after removal of the testa, roasting and boiling. Sometimes they are made into flour. In India they are used as a source of carbohydrate, for sizing cloth, paper and jute products and in the food processing industries. Polyose obtained from the seeds is a good substitute for fruit protein. The seed testa contains 23% tannin, which when suitably blended is used for tanning leather. Seeds give an amber-coloured oil which can be made into a varnish to paint statues (Rojas-Sandoval, 2018). The flowers and leaves are also used in curries, salads and soups. Leaves also make good fodder, although they are rarely used for this purpose as it affects the fruit yield. The average amount of crude protein in the leaves is 12-15%; this tends to vary with the season and locality (Rojas-Sandoval, 2018). *T. indica* is used for many medicinal purposes. Leaves ground into a paste with lime juice and the heartwood of Acacia chundra are applied to boils to prevent suppuration and inflammatory swellings. A decoction of leaves is used as fomentation on boils and abscesses. The seed testa macerated with vinegar or lime juice is used on the face to prevent formation of pimples. Internally, leaves and pulp act as cholagogue laxatives and are often used for congestion of the liver, habitual constipation and haemorrhoids. The ripe fruit is used as a refrigerant, digestive, carminative and laxative. The powdered seed is used as a dressing on boils and the flowers are used internally as remedy for jaundice. Filtered hot juice of young leaves and a poultice of the flowers is externally applied on eyes for diseases such as conjunctivitis (Rojas-Sandoval, 2018). In Cambodia, the bark is used as an astringent for diarrhoea, and the powdered seed for dysentery and as a poultice on boils. In Indonesia, an oil extracted from the seed is used for the hair. In Mauritius, the pulp of the fruit is used as a liniment for rheumatism. In Brazil, both fruit pulp and the leaves are regarded as purgative, diaphoretic and emollient. In Madagascar, an infusion of the leaves is given as an anthelmintic and for stomach disorders. In West Africa, the powdered dry leaves are used on wounds and a decoction of the bark as a lotion to wash wounds and ulcers; in Nigeria the roots are a component in a remedy for leprosy (Rojas-Sandoval, 2018). *T. indica* was tested as an agroforestry species in Haryana, India, on reclaimed salt-affected soils with crops such as rice, wheat, pearl millet, mustard, lentils and sorghum. The reduction in crop yields was less with *T. indica* than with *Tectona grandis* or *Ailanthus excelsa*, due to the smaller canopy of *Tamarindus indica. T. indica* flowers are an important source of honey (Rojas-Sandoval, 2018).

Edible morphological parts of tamarind are the fruit pulp, leaves, flowers, and seeds. It is available in the market as a pod form or as a paste. The tamarind fruit pulp is eaten raw as a spice in various Indian food dishes like gravy dishes, cooked with vegetables or pulses with tamarind sauce. Tamarind is an important ingredient in chutneys (pickles) and is also added to some sea fish recipes called Tamarind Fish. Tamarind is a staple in the South Indian diet, where it is used to prepare *Rasam*, *Sambar*, *Puliyogare* (South Indian rice preparation with tamarind), *Pulikuzhambu* (sour soup of tamarind, with chili and salt) which are popular in Tamil Nadu. The tamarind fruit pulp is acidic in taste and has been used for centuries as a skin scrubbing material to promote smoother and lighter skin. The fresh sour leaves and flowers are mixed with vegetables, cooked, and eaten in India. In South India, flowers are used to prepare tangy pickles. *Seeds:* Seeds are rich in essential minerals and proteins. Tamarind seeds are roasted, fried, boiled, and consumed as snacks. Seeds contain high starch content which is used in food, paper, and jute industries. Tamarind

gum, obtained from the seed kernels forms a stiff gel and is used as a thickening, stabilizing, and gelling agent in the food industries. Seed kernel powder is used as a stabilizer during ice cream preparation. Seeds contain chemical constituent polyose which is used in the preservation of fruits (Muraga Raja., *et al*., 2022).

Nutrition (Muraga Raja., *et al*., 2022): The chemical composition of tamarind varies with respect to different parts of tamarind (Table 1). The tamarind fruit (dried and riped) consists of pulp and seed. The pulp constitutes 30–50 % of the ripe fruit and 11-30% of shell and fiber and 25-40% of seed.

Leaves and flowers: Tamarind leaves consists of essential oils, free and conjugated fatty acids and flavonoids. The presence of significant levels of selenium and other micro-elements also were identified. The leaf oil is rich in 25% of limonene and 41% benzyl benzoate. They also contain triterpenes, lupanone, and lupeol. Leaves are also a rich source of protein, lipid, fiber, and vitamins such as thiamine, riboflavin, niacin, ascorbic acid, and β-carotene. Leaves are composed of 13 essential oils, of which limonene and benzyl benzoate are the most important compounds, followed by pentadecanol and hexadecano.

Stem bark: The root bark was found to contain n-hexacosane, eicosanoic acid, b-sitosterol, octacosanyl ferulate, 21-oxobehenic acid, and (+)-pinitol. They also consist of flavonoids, cardiac glycosides, alkaloids, saponins, and tannins.

Bark: Tamarind bark is rich in tannins and polyphenols such as N-hexacosane, eicosanoic acid, b-sitosterol, octacosanyl ferulate, 21-oxobehenic acid, (+) - pinitol and phenolic antioxidant proanthocyanidins (catechin, procyanidin B2, epicatechin, procyanidin trimer, procyanidin tetramer, procyanidin pentamer, procyanidin hexamer along with taxifolin, apigenin, eriodictyol, luteolin and naringenin).

Pulp: The dried pulp consists of 8–18 % tartaric acid and 25–45% reducing sugars (70 % is glucose and 30 % fructose). The tender fruits contain around 16% free form of tartaric acid. The sweetness of ripe tamarind fruit is balanced by tartaric acid which has an intense acid taste. The fruit contains tartaric acid, reducing sugars, pectin, tannin, fiber, and cellulose. Tamarind contains organic acids like oxalic acid, succinic acid, citric acid, quinic acid, and a low level of ascorbic acid. Pulp was also identified with free amino acids namely proline, serine, β-alanine, phenylalanine, and leucine. These are a rich source of minerals like potassium, phosphorus, calcium, and iron.

They are high in magnesium, and sodium but low in copper and zinc. They excel in riboflavin, thiamine, and niacin whereas poor in vitamin A and C25. The volatile constituents were identified in pulp such as 2-phenyl acetaldehyde with a fruity and honey-like odor, 2-furfuryl with a caramel-like flavor, and hexadecanoic acid and limonene having a citrus flavour. TI (Trypsin inhibitor) is higher in the pulp than any other parts of tamarind.

Seed: The seed contains 20–30% seed coat (testa) and 70-75% kernel (endosperm). (70–75 %). The seed contains 13-20% protein and 5-16 % oil. Testa is also rich in 20 % and 41% benzyl benzoate14. They also contain triterpenes, lupanone, and lupeol. Leaves are also a rich source of protein, lipid, fiber, and vitamins such as thiamine, riboflavin, niacin, ascorbic acid, and β-carotene. Leaves are composed of 13 essential oils, of which limonene and benzyl benzoate are the most important compounds, followed by pentadecanol and hexadecanol.

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Seed: The seed contains 20–30% seed coat (testa) and 70-75% kernel (endosperm). (70–75 %). The seed contains 13-20% protein and 5-16 % oil. Testa is also rich in 20 % fibre and 20% tannins. Whole tamarind seed consists of crude protein, crude fibre, crude fat, tannins and TI. Seeds contain 63 % starch and 5–6% of semi-drying oil. It also contains phytic acid and albuminoid tannins. .

Table 1. Chemical constituents of various morphological parts

Morphological part	Chemical constituent
Leaves and flowers	Essential oils, free and conjugated fatty acids, flavonoids, selenium with other micro-elements, limonene, benzyl benzoate, pentadecanol, hexadecanol[14]triterpenes, lupanone, lupeol, protein, lipid, fibre, vitamins such as thiamine, riboflavin, niacin, ascorbic acid, β-carotene
Stem bark	n-hexacosane, eicosanoic acid, b-sitosterol, octacosanyl ferulate, 21-oxobehenic acid, and (+)-pinitol, flavonoids, cardiac glycosides, alkaloids, saponins, tannins
Bark	Tannins, polyphenols like N-Hexacosane, eicosanoic acid, b-sitosterol, octacosanyl ferulate, 21-oxobehenic acid, and (+) - pinitol and phenolic antioxidants, catechin, procyanidin B2, epicatechin, procyanidin trimer, procyanidin tetramer, procyanidin pentamer, procyanidin hexamer, taxifolin, apigenin, eriodictyol, luteolin and naringenin.
Pulp	Tartaric acid, reducing sugars, pectin, tannin, fibre, cellulose, organic acids like oxalic acid, succinic acid, citric acid, quinic acid, ascorbic acid, free amino acids namely proline, serine, β-alanine, phenylalanine and leucine, minerals like potassium, phosphorus, calcium, iron, magnesium, sodium, copper and zinc, vitamins like riboflavin, thiamine and niacin, volatile constituents such as 2-phenyl acetaldehyde and TI (trypsin inhibitor).
Seed	Protein, fibre, tannins, crude protein, crude fibre, crude fat, tannins, TI, carbohydrate, starch, phytic acid and albuminoid tannins.

Tamarind pulp is widely used for cooking in South and Southeast Asia, Mexico, the Middle East, and the Caribbean. The seeds and leaves are also edible.It is used in sauces, marinades, chutneys, drinks, and desserts. It's also one of the ingredients of Worcestershire sauce (Jennings, 2023). Tamarind pulp can also be used as a metal polish. It contains tartaric acid, which helps remove tarnish from copper and bronze. Tamarind is used as a flavoring in many dishes. It may also have medicinal properties and can be used as a tarnish remover (Jennings, 2023). Various parts of the tamarind plant are of interest to several industries for their potential in creating sustainable and low-cost products. In the food industry, it is used for the following: Substitute for lime, Preservative, Gelling agent, Thickener, Stabilizer. Tamarind may also be useful in areas such as: Biofuel, Construction industries, Goods packaging, Papermaking, Leather industries, Cosmetics (Jones, 2025). The fruits are used in cooking. Wood preferred for fuel. Bark ash mixed with coconut oil and applied to heal burn wounds. Local people believed planting tamarind tree in front of house brings bad omen. People used the fruit as a poultice applied to foreheads for treating fevers. It is also reported to have laxative, anti-microbial, antiparasitic, anti-fungal, anti-viral and anti-nematodal properties. They are also used for treatment of stomach ailments such as abdominal pain, diarrhea and constipation (Indiabiodiversity, 2025).

(Soni, 2025)

Flavoring Agent: Tamarind pulp is a staple in various cuisines, adding a tangy depth to dishes like Indian curries, Thai stir-fries, and Mexican salsas.

Beverages: In many cultures, tamarind is used to prepare refreshing drinks, such as the Mexican "agua de tamarindo" and Indonesian "es asem," offering a sweet and sour taste

Condiments and Sauces: It's a key ingredient in condiments like Worcestershire sauce and various chutneys, enhancing flavor profiles with its distinctive taste

(Soni, 2025)

Food & Beverages – Used in curries, chutneys, sauces, soups, candies, and refreshing drinks.
Pharmaceuticals – Tamarind extracts are used in traditional medicine for digestive and anti-inflammatory benefits.
Cosmetics & Skincare – Tamarind pulp is a natural exfoliant and skin brightening agent in beauty products.
Industrial Applications – Tamarind

The tamarind's almost-perfect sweet and sour balance makes it unusual in the plant world. The fruit may be eaten fresh, but it is most commonly used with sugar and water in the American tropics to prepare a cooling drink. Tamarind pulp is used to flavor preserves and chutney, make meat sauces, and pickle fish. Candy can be made by mixing the pulp with dry sugar and molding it into desired shapes. Southeast Asians often use the tamarind in combination with chiles to make a paste for basting fish and chicken that is to be grilled, like the recipe that follows—a dish that, once you try it, may make you become a tamarind devotee (Ciachef, 2025). Most parts of the tamarind tree (including the wood, bark, flowers, leaves, pulp and seeds) are used for a variety of commercial, culinary and medicinal purposes. Tamarind trees are used as shade trees and ornamental trees (common along highways and in parks) (Wikiwand, 2025; Wikipedia, 2025). The fruit pulp is edible and popular. It is used as a spice in both Asian and Latin American cuisines, and is also an important ingredient in Worcestershire sauce, HP sauce and the Jamaican-produced Pickapeppa sauce [(1)]. The hard green pulp of a young fruit is very tart and acidic and is most often used as a component of savory dishes. The ripened fruit is sweeter, yet still distinctively sour, and can be used in desserts and sweetened drinks, or as a snack. In Thailand, there is a carefully cultivated sweet variety with little to no tartness grown specifically to be eaten as a fresh fruit. The leaves are also distinctly tart in flavor, and are used in many soups in the North Eastern part of Thailand. In temples,

especially in Asian countries, the pulp is used to clean brass shrine furniture, removing dulling and the greenish patina that forms. The wood is a bold red color. Due to its density and durability, tamarind heartwood can be used in making furniture and wood flooring. A tamarind switch is sometimes used as an implement for corporal punishment. Tamarind trees are very common in South India, particularly in Tamil Nadu and Andhra Pradesh. They are used as ornamental trees and to provide shade on the country roads and highways. Tamarind is extensively used in the cuisine of both these states. Tamarind is a staple in the Tamil Nadu diet, where it is used to prepare Rasam, Sambhar, Puliyogare, and various types of chutneys. The pulp, leaves, and bark also have medical applications. For example, in the Philippines, the leaves have been traditionally used in herbal tea for reducing malaria fever. Due to its medicinal value, tamarind is used as an Ayurvedic Medicine for gastric and/or digestion problems. In Egypt, there is an acidic chilled drink made from tamarind which is popular in summertime. It is called "tamr hindi". In Madagascar, the tree is known as the kily tree. Its fruits and leaves are a well-known favorite of ring-tailed lemurs, providing as much as 50% of their food resources during the year if available (Wikidoc, 2025). Tamarind is available in specialty food stores worldwide in pod form or as a paste or concentrate. It is also sold in various snack forms in Southeast Asia and in Mexico where it is dried and salted, candied (see for example pulparindo), and served as a cold drink. Pad Thai, a Thai dish popular with Europeans and Americans, sometimes includes tamarind for its tart taste (though lime juice and/or white vinegar are more commonly used). A tamarind-based sweet-and-sour sauce served over deep-fried fish is also a common dish in Central Thailand. In Singapore and Malaysia it is used to add a sweet-sour taste to gravy for fish in a dish called asam fish. In the Philippines it is used to add a sour taste in Sinigang soup. In Latin America, especially Mexico, and Latin American immigrant communities in the US, the fruit is wildly popular and is fashioned into a drink, "Agua de Tamarindo", and many kinds of treats. Many popular *Tamarindo* concoctions are hard candies and suckers and one of the most popular aguas frescas is flavored with tamarind. In the state of Andhra Pradesh in India, a tangy pickle is made from Tamarind flowers. File:Tamarind clara.jpgTamarind on a place of the foundation of city Santa Clara, Cuba.The tamarind tree is the official plant of Santa Clara, Cuba. Consequently it appears in the coat of arms of the city. Other uses: tamarind has recently become popular in bonsai culture, frequently used in Asian countries like Indonesia, Taiwan and the Philippines. In the last Japan Airlines World Bonsai competition, Mr. Budi Sulistyo of Indonesia won the second prize with an ancient tamarind bonsai (Wikidoc, 2025). In addition to the traditional uses listed above, there are plenty of other ways to use tamarind in your kitchen. Here are a few suggestions. 1) Make a carrot-tamarind chutney to serve with pakoras or other fried foods. 2) Mix some prepared tamarind paste into a cocktail (maybe a michelada or whiskey sour?). 3) Brighten up your homemade barbecue sauce. 4) Make a tamarind-spiked peanut sauce for dunking everything from crudités to grilled chicken (Vaughn and Dunn, 2024).

Chemical composition

The tamarind fruit consists mainly of pulp and seeds. The fruit, both ripe and dry, contains mainly tartaric acid, reducing sugars, pectin, tannin, fi bre and cellulose. The whole seeds also contain protein, fat, sugars and carbohydrates. Both pulp and seeds are good sources of potassium, calcium and phosphorous and contain other minerals like sodium, zinc and iron (Saideswara Rao and Mary Mathew, 2012).

Pulp: The most valuable and commonly used part of the tamarind tree is the fruit. The pulp constitutes 30–50 % of the ripe fruit, the shell and fi bre account for 11–30 % and the seed about 25–40 %. The dried tamarind pulp of commerce contains 8–18 % tartaric acid (2, 3-dihydroxy butanedioic acid–C4H6O6, a dihydroxy carboxylic acid) and 25–45 % reducing sugars, of which 70 % is glucose and 30 % fructose. The tender fruits contain most of the tartaric acid in free form (up to 16 %). The sweetness of ripe tamarind fruit is, however, outweighed by tartaric acid which has an intensively acidic taste. The tartaric acid and the sugar contents reportedly vary from place to place. In Thailand, the tartaric acid content varied from 2.5–11.3 % and the sugar from 5.0–40.0 %. The former in sweet tamarind was as low as 2.0–3.2 % and the latter as high as 39.1–47.7 %. In sour tamarind the tartaric acid content varied from 8.4–12.4 % and the sugar from 21.4–30.9 %. Tamarind contains other organic acids, such as oxalic acid, succinic acid, citric acid and quinic acid. The ascorbic acid content in tamarind is reportedly very low and varies from 2–20 mg/100 g. Free amino acids, such as proline, serine, β-alanine, phenylalanine and leucine, were identified in the pulp. Tamarind pulp is rich in minerals such as potassium (62–570 mg/100 g); phosphorus (86–190 mg/100 g); and calcium (81–466 mg/100 g), and iron (1.3–10.9 mg/100 g). Magnesium content is high (25.6–30.2 mg/100 g), as is sodium (23.8–28.9 mg/100 g), whereas copper (0.8–1.2 mg/100 g) and zinc (0.8–0.9 mg/100 g) are low (Saideswara Rao and Mary Mathew, 2012). It also excels in ribofl avin and is a good source of thiamine and niacin, but is poor in vitamin A and vitamin C. The major volatile constituents of tamarind were reported. As mentioned earlier, the most outstanding characteristic of the tamarind fruit is that it is one of the most acidic of all fruits, because of its tartaric acid content which imparts the sour taste and outweighs the high total sugar content. It wsa reported that several pyrazines and thiazoles were found in tamarind and that the overall aroma of tamarind is characterized by its warm, citrus-like notes and some roasted undertones. Non-volatile fl avour components in the pulp have been identifi ed and analysed by using high-performance liquid chromatography. It was reported that major components of the volatiles were 2-phenyl acetaldehyde with a fruity and honey-like odour, 2-furfuryl with a caramel-like fl avour and hexadecanoic acid and limonene having a citrus fl avour. Volatile components of tamarind fruits were isolated by simultaneous steam distillation/solvent extraction as well (Saideswara Rao and Mary Mathew, 2012). Seeds: The seed consists of the seed coat or testa (20–30 %) and the kernel or endosperm (70–75 %). Unlike the pulp, tamarind seedis rich in protein (13–20 %) and oil (4.5–16.2 %). The seed coat is rich in fi bre (20 %) and tannins (20 %) as well. It was reported that whole tamarind seed contains 131.3 g/kg crude protein, 67.1 g/kg crude fi bre, 48.2 g/kg crude fat, 56.2 g/kg tannins and trypsin inhibitor activity (TIA) of 10.8, with most of the carbohydrate in the form of sugars. The trypsin inhibitor activity is higher in the pulp than in the seed, but both are heat labile. The seeds contain 63 % starch and 4.5–6.5 % of semi-drying oil. The seed also contains 47 mg/100 g of phytic acid, which has minimal effect on its nutritive value. It also contains 14–18 % albuminoid tannins located in the testa. Following the estimation of the composition of seeds and evaluation of its Properties opined that tamarind seeds are potential sources of food or food ingredients. The chemical

composition and nutritive value of tamarind seeds and kernels was determined by several workers. Fatty acid composition of tamarind kernel oil was reported by several workers. Among fatty acids, linoleic acid, oleic acid and palmitic acid were the major constituents. Dehusked tamarind seeds have been found to be a rich source of pectin, the jelly-forming constituent of many fruits, vegetables, seeds. Tamarind seed polysaccharide (TSP) is the purifi ed product as well as major component of tamarind kernel powder (TKP). TSP had different specifi cations to TKP. There have been numerous publications in the past 25–30 years concerning the primary structure of TSP. The functional properties of tamarind, such as nitrogen solubility index, waterabsorption capacity, emulsifying capacity, foaming capacity and foam stability, were analysed (Saideswara Rao and Mary Mathew, 2012).

Tamarind foliage, pods, seeds and pod husks are used as feedstuffs. The foliage has a high forage value, but it is rarely lopped for this purpose because it affects fruit yields (Heuzé and Tran, 2015). The seed meal has been recommended as a source of protein for cattle (Barman *et al*., 2006). The high tannin content of tamarind pod husks may be useful to depress methane production in crossbred dairy cows (Heuzé and Tran, 2015). Dairy cows fed a diet containing 7.5% pod husks showed a higher live weight gain and milk yield than animals fed a compouned feed mixture without tamarind seed husks (Heuzé and Tran, 2015). Ripe fruits have 40-50% edible pulp which contains (per 100 g): water 17.8-35.8 g, protein 2-3 g, fat 0.6 g, carbohydrates 41.1-61.4 g, fibre 2.9 g, ash 2.6-3.9 g. Fresh seeds contain 13% water, 20% protein, 6% fat, 59% carbohydrates and 2% ash. The acidity is caused by tartaric acid which does not disappear with ripening but is more or less matched by increasing sugar levels. Hence *T. indica* is said to be simultaneously the most acid and sweetest fruit. The average amount of crude protein in the leaves is 12-15%; this tends to vary with the season and locality (Rojas-Sandoval, 2018).

The tamarind fruit consists mainly of pulp and seeds. The fruit, both ripe and dry, contains mainly tartaric acid, reducing sugars, pectin, tannin, fibre and cellulose. The whole seeds also contain protein, fat, sugars and carbohydrates. Both pulp and seeds are good sources of potassium, calcium and phosphorous and contain other minerals like sodium, zinc and iron. The various components of tamarind are detailed in the following sections (Azad, 2018). The most valuable and commonly used part of the tamarind tree is the fruit. The pulp constitutes 30–50 % of the ripe fruit (Purseglove, 1987; Shankaracharya, 1998), the shell and fibre account for 11–30 % and the seed about 25–40 %. The dried tamarind pulp of commerce contains 8–18 % tartaric acid (2, 3-dihydroxy butanedioic acid-$C_4H_6O_6$, a dihydroxy carboxylic acid) and 25–45 % reducing sugars, of which 70 % is glucose and 30 % fructose. The tender fruits contain most of the tartaric acid in free form (up to 16 %). The sweetness of ripe tamarind fruit is, however, outweighed by tartaric acid which has an intensively acidic taste. The tartaric acid and the sugar contents reportedly vary from place to place. In Thailand, the tartaric acid content varied from 2.5–11.3 % and the sugar from 5.0–40.0 %. The former in sweet tamarind was as low as 2.0–3.2 % and the latter as high as 39.1–47.7 %. In sour tamarind the tartaric acid content varied from 8.4–12.4 % and the sugar from 21.4–30.9 %. Tamarind contains other organic acids, such as oxalic acid, succinic acid, citric acid and quinic acid. The ascorbic acid content in tamarind is reportedly very low and varies from 2–20 mg/100 g.

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A single cup (120 grams) of the pulp contains (Jennings, 2023):
Magnesium: 26% of the daily value (DV)
Potassium: 16% of the DV
Iron: 19% of the DV

Calcium: 7% of the DV
Phosphorus: 11% of the DV
Copper: 11% of the DV
Vitamin B1 (thiamin): 43% of the DV
Vitamin B2 (riboflavin): 14% of the DV
Vitamin B3 (niacin): 15% of the DV
It has trace amounts of (Jennings, 2023).

It also contains 6 grams of fiber, 3 grams of protein, and less than 1 gram of fat. This comes with a total of 287 calories. These calories almost all come from sugar — but whole fruits do typically contain a lot of natural sugar. Despite its sugar content, tamarind pulp is considered a fruit, not an added sugar. Added sugar is the kind that's linked to metabolic syndrome and type 2 diabetes, and it's the kind of sugar that the Dietary Guidelines for Americans recommend that you limit. It also contains polyphenols, which are naturally occurring plant compounds that have health benefits. Many of them act as antioxidants in the body. Tamarind contains vitamins, minerals, amino acids, and beneficial plant compounds (Jennings, 2023).

Tamarind is a rich source of essential nutrients and minerals, making it a popular ingredient in many traditional Indian dishes. It is particularly high in vitamin C, which is essential for maintaining a healthy immune system, and also contains significant amounts of vitamin B, calcium, iron, and phosphorus. In addition to its nutritional value, tamarind has several potential health benefits. It is known for its anti-inflammatory properties and may help to reduce pain and inflammation in the body. Tamarind is also believed to have antimicrobial properties, which may help to fight off bacterial and fungal infections. Tamarind is also a good source of antioxidants, which can help to protect the body against damage from free radicals. Free radicals are unstable molecules that can cause oxidative stress and damage to cells, which can contribute to the development of chronic diseases such as cancer, heart disease, and Alzheimer's disease. Overall, tamarind is a nutritious and healthy ingredient that can be enjoyed in a variety of dishes. However, it is important to consume tamarind in moderation, as it is high in sugar and can be detrimental to dental health if consumed in excess. In conclusion, the Tamarind tree is a vital part of Indian culture and cuisine, with numerous benefits for both humans and the environment. Its unique taste and health benefits make it a popular ingredient in traditional dishes and modern culinary creations. Additionally, its ability to thrive in harsh conditions and improve soil fertility make it a valuable addition to agroforestry practices. The ecological role of the Tamarind tree cannot be overlooked, as it provides food and habitat for a variety of animals and insects, contributing to the overall biodiversity of the ecosystem. Its adaptability to different soil types and climatic conditions make it a versatile and resilient tree, capable of withstanding various environmental stresses. The commercial cultivation of Tamarind in India has provided farmers with a steady source of income, particularly in rural areas. Its low maintenance requirements and high economic value make it an attractive crop for small and marginal farmers, who can benefit from the additional income generated by selling its fruits. Overall, the Tamarind tree is an important component of India's rich biodiversity and cultural heritage. Its potential for environmental, economic, and social benefits make it a tree worth cultivating and preserving for future generations (Greenverz, 2025).

Energy 239 calories; total fat 0.6gm; sodium 28mg; potassium 628mg; carbohydrate 62 gm; dietry fibres 5 gm; sugar 57 gm; protein 2.8 gm; vitamin C 5%; vitamin B6 5%; calcium 7 %; iron 15% & magnesium 23% per 100 gms of the fruit plup. The tender leaves and fruits are made into a chutney. The bark is used for medicinal preparation. Wood very hard and heavy used for agricultural purposes and constructions. Both unripe and ripe fruit are edible. Children are fond of eating the flowers and leaves (Indiabiodiversity, 2025). Tamarind is nutritious. The pulp contains vitamin C. Its leaves are a source of lipids, fatty acids, vitamins, and flavonoids. Tamarind fruit is considered by the World Health Organization to be an ideal source of all essential amino acids except tryptophan. Its seeds may be used as an accessible protein source in areas where protein malnutrition is common.4 Protein and amino acids contribute to building strong muscles. The nutrition content of 100 grams of raw tamarind includes: Water: 31.4 grams, Energy: 239 kilocalories, Protein: 2.8 grams, Total lipid (fat): 0.6 grams, Ash: 2.7 grams, Carbohydrate, by difference: 62.5 grams, Fiber, total dietary: 5.1 grams, Sugars, total: 38.8 grams, Calcium: 74 milligrams, Iron: 2.8 milligrams, Magnesium: 92 milligrams, Phosphorus: 113 milligrams, Potassium: 628 milligrams, Sodium: 28 milligrams, Zinc: 0.1 milligrams, Copper: 0.086 milligrams, Selenium: 1.3 micrograms, Vitamin C, total ascorbic acid: 3.5 milligrams (Jones, 2025). The nutritional values per 100 gms of tamarind are: Vitamin A: 30 I.U. Vitamin B: Thiamine .34 mg.; Riboflavin: .14 mg.; Niacin: 1.2 mg.; Vitamin C: 2 mg. Calcium: 74 mg. Iron: 2.8 mg. Phosphorus: 113 mg. Fat: .6 gm. Carbohydrates: 62.5 gm. Protein: 2.8 gm. Calories: 239 (Aarevah, 2025).

Raw tamarind is 63% carbohydrates, 31% water, 3% protein, and 1% fat. In a reference amount of 100 g (3.5 oz), raw tamarind supplies 240 calories of food energy, and is a rich source (20% or more of the Daily Value, DV) of thiamine (36% DV) and dietary minerals, including magnesium and potassium at 22% and 21% DV, respectively. Lupeol, catechins, epicatechin, quercetin, and isorhamnetin are present in the leaf extract. Ultra-high performance liquid chromatography analyses revealed that tamarind seeds contained catechin, procyanidin B2, caffeic acid, ferulic acid, chloramphenicol, myricetin, morin, quercetin, apigenin and kaempferol (Wikipedia, 2025). *Tamar hindi* or Indian date was the evocative name given by Persians and Arabs to the commonly found tamarind. Within the brittle, brown pod is a fleshy acid fruit that contains tartaric acid and pectin (Manikanthan, 2025).

The fruit is harvested by pulling the pod from its stalk. A mature tree can produce up to 175 kilograms of fruit per year. Veneer grafting, shield (T or inverted T) budding, and air layering may be used to propagate desirable cultivars. Such trees will usually fruit within three to four years if provided optimum growing conditions. The fruit pulp is edible. The hard green pulp of a young fruit is considered by many to be too sour, but is often used as a component of savory dishes, as a pickling agent or as a means of

making certain poisonous yams in Ghana safe for human consumption. As the fruit matures it becomes sweeter and less sour (acidic) and the ripened fruit is considered more palatable. The sourness varies between cultivars and some sweet tamarind ones have almost no acidity when ripe. In Western cuisine, tamarind pulp is found in Worcestershire sauce, HP Sauce, and some brands of barbecue sauce (especially in Australia, with the tamarind derived from Worcestershire sauce. Tamarind paste has many culinary uses including as a flavoring for chutneys, curries, and the traditional sharbat syrup drink. Tamarind sweet chutney is popular in India and Pakistan as a dressing for many snacks and often served with samosa. Tamarind pulp is a key ingredient in flavoring curries and rice in south Indian cuisine, in the Chigali lollipop, in rasam, Koddel and in certain varieties of masala chai. Across the Middle East, from the Levant to Iran, tamarind is used in savory dishes, notably meat-based stews, and often combined with dried fruits to achieve a sweet-sour tang. During Ramadan, tamarind is used to prepare a traditional beverage known as "tamr-hindi," which is particularly popular in the Levant region. The drink is made by boiling tamarind paste in water, sweetening it with sugar, and then straining the mixture. In some variations, rosewater and lemon juice are added to enhance its flavor. Street vendors play a significant role in distributing this beverage, carrying large copper pots filled with the juice on their backs. They typically arrange numerous cups around their waist to conveniently serve the drink to passersby in the streets. In the Philippines, the whole fruit is used as one of the souring agents of the sour soup *sinigang* (which can also use other sour fruits), as well as another type of soup called *sinampalukan* (which also uses tamarind leaves). The fruit pulp are also cooked in sugar and/or salt to make *champóy na sampalok* (or simply "sampalok candy"), a traditional tamarind candy. Indonesia also has a similarly sour, tamarind-based soup dish called sayur asem. Tamarind pulp mixed with liquid is also used in beverage as tamarind juice. In Java, Indonesia, tamarind juice is known as *es asem* or *gula asem*, tamarind juice served with palm sugar and ice as a fresh sour and sweet beverage (Wikiwand, 2025). In Mexico, Central America, and the Caribbean, the pulp is diluted with water and sugared to make an agua fresca drink. It is widely used throughout all of Mexico for candy making, including tamarind mixed with chilli powder candy. In Sokoto, Nigeria, tamarind pulp is used to fix the color in dyed leather products by neutralizing the alkali substances used in tanning. Tamarind pulp is the most common part of the tamarind plant utilised for culinary purposes, being used in a range of chutneys, curries, sauces (such as orcestershire sauce and barbecue sauce) and beverages (such as tamarindo). In Sri Lanka tamarind pulp has been used as a lime alternative and in Senegal the pulp is mixed with sugar to produce sweet meats known as 'bengal'. In India tamarind pulp is made into a juice used in the preservation of fish and in many countries of East Africa the pulp is used in the making of a dish called 'ugali' (a type of maize flour porridge). Tamarind fruits have been utilized in the production of tamarind syrup in Puerto Rico which is used by street vendors to flavor shaved ice. The seeds of the tamarind plant are also used for culinary purposes but the whole seed cannot be directly consumed and need to be soaked and boiled in water before they are edible. The seeds are commonly used in jellies, marmalades and jams because they contain pectin which gives them 'jelly forming properties' and have also been used as a stabilizer in the production of cheese, ice cream and mayonnaise. In Indonesia, after the seeds have been roasted, they are consumed as a snack accompanied with salt and grated coconut and in Thailand tamarind seeds are used as a coffee alternative. The leaves and bark are also edible, and the seeds can be cooked to make safe for consumption. Blanched, tender tamarind leaves are used in a Burmese salad called *magyi ywet thoke.* Tamarind seeds contain high levels of protein (26.9 grams per 100 grams) and oil (10.9 grams per 100 grams) and in some countries, tamarind seeds are used as an emergency food because of their high protein levels. The leaves of the tamarind plant are high in calcium and protein and have been consumed by domestic animals and wild animals, including elephants, as a fodder (Wikiwand, 2025).

Folklore Medical Practices (Muraga Raja *et al*., 2022).

For Hand, Leg and Joint Pain: Matured tamarind leaves and castor oil are used to relieve pain. Castor oil is slightly warmed and applied to the parts where pain exists. After applying the castor oil, tamarind leaves are patched. The leaves are left in the pain areas for about three hours, after which the area is washed with hot water. The same procedure is repeated both in the morning and in the evening for three days continuously. Pain is relieved, especially in the joints. On these three days of treatment, pepper, dried ginger, garlic, and asafoetida are finely ground and the same mixture is used for preparing curry. This curry has to be consumed with freshly boiled rice.

For Inflammation: The tamarind leaves are separated and sauted (fried) in a mud pot with a spoonful of neem (*Azadirachta indica*) oil. These leaves are applied to the inflammated areas when it is hot. For Bronchial Asthma: Two handfuls of tamarind leaves are mixed with the fresh decanted rice water (starch) from cooked rice. This mixture is mixed thoroughly so that the leaves are spread evenly throughout the rice water. The mixture is kept overnight. The next day, leaves are separated from the mixture and the leaves are ground in a stone grinder with 3g of *Alpinia officinarum*. The grounded leaves are squeezed to get the extract (juice). To the above extract, a half tumbler lemon juice (without seeds) is mixed. Freshly prepared above mixture is given to the patients with bronchial asthma only in the morning for five continuous days.

For Wounds: Tamarind leaves are boiled with three glasses of water. Water is decanted while hot. This water is used to wash the wounds before the application of any medicine.

For Eye Diseases: The tender leaves of tamarind are cooked with pigeon pea (toor dal) and eaten with rice to get rid of eye diseases. The tamarind leaves are ground and applied around the eyes for the treatment of irritation and redness in the eyes and are also used in other eye diseases.

To Reduce pitham: Pickle (chutney) is prepared by grinding a mixture of a handful of tamarind flowers, stone salt (*sendha namak*), tamarind fruit pulp, ginger, and coriander leaves in a stone grinder. This chutney when consumed with fresh rice in the

morning will gradually reduce *pitham*. The above procedure is also followed with tender fruits of tamarind instead of tamarind flowers.

For Cold: A handful of tamarind leaves are boiled with water in a mud pot, cooled and filtered. Half a tumbler of this mixture with sugar is consumed early morning and evening to cure cold.

For Arthritis: Equal quantities of tamarind leaves and flowers sauted (fried) with castor oil. This mixture is applied to the areas of pain which gradually reduces all kinds of arthritis.

For Painful Urination (Dysuria): A handful of cleaned tamarind flowers are boiled in one tumblerful of water in a mud pot, cooled, and filtered. To a half tumbler of the above filtrate, one spoonful of palm sugar is added and consumed both in the morning and in the evening. Gradually the painful urination gets cured. For painful urination due to an overheated body, the seeds of the tamarind fruit are taken two in numbers and chewed along with the outercoat of the seed.

For Blood Clots: Curry is prepared with the thick ripe fruit pulp of tamarind. This curry is taken in an iron spoon and salt is added in a ratio of 1:4 and heated. This hot mixture is applied to the blood clot area as treatment.
For Poisoning due to Scorpion Bite: Ripe pulp of tamarind fruit is mixed with an equal quantity of slaked lime in the palm. In this process, heat is generated. This mixture, while hot is applied to the scorpion biten area. The mixture gets patched up on the applied area which absorbs the poison.

For Dysentery: The outer covering is removed from the seeds of the tamarind fruit. The removed covers of seeds are sauted and ground in a stone grinder into a fine powder. The measured quantity of the above powder is mixed with a spoonful of honey and consumed both in the morning and evening which cures dysentery.

For Nervous Weakness (Sexual Dysfunction): The outer covering of the seeds of the tamarind fruit is removed and the white inner part (kernel) of the seed is fried to redness. This fried inner part of the seed is ground into powder and stored in a wide-mouthed glass bottle. One teaspoonful of this powder is mixed with a tumblerful of boiled cow's milk and a spoonful of rock sugar is consumed before going to bed for continuous 40 days. It is strictly advised that there should not be any sexual intercourse during this treatment period.

For Hot Wounds: This treatment is for the boil wounds due to hot water, hot oil, or boils due to fire. The bark of tamarind is dried, ground in a stone grinder, and sieved. The above mixture is stored in a wide-mouthed container. Coconut oil is applied to the boil wound and the prepared powder is sprinkled on the coconut oil and again a layer of coconut oil is applied. This way of application for continuous 7 days heals the boil wounds.

For Inflammation in Uvula (Tonsils): An equal quantity of old fruit pulp of tamarind and salt is ground into a fine paste in a stone grinder. This paste is applied to the uvula to reduce inflammation.

For Dental Diseases: The outer covering of the seeds of the tamarind fruit is removed by grinding in the stone grinder with an iron rod. The outer covering of the seed is collected and the same quantity of bark of *Prosopis juliflora* (*Karuvelam pattai*) is ground in a stone grinder into fine powder. To this, salt is added in the ratio of 1:8 and mixed well. This mixture is stored in a wide-mouthed glass container and is used to brush the teeth in the morning. This practice will gradually prevent and cure all kinds of tooth diseases.

For Peptic Ulcer: The inner bark of the tamarind tree is dried in sun, ground into powder in a stone grinder, and sieved. This powder is stored in a container and consumed on daily basis to get rid of peptic ulcers and also other stomach disorders.

Health Benefit (Muraga Raja *et al*., 2022)

General: Researches have showed that tamarind pulp, seed, leaves and stem bark have pharmacological activities such as antimicrobial, antioxidant, antiinflammatory, molluscidal, hypoglycaemic, tihypercholesterolemic activity, antidiabetogenic, antivenom, and antiemetic, immunomodulatory, retarding fluorosis, antiplatelet, analgesic, UVB protection and corneal healing.

Antioxidant Activity: Tamarind fruit was found to contain high levels of phenolics and showed high antioxidant activity. High ntioxidant activity could provide protection against certain human degenerative conditions related with oxygen free radical damage. Tamarind fruit or foodstuffs from tamarind fruit pulp may act as functional foods, providing beneficial effects on human health. *T. indica* seeds are important sources of antioxidant activity as it contains 2-hydroxy3',4'-dihydroxyacetophenone, metdihydroxybenzoate, (-)-epicatechinand 3,4 dihydroxyphenylacetate, in addition to oligomeric proanthocyanidins (OPC). OPCs are potent antioxidant, anti-inflammatory, antihistaminic agent and ultraviolet protection. OPCs also stabilize elastin, collagen and ground substances. A detailed study on the composition of *T. indica* seeds were done to evaluate its antioxidant potential, fatty acid profile and content of tocopherols. The findings led to the interest in using the extract derived from the seeds of tamarind for cosmetics.

Hypoglycemic Activity: Aqueous extract of the tamarind seeds had potent antidiabetic activity that reduced blood sugar levels in streptozotocin (STZ) induced diabetic male rat. The tamarind seeds are included in a lower percentage in diet (4% and 8%) and

were found to reduce the blood glucose level and serum cholesterol in rats. Administration of seed pectin also reduced blood glucose concentration by 30% after 24 hours. Another study was done on human volunteers for preventing and/or treating type 2 diabetes.

Anti-Hypercholesterolemic/Anti-Hyperlipidemic Activity: Treatment of obese rats with the *T. indica* pulp extract showed decrease in the levels of plasma total cholesterol, low-density lipoprotein cholesterol and triglyceride and increased high density lipoprotein cholesterol leve.

Antimicrobial Activity: Phytochemical studies of the leaf extracts showed the presence of saponins, alkaloids and glycosides. The extracts were active against both gram positive and gram negative bacteria. Tamarind consisted of a broad-spectrum of antimicrobial action which could be considered as highly active against infectious disease and also for chemotherapy. *T. indica* leaf extracts showed anti-*Burkholderia pseudomallei* (a life-threatening infection common among paddy cultivators) inhibitory potentials under *invitro* conditions. Also, a study showed aqueous and fluid extracts of fresh and dried tamarind leaves were found to contain phenols and flavonoids. The phenols were found to be active against *Bacillus subtilis* cultures, but not against other microorganisms. The antimicrobial activity of the ethanolic extract of the stem bark of *T. indica* was notable, however, the tamarind fruit extracts exhibited comparatively better action.
Antivenom Activity: Tamarind seed extract showed to reduce and neutralize the effects of envenomation such as local tissue damage, inflammation and hypotension caused by the venom of *Vipera russelli.*

Analgesic Activity: Phytochemical test showed the presence of sterols and triterpenes in the extract, hence Tamarind plant parts might be responsible for the analgesic activity.

Spasmogenic and Spasmolytic Activity: he aqueous extract of *T. indica* was found to induce spasm. Another study showed that, the methanolic extract of tamarind fruits have spasmolytic activity.

Anti-aging Activity: Extracts of *T. indica* were found to exhibit antioxidant effect, and also showed antiglycation effect which could be further developed for use in anti-aging cosmetics.

Sialagogue Activity: Tamarind has been reported to increase the flow of Saliva.

For Preventing Pregnancy: In Tamil Nadu, India, tribals of the *Anaikkatty* hills drink the ground root bark powder infusion for abortion and to prevent pregnancies.

Other Uses: In West Africa, tamarind bark is used to treat diarrhoea, also in East Africa, the leaves are used for similar purpose. In the Philippines and Eastern Sudan, the bark is used as astringent and is also used as a tonic and in lotions or poultices to treat the sores, ulcers, boils and rashes. In Kenya, bark decoction is used to treat cough and as a gargle to treat sore throat. In Uganda, decoction of the bark is used for treating uterine fibroids and root decoction is used to treat syphilis. In the Philippines, tamarind flower extract is used as a remedy for eye diseases and conjunctivitis.

The various parts of tamarind either alone or as formulation were tested for their clinical efficacy. The clinical efficacy of tamarind evaluated are discussed below and also shown in Table 2.

Tamarind has played an important role in traditional medicine. In beverage form, it was commonly used to treat diarrhea, constipation, fever, and malaria. The bark and leaves were also used to promote wound healing. Modern researchers are now studying this plant for potential medicinal uses. The polyphenols in tamarind have antioxidant and anti-inflammatory properties. These can protect against diseases such as heart disease, cancer, and diabetes (Jennings, 2023):

Its antioxidants may boost heart health: This fruit may boost heart health in several ways. It contains polyphenols like flavonoids, some of which can help regulate cholesterol levels. One study in hamsters with high cholesterol found that tamarind fruit extract lowered total cholesterol, LDL (bad) cholesterol, and triglycerides (4Trusted Source). Another animal study in vivo found that the antioxidants in this fruit can help reduce oxidative damage to LDL cholesterol, which is a key driver of heart disease. Tamarind pulp contains plant compounds that may protect against heart disease and oxidative damage but more research needs be conducted on human participants in order to better understand its benefits.

It's high in beneficial magnesium: Tamarind is also relatively high in magnesium. One ounce (30 grams), or a little less than 1/4 cup of pulp, delivers 5% of the DV. Magnesium has many health benefits and plays a role in more than 600 body functions. It can also help lower blood pressure and has anti-inflammatory and antidiabetic effects. However, up to 20% of people in the United States do not get enough magnesium. It may have antifungal, antiviral, and antibacterial effects: Tamarind extract contains natural compounds that have antimicrobial effects (6). In fact, studies show that this plant may have antifungal, antiviral, and antibacterial activity (6). It has also been used in traditional medicine to treat diseases like malaria (1). A compound called lupeol is credited with tamarind's antibacterial effects (1). Several studies show that tamarind can combat many different microbes. It may help kill bacteria, viruses, fungi, and parasites.

Tamarind candy may lead to unsafe levels of lead: Lead exposure is dangerous, especially for children and pregnant people. It can damage the kidneys and nervous system. The Centers for Disease Control and Prevention (CDC) cited tamarind candy as a

Table 2. Clinical studies on Tamarind

Sl. No	Medicinal use	Plant part used	Type of study	Study finding	References
1.	Genitourinary system	Seed powder	Randomised, double-blind, controlled	Improved premature ejaculation	56
		Fruit pulp	Single blind randomised controlled trial	Reduced low backache and lower stomach discomfort in women with abnormal vaginal discharge	57
		Seed powder tampons	Single blind randomised controlled trial	Restored uterine prolapse and showed symptomatic relief	58
		Seed powder	Double-blind randomised clinical trial	Reduced vaginal discharge, pelvic pain and cervical irritation in bacterial vaginosis	59
		Pulp powder	Interventional clinical study	Menstrual bleeding and stomach pain improved in women who missed their menstruation	60
2.	Cardiovascular system	Leaves powder	Quasi-experimental research	Enhanced haemoglobin levels in anaemic subjects	61
3.	Skeletal system	Seed extract	Double blind clinical investigation	Reduced physical activity-induced knee discomfort and restored joint activity in non-arthritic people	62
		Seed extract	Double-blind placebo-controlled clinical trial	Enhanced knee joint function and reduced discomfort in osteoarthritic patients	63
		Leaves	Single-blind randomized controlled trial	Hot herbal compress containing tamarind & other herbs lowered pain intensity and enhanced pain pressure threshold in myofascial pain syndrome patients	64
4.	Anti-inflammatory system	Seed extract	Double-blind placebo-controlled clinical trial	inhibited the pro-inflammatory markers IL-6, TNF-α, C-reactive protein, matrix metalloproteinase 3, and cartilage degradation product in the blood in osteoarthritic patients	65
5.	Drug facilitation	Fruit extract	Pharmacokinetic study	Increased bioavailability of aspirin &ibuprofen in healthy volunteers	66, 67
6.	Endocrine system	Pulp with other herbs	Randomised cross-over study	Significantly lowered postprandial insulinemic responses in healthy young people	68
		Fruit pulp	Randomized trial	Reduced total cholesterol and low density lipoprotein (LDL) in healthy subjects	69
7.	Metabolism	Fruit pulp	Case report	Reduced the liver enzymes SGOT and SGPT as an adjunct treatment in anticancer drug-induced hepatotoxicity	71
8.	Digestive system	Bark and leaves	Comparative clinical trial	Indigestion, heartburn, acid eructation, nausea, flatulence, weariness, and anorexia were reduced	72
		Xyloglucan from seeds	Multicenter open label randomised clinical trial	Treatment of acute diarrhoea, improved diarrhoeal symptoms, nausea, vomiting, and flatulence in children with acute gastroenteritis	73, 74, 75
9.	Skin	Fruit extract lotion	Double- blind, randomized side of face and placebo-controlled trial	Melanin value reduced in facial skin	77
		Fruit extract lotion	Single-blinded, randomized side of arm, and controlled study	Did not produce erythema or transdermal water loss indicating safety profile	78
		Polyherbal gel of tamarind	Placebo controlled clinical trials	Reduced the stiffness, thickness, pigmentation, and irregularity of post-surgical scar development in patients who had bilaterally symmetric procedures	79, 80
10.	Eye	Tamarind seed polysaccharide	Open-label, randomised, single-centre clinical study and randomized, double-masked study	Ocular surface disease index (OSDI) score improved when compared to baseline and control values. Decreased tear breakdown time, corneal and conjunctival damage	81, 82
		Tamarind seed polysaccharide eye drops	Prospective, multicenter study	Reduced hyperaemia in conjunctiva, pain, burning and stinging sensation in glaucoma patients. Corneal and conjunctival sensitivity improved in glaucoma patients	83, 86
		Tamarind seed polysaccharide eye drops	Interventional, prospective, contralateral eye trial	Enhanced tear production and tear stability	84
		Tamarind seed polysaccharide eye drops	Prospective, randomized, controlled study	Keratoconjunctivitis patients benefited from dry eye with improved ocular surface protection	85
11.	Antioxidant activity	Dietary supplement of tamarind	Prospective, single arm design study	Increased antioxidant status by lowering the oxidative stress marker 8-hydroxy-2-deoxyguanosine and enhancing antioxidant capacity in glaucoma patients	87
12.	Unspecified	Fruit pulp	Randomised diet-controlled clinical trials	Increased fluoride excretion in urine in school children. Reduced zinc, magnesium, and creatinine elimination but had no effect on calcium or phosphorous elimination	88, 89

cause of lead poisoning in several cases in 1999. The fruit itself doesn't contain lead. However, because it is acidic, it may cause lead to leech from certain ceramic vessels into food. Although it has fewer calories and less sugar than many other types of candy, it is still candy — making it the least nutritious form of tamarind. Some tamarind candy has been found to contain unsafe amounts of lead, due to cross-contamination. For that reason, children and pregnant people should consult a healthcare professional before consuming it.

How to eat tamarind: You can enjoy this fruit in several ways. One is to simply eat the fruit from the raw pods, as shown in this video. You can also use tamarind paste in cooking. You can either prepare it from the pods or purchase it as a block. The paste is often mixed with sugar to make candy. Tamarind can also be used to make condiments like chutney. Additionally, you can use the frozen, unsweetened pulp or sweetened tamarind syrup for cooking. You may also use this fruit to add a sour note to savory dishes, instead of lemon. There are several ways to enjoy tamarind. It can be used in sweet and savory dishes or eaten straight from the pod. Tamarind has been used in traditional medicine for centuries. According to a research review, it has traditionally been used to (Welch and Kayli Anderson, 2024): Treat gastrointestinal symptoms like diarrhea, constipation, and abdominal pain. Promote wound healing. Fight bacterial infections. Treat malaria and Reduce fever. Modern-day scientists are currently looking into the potential health benefits of tamarind. Just keep in mind that research is still very early, and not all of it is in humans. That said, there's some evidence to suggest it may be worth studying in humans as a next step to see if these perks hold true, including: Reducing oxidative stress, Improving heart health, Treating high blood pressure and Protecting the liver (Welch and Kayli Anderson, 2024). Tamarind is considered to be generally safe when consumed in moderate amounts. "There are no reported cases of toxicity associated with the consumption of tamarind, and the amount typically used in food is unlikely to cause any harm." And given the fact that tamarind is a laxative, you may want to avoid eating large amounts of the fruit since it may cause gastrointestinal issues. Additionally, people with diabetes may want to stay away from any forms of tamarind that contain added sugars, such as candy or soda, to avoid blood sugar spikes. You may also want to check the FDA website to ensure there hasn't been an import alert issued on the tamarind product you're consuming. In the past, the FDA has issued warnings about certain tamarind products due to issues such as lead contamination or questions about proper evidence demonstrating that the product is free from contaminants that don't meet U.S. standards for cleanliness and safety (Welch and Kayli Anderson, 2024). You already know that fruit is healthy. But what's so great about tamarind in particular? "Tamarind is rich in antioxidants and high in calcium, fiber and magnesium," Peart shares. Tamarind's nutritional profile makes it clear that it can be a healthy addition to your diet. So, if you're ready to get snacking or to start cooking, consider this your all-clear to give it a go. "Tamarind is nutrient-rich, so, on balance, it's a healthy food when you enjoy it in moderation," Peart adds. "Just stick to one serving at a time, which is half a cup." Here's a look at what that means for you and some of the potential and proven health benefits of tamarind (Health, 2024):

Full of antioxidants*:* Antioxidants are naturally occurring chemicals found in some foods. They help your body fight cellular damage from free radicals, unstable molecules that can cause oxidative stress and can lead to disease and other health issues, including: Autoimmune diseases. Cardiovascular and inflammatory disease. Cataracts. Cancer. Neurodegenerative diseases, like Alzheimer's and Parkinson's. But antioxidants pair up with free radicals and prevent them from going rogue inside your body. That means they have big overall benefits for your health — and tamarind is full of them. It's especially high in an antioxidant called beta-carotene, which supports eye health.

Good source of magnesium*:* One serving of tamarind offers more than 25% of your recommended daily amount of magnesium. This important nutrient supports more than 300 essential processes in your body, including regulating nerve and muscle function, maintaining blood pressure control and maintaining strong bones.

Helps reduce inflammation: Inflammation in the body is associated with all sorts of risks, including injury, illness and chronic diseases. But reducing inflammation reduces your risks — and your diet can go a long way in helping that. "Tamarind pulp is rich in potassium and polyphenols, like flavonoids, which reduce inflammation," Peart says. Flavonoids are natural plant chemicals with antioxidant properties, and antioxidants are one of the key fighters against inflammation. That doesn't mean that tamarind alone will be the superhero you need to combat inflammation. But it can definitely help.

May play a role in obesity therapy*:* Tamarind seeds in particular may play a role in helping manage and treat obesity. "Obesity triggers metabolic and hormonal changes related to low-grade, chronic inflammation," Peart explains. "Tamarind is a powerful anti-inflammatory that contains trypsin inhibitor, a molecule involved in hunger and satiety hormones that can essentially lead to a feeling of fullness." More studies are needed to determine exactly how and whether trypsin inhibitors have a role to play in obesity treatment, but some of the evidence is promising so far.

May be good for people with diabetes*:* If you have diabetes, you're probably already familiar with the glycemic index. It classifies foods with carbohydrates in them based on whether they're likely to raise your blood sugar. Foods that rank low on the glycemic index are less likely to cause your blood sugar to rise quickly, making them a good choice for your diet. This is especially important if you have diabetes — and tamarind may be one of those foods. Right now, there's limited evidence of this possible benefit, but researchers continue to study it. "Tamarind is relatively high in sugar, at 34 grams per half cup," Peart notes, "but it's also low on the glycemic index, which means that it doesn't cause spikes in blood sugar. Its potential role in diabetes management is still being sorted out*."*

In Southeast Asia, tamarind fruit is used as a poultice applied to the foreheads of people with fevers. The fruit exhibits laxative effects for relief of constipation. Extracts of steamed and sun-dried old tamarind pulp (*asem kawa*) in Java are used to treat skin problems, like rashes and irritation; one traditional practice indicated tamarind could be ingested after dilution for use as an

abortifacient. Different parts of the tamarind plant have been used globally for other purposes in folk medicine.https://en.wikipedia.org/wiki/Tamarind#cite_note-:444-40 In the northern parts of Nigeria, the roots of the tamarind plant are used to treat leprosy and in America tamarind pulp has been utilised as a laxative and to treat a range of ailments such as alleviating sunstroke and sore throats. In Thailand the pulp has been transformed into a tablet to reduce excess weight and in Brazil the pulp is used for its moisturising effects. The pulp has also been used in traditional medicine to treat colds, diarrhoea and to reduce inflammation. Tamarind seeds have been used in powdered form to aid dysentery in India and Cambodia and in Ethiopia softened tamarind seeds are used to rid parasitic worms. The bark of the tamarind tree is used to treat malaria in Uganda and has been made into lotions in the Philippines to treat ulcers and boils (Wikipedia, 2025).

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Health benefits of tamarind, a tropical fruit, include providing antioxidants and lowering blood glucose. Researchers are exploring how tamarind might help protect against health conditions such as diabetes, inflammatory bowel disease, cardiovascular diseases, and more. Traditionally, the fruit is used in cooking, but various parts of the plant are also employed industrially, contributing to biofuels, electrochemical, and composite industries. Tamarind is used medicinally in countries like Bangladesh, India, Sudan, and Nigeria. Research has shown that it may offer several health benefits. Tamarind has been shown to have strong antioxidant properties.3 Antioxidants are substances in the body and available through food or supplements that help protect cells and promote overall wellness. One of the main effects of antioxidants is the reduction of harm from free radicals (unstable molecules that can damage healthy cells). The positive impact of tamarind in protecting cells has been observed in studies such as one that found it countered free radical damage to the liver. Some preliminary research has shown a connection between the antioxidant properties in tamarind and possible anti-cancer effects. Although most research consists of small samples or was done on animals, there is preliminary evidence that tamarind extracts or gum may help in the following ways: 1) Delaying the progress of carcinoma. 2) Improving the efficacy of tamoxifen when used with the anticancer drug. 3) Protecting against the risk of some types of cancer (Jones, 2025). Chronic inflammation is a result of the immune system being overstimulated for a long time. This inflammation is associated with numerous health issues including heart disease, diabetes, cancer, arthritis, Crohn's disease, ulcerative colitis, and more. Preclinical research (animal and lab studies) has shown that tamarind is a powerful anti-inflammatory. These properties may explain why tamarind has been effective at treating digestive issues, throat issues, and arthritis in traditional medicine. The anti-inflammatory properties of the protein trypsin found in tamarind seeds have also been studied as having the potential to support obesity treatment. However, further research with human participants is needed. The research on tamarind's impact on blood sugar is limited to animal studies and small experiments. However, there is evidence that properties in the topical fruit and its seeds can help people with hyperglycemia and diabetes regulate their blood sugar. In studies of rats, for instance, adding tamarind seeds to the animals' diet reduced high blood glucose and improved glycogen storage in the liver.These effects may be connected with tamarind's ability to lower belly fat and reduce inflammation. In the same study of rats that showed benefits to glucose levels, researchers found that tamarind seeds improved hypercholesterolemia, a condition in which a person has high levels of low-density lipoprotein (LDL), which puts them at risk for heart disease such as atherosclerosis. Additional research on hamsters with hypercholesterolemia showed that extracts of the fruit lower total cholesterol by 50%, LDL (the bad cholesterol) by 73%, and triglycerides by 60%. It increased the good cholesterol, HDL, by 61% (Jones, 2025). Among its traditional uses, tamarind has been touted as an aphrodisiac. There is some research to back these claims, including findings from animal studies such as: 1) An extract from the pulp of the fruit improved sexual desire and arousal among females in animal studies. 2) Sperm count increased in animal studies with subjects given tamarind. 3) Tamarind resulted in improved testosterone levels. Like many fruits and vegetables, tamarind contains another important compound that supports overall health: lupeol. This substance has antibacterial effects and may be why tamarind has been effective as a treatment for diarrhea, fever, and wound healing. In regions where the tamarind tree is native, the fruit has been used for centuries as an antiparasitic treatment. Research shows that the treatments derived from the leaves are effective against malaria.14 Other uses are also being researched (Jones, 2025).

Tamarind is rich in antioxidants, fiber, and magnesium. It's also a good source of potassium, iron, phosphorus, copper, calcium, and vitamins B1, B2, and B3 (Gollin, 2025). Tamarind pulp, paste, syrup, and purée can be incorporated into all kinds of dishes and condiments, adjusting the amount according to taste. Here are some ideas to jumpstart experimentation (Gollin, 2025). The Tamar Fruit, blossom, leaves, bark, and seeds are all recognised to have medicinal properties and are used to cure a variety of illnesses all over the world. Vitamins, minerals, and electrolytes are abundant in this. Because the tamarind acts as a "coolant," it is frequently consumed in Middle Eastern desert nations. As a result, this fruit has a wide range of health benefits. Tamarind fruit is also used for the following treatments (ABCinternationals, 2025):

Drinking tamarind juice can make you feel cooler.

Helps prevent sunstroke and heat stroke.

Aids in lowering blood cholesterol levels, that supports a healthy heart. Juice from tamarinds has a slight laxative effect.
Bile disorders can be effectively treated and healed using tamarind juice.
The pulp of ripe tamarinds is excellent for treating constipation and digestive issues.
To treat an appetite loss, tamarind pulp is softened in water and swallowed.
Because tamarinds are high in vitamin C, their pulp is beneficial for preventing and treating scurvy.When used in various combinations, tamarind pulp, leaves, and blossoms offer immediate treatment when applied to swollen and uncomfortable joints. Conjunctivitis is treated with the use of tamarind pulp juice. To treat dry eye syndrome, tamarind seed-based eye drops are advised. Burns can be effectively treated with tamarind leaves. The burnt mixture relieves the wound and is very effective over the burnt areas. Since ancient times, tamarind has been used to treat sore throats. Tamarind water gargled is an extremely effective sore throat remedy. To treat jaundice and catarrh, tamarind is taken as a water pill. For the purpose of controlling bleeding piles, tamarind blossom juice is ingested. It is a great source of antioxidants and guards against cancer. One of the most efficient and simple ways to treat the common cold is with tamarind. Additionally, tamarind pulp is a powerful fever reducer. To lower the temperature, take 15g of tamarind. By boiling the tamarind pulp with some dates, cloves, sugar, cardamoms, and a tiny bit of camphor in a half-liter of milk, you can even make sherbet. The virus that produces fever is effectively combated by this infusion.
The preparation of tamarind milk, which involves boiling the pulp in milk, is also quite successful in treating dysentery. For best benefits, combine finely ground tamarind seeds with equal amounts of sugar and cumin and take two to three times daily.

Tamarind is commonly used as a flavoring in regional cuisine in Maharashtra, Tamil Nadu, Karnataka and Andhra Pradesh when preparing *Rasam*, *Sambhar*, *Vatha Kuzhambu* and *Puliyogare* and so on. And no mouth-watering chaat is complete without the ubiquitous *imli* chutney. Even the tamarind flowers are used to make delicious dishes. Its leaves are cooling and anti-bilious, and help to destroy worms in the stomach. Further, the leaves are also useful in treating jaundice, while the bark serves as an astringent. The pulp of the fruit is digestive cooling, laxative and anti-septic (Manikanthan, 2025):

Digestive disorders: An infusion of the pulp prepared by softening it in water can be consumed to overcome bilious vomiting, constipation, indigestion, and loss of appetite.

Scurvy: Caused due to a deficiency of Vitamin C, scurvy results in spots on the skin, spongy gums and bleeding from the mucous membranes. Tamarind pulp, being rich in Vitamin C, is valuable in preventing scurvy.

Common Cold: Prepare tamarind-pepper *rasam* by boiling diluted tamarind with a teaspoon of black pepper powder for a few minutes. Apart from being a perennial favorite, *rasam* is a much-favored home remedy for colds in South India.
Dysentery: The tamarind drink is extremely helpful in treating dysentery.

Inflammation of joints: Crush tamarind leaves in water and make a bandage. Applying this to the inflamed part of the joint and ankles lessens the swelling and pain.

Following are some of the health benefits of Tamarind (Krishihelpline, 2025)

- Tamarind supports digestive health.
- Tamarind is good for heart health.
- Tamarind is a good source of iron, hence good blood circulation.
- Tamarind may aid in nerve function.
- Tamarind aids in weight loss.
- Tamarind also helps in managing diabetes.

(Soni, 2025)

Digestive Health: Tamarind has been traditionally used as a natural laxative due to its high malic and tartaric acid content, aiding in relieving constipation.

Rich in Antioxidants: The fruit contains compounds like lupeol, catechins, and quercetin, which have antioxidant properties, helping to combat oxidative stress.

Heart Health: With significant levels of potassium and magnesium, tamarind contributes to cardiovascular health by supporting normal blood pressure and heart function.

Is It Possible to Be Allergic to Tamarind?

It's possible to be allergic to tamarind, but this is very rare. "If you do have an allergic reaction after consuming it, it might cause difficulty breathing, wheezing, hives, or stomach issues such as pain." Talk with your doctor or allergist if you're concerned about a tamarind allergy (Welch and Kayli Anderson, 2024).

CULTIVATION

Seeds can be scarified or briefly boiled to enhance germination. They retain their germination capability for several months if kept dry.The tamarind has long been naturalized in Indonesia, Malaysia, Sri Lanka, the Philippines, the Caribbean, and Pacific Islands. Thailand has the largest plantations of the ASEAN nations, followed by Indonesia, Myanmar, and the Philippines. In parts of Southeast Asia, tamarind is called *asam*. It is cultivated all over India, especially in Maharashtra, Chhattisgarh, Karnataka, Telangana, Andhra Pradesh, and Tamil Nadu. Extensive tamarind orchards in India produce 250,000 tonnes (280,000 short tons) annually. In the United States, it is a large-scale crop introduced for commercial use (second in net production quantity only to India), mainly in southern states, notably south Florida, and as a shade tree, along roadsides, in dooryards and in parks. A traditional food plant in Africa, tamarind has the potential to improve nutrition, boost food security, foster rural development and support sustainable landcare. In Madagascar, its fruit and leaves are a well-known favorite of the ring-tailed lemur, providing as much as 50 percent of their food resources during the year if available. Throughout South Asia and the tropical world, tamarind trees are used as ornamental, garden, and cash crop plantings. Commonly used as a bonsai species in many Asian countries, it is also grown as an indoor bonsai in temperate parts of the world (Wikipedia, 2025). Tamarind is toxic to dogs. The symptoms – which may include vomiting or diarrhea within 6–12 hours of ingestion, lethargy, dehydration or acute kidney injury – and proposed mechanism (via tartaric acid) are the same as in grape toxicity in dogs. Tamarind contains a few times more tartaric acid than grapes on a weight basis (Wikipedia, 2025).

Thailand has become a major producer of tamarind, with its sweet and sour cultivars, particularly the sweet tamarind types, grown there. The total planted area of tamarind in Thailand is 105 785 ha with the area in production being 60 451 ha nd the non-production area 45 335 ha as per the reports of Department of Agricultural Extension in 1998. Documents show that Mexico also produced tamarind commercially, with over 4400 ha producing over 37 000 tons of pulp. It exported a small amount of processed pulp to Central and South American countries and to the USA. Costa Rica, another Central American country, has shown a potential for expansion by producing 200 tonnes annually (Saideswara Rao and Mary Mathew, 2012). Seeds can be scarified or briefly boiled to enhance germination. They retain their germination capability for several months if kept dry.The tamarind has long been naturalized in Indonesia, Malaysia, Sri Lanka, the Philippines, the Caribbean, and Pacific Islands. Thailand has the largest plantations of the ASEAN nations, followed by Indonesia, Myanmar, and the Philippines. In parts of Southeast Asia, tamarind is called *asam*. It is cultivated all over India, especially in Maharashtra, Chhattisgarh, Karnataka, Telangana, Andhra Pradesh, and Tamil Nadu. Extensive tamarind orchards in India produce 250,000 tonnes (280,000 short tons) annually. In the United States, it is a large-scale crop introduced for commercial use (second in net production quantity only to India), mainly in southern states, notably south Florida, and as a shade tree, along roadsides, in dooryards and in parks. A traditional food plant in Africa, tamarind has the potential to improve nutrition, boost food security, foster rural development and support sustainable landcare. In Madagascar, its fruit and leaves are a well-known favorite of the ring-tailed lemur, providing as much as 50 percent of their food resources during the year if available (Wikiwand, 2025).

Climate: The tree is well-adapted to semi-arid tropical regions with alternate wet and dry seasons, but it can be grown in heavy rainfall areas also, if drainage is provided. It requires a good rainfall, the average being 500-1500 mm during its growth, flowering and fruiting periods i.e., from June-October. It needs dry weather from January-March for maturity and ripening of fruits. It is grown in areas where the temperature reaches a maximum of $46^{O}C$ and a minimum of $0^{O}C$. It can withstand drought, but is sensitive to frost. The optimum elevation for tamarind cultivation is 1000 m above mean sea level. The plants shed their leaves after the fruits are harvested and enter into a short period of dormancy before it starts flowering in the month of March (Admin, 2021).

Soil: Tamarind is grown on a variety of soils ranging from gravely to deep alluvial soils. But, it thrives best on deep, loamy or alluvial soils. It can tolerate slightly saline and alkaline soils. The plant also adopts to poor soils (Admin, 2021).

Land preparation: The land is prepared well by ploughing, leveling and harrowing. The pits (90-100 cm^3) are dug at 10 m x 10 m or 13 m x 13 m for seedlings and 6.5 m x 6.5 m for buddings and grafts. The pits are filled by mixing with soil and 15-25 kg farm yard manure/compost, 100 g. Super phosphate and 1 ½ kg neem cake per pit (Admin, 2021).

Planting: Planting is done during June-November. While planting the seedlings/buddings/ grafts are planted in the center of the pit. They are provided with suitable support by staking.

Fertilizer application (Admin, 2021):

The fertilizer recommendation for plants of different age groups is as follows

Age of the plant		Per seedling tree (g)	Per budded/grafted Plant (g)
1st Year	N	73	36
	P	18	9
	K	68	34
2nd Year	N	146	73
	P	38	19
	K	136	68
3rd Year	N	219	109
	P	54	27
	K	204	102
4th Year	N	292	146
	P	72	38
	K	272	136
5th Year	N	365	182
	P	90	45
	K	340	170
6th Year	N	438	219
	P	108	54
	K	408	204
7th Year	N	511	255
	P	126	63
	K	476	238
8th Year	N	584	292
	P	144	72
	K	544	272
9th Year	N	657	328
	P	162	81
	K	612	306
10th Year and onwards	N	730	365
	P	180	90
	K	680	340

The recommended dose of fertilizers should be applied to individual plants and forked into the soil in the basin during June-July. In addition to the inorganic fertilizers it is recommended to apply Farm Yard Manure @ 20 kg, 30 kg and 50 kg per plant/year for plants in the age groups of 1-5 years, 6-8 years and above 9 years, respectively (Admin, 2021). Aftercare: Regular irrigation for the first two years should be given whenever there is no rainfall till the plants are established. The field is kept weed free during the initial stages. Side shoots are removed from the seedling and suckers from the budded/grafted plants for first two years. The land is ploughed and harrowed between the rows during monsoon during the first 5-8 years in case of seedlings and two years in case of budded plants/grafts. Ragi, jowar, horsegram, field bean and red gram could be raised as inercrops. Basins should be prepared around each plant. Whenever no cover crops are grown the interspaces are ploughed 2-3 times in an year. This not only helps to check the weeds but also help in conserving soil moisture. Tamarind is mostly a rainfed crop but providing 1-2 irrigations during flowering and fruit set will give better yields (Admin, 2021).

Inter crops: *Amla,* Pomegranate, *Karonda*, *Anona* can be grown as intercrops at a spacing of 5 x 2.5 m upto 10 years and short duration vegetables like cucumbers, pumpkin, ashgourd, watermelon and snake gourd could be grown as inter crops in the basins of tamarind upto about 3-4 years (Admin, 2021).

Pests: Fruit borer is the major pest of this crop which causes heavy crop loss. The damage can be minimized by spraying 40 g carbaryl or 20 ml melathion or 20 ml endosulphon or 13 ml monocrotophos in 10 liters of water starting with first week of August and in the third week of August. Tree hopper, mealy bugs and scale insects also attach this crop. They can by controlled by spraying monocrotophos (0.1%). The other pests include: the beetles and larva of *Lasioderma serricorne, Pachymerus gonagra* and *Calandra linearis* which bore the seeds; the larvae of *Tribolium castaneum, Argyroploce illepida* and *Virachola isocrates* attack the fruits and destroy the seeds; and *Aspidiotus* Sp, feed on the sap of fruits. In addition, *Aspidiotus* Sp., *Chionaspis acuminatatricolor* feed on sap of the young twigs and branches. *Xiphinema citri* and *Longidorus elongatus* are the nematodes associated with the roots of the tree (Admin, 2021).

Diseases: Powdery mildew disease is noticed occasionally in tamarind. The disease can be controlled by spraying weetable sulphur (0.2%) or kelthane (0.1%). The tree is affected by a number of root diseases, such as sap rot (*Xylaria euglorsa*), browinish sap rot (*Polyporus calcuttensis*) and white rot (*Trametes floccosa*). Among the other diseases, *Meliola tamarindi* cause the sooty mould, *Pholiota gollani* has been recorded on the trunk of living trees; *Polystictus sarbadhikarii* on the dead trunk and

different species of *Hypoxylon* on the decorticated wood, branches and bark. A bacterial leaf-spot has been recorded in trees near Pune (Admin, 2021).

Harvesting and yiel: The seedling plants start yielding in 8-12 years whereas, budded/grafted platns in 4-5 years after planting. Harvesting is done during January-April, average yield being 25 tonne of pods per hectare (180-225 kg/fully grown tree). The budded/grafted plants yield 100 kg per tree per year (Admin, 2021). The tamarind tree can produce a significant amount of fruit once it reaches maturity. A mature tree can produce up to 300-500 kg of fruit per year, depending on the variety and growing conditions. The fruit typically ripens in the dry season, and it can be harvested when it turns brown and brittle (Greenverz, 2025). The plants grown from seedlings can start yielding from 8th year where as the plants from grafts and budding can start yielding from 4th year. Hand picking or beating with a stick can be practiced as part of harvesting tamarind fruit (Krishihelpline, 2025). As average yield of 30 tones of pods/hectare can be obtained with good farm management practices (Krishihelpline, 2025).

Production: At present, tamarind is cultivated in 54 countries of the world: 18 in its native range, including central African countries, and 36 other countries including India and Thailand where it was introduced and it has become naturalized in several regions. In the American continent, commercial plantations were reported in Belize, Central American countries and in north Brazil. The major producing countries are Brazil, Bahamas, Costa Rica, Bangladesh, Cuba, Burma, Egypt, Cambodia, Guatemala, Dominican, Republic, India, Fiji, Indonesia, Gambia, Mexico, Kenya, Nicaragua, Pakistan, Puerto Rico, Senegal, Philippines, Tanzania, Sri Lanka, Vietnam, Thailand, Zambia, Venezuela and Zanzibar. However, tamarind is grown as a major plantation only in a few countries such as India and Thailand. India is the world's largest producer of tamarind products. Tamarind is abundantly available in the Indian states of Madhya Pradesh, Bihar, Andhra Pradesh, Karnataka, Tamil Nadu, West Bengal, Orissa and Kerala. Figures available for the production of tamarind in India for the years 2007-8 and 2008-9 indicated yields of 188 278 tonnes and 193 873 tonnes from 55 682 ha and 54 222 ha, respectively. India exports processed tamarind pulp to western countries, mainly the European and Arab countries and, more recently, the USA. During the year 2009–10 India exported 12 200 tonnes of different tamarind products valued at Rs 4705.50, lakhs. Tamarind products are exported to around 60 countries (Saideswara Rao and Mary Mathew, 2012). Tamarind production is expanding and, although the production should be substantial, statistical records, as yet, do not provide details on tamarind. There are two main types of tamarind, those with a sweet pulp and those with a sour pulp. Most countries produce the sour type, comprising about 95% of the total world production. India is the largest producer of sour tamarind in Asia and its annual production is in the range of 250,000-300,000 t. This production is obtained by harvesting trees along roadsides and in windbreaks, backyards and trees used for shade. Thailand is the other large Asian producer, growing 30% of the sweet type, which is gaining status as a small-scale plantation crop, in addition to the sour type. The sweet type is gaining in popularity on world markets and commercial orchards are being established in Thailand (Rojas-Sandoval, 2018). Tamarind kernel powder (TKP) is in great demand and nearly 20,000 t are produced annually in India; however, there are initiatives underway to improve the postharvest and processing techniques. Annual returns from TKP are estimated at 16,000,000-17,000,000 Indian rupees (US$346,400-368,050). The fresh pods are valued and large, sweet pods are highly priced, particularly out of season. Tamarind is also produced commercially in Mexico and Costa Rica. Mexico is the largest producer in the Western hemisphere, where tamarind is extensively grown in established orchards. Many other countries produce tamarind, but not on a commercial scale (Rojas-Sandoval, 2018). India is the greatest producer of *T. indica* products: over 250,000 tonnes of fruits were harvested in 1964 and some 3000 tonnes are exported to Europe and North America for use in meat sauces and beverages. Thailand also exports *T. indica* products (Rojas-Sandoval, 2018).

Diseases: Several diseases have been reported to infect tamarind. In the nursery, mildew caused by *Oidium* species is a very common disease. Other diseases include leaf spot, stem disease, root and wood rot, stem rot, trunk and collar rot, stem canker and a bark parasite. *Cercospora* leaf disease results in severe defoliation, while stony fruit disease, caused by the fungal pathogen *Pestalotia macrotricha*, makes the fruit hard and stony with fibrous structures. Several diseases that cause tree rots and bacterial leaf-spots have been reported in India on *T. indica*. A new fungal pathogen that causes severe leaf spot disease on *T. indica* fruits has been identified and described as *Phomopsis tamarindii* sp. nov. Several diseases that cause tree rots and bacterial leaf-spots have been reported in India on T. indica. A new fungal pathogen that causes severe leaf spot disease on *T. indica* fruits has been identified and described as *Phomopsis tamarindii* sp. Nov (Rojas-Sandoval, 2018).

Pests: A host of pests can attack tamarind in different parts of the world, including mealybugs, beetles, toy beetles, bagworms, leaf-feeding caterpillars, aphids, white flies, thrips, green locust, shot-hole borers and a variety of scales (often spread by ants). Various weevils and borers can also infest the ripening pods or stored fruit. The most serious insect pests are thrips, aphids, coccids and white flies that attack new growth. Flowers, young fruit and seeds can be damaged by caterpillars and some beetles. Fruit are also attacked during storage. *Caryedon serratus* is a significant pest of seeds, and can cause up to 100% damage in stored seeds. Larvae attack the fruit and seeds in the field as well as the fruit and roasted seeds during storage in India. They have also been reported in Puerto Rico and other places in Latin America. In Florida and Hawaii, *Calandra linearis* attacks the fruit and seeds and is considered a common pest. Sap-suckers are the worst pests on the young shoots and fresh foliage. In some seasons, fruit borers can cause considerable damage to fruits, resulting in a significant reduction in economic returns. Control measures targeted at eliminating the hairy caterpillar *Euproctis lunata*, have included flame cultivators, insecticidal dusting, and catch and eradicate strategies. Host resistance, use of solar heat, and insecticidal essential oils have been evaluated as potential control measures against *C. serratus*. Nematodes such as *Radopholus similis*, *Longidorus elongatus*, *Xiphinema citri* and *Meloidogyne incognita* can attack the roots . T. indica trees are under potential attack by more than 40 insect species. These include shothole borers, toy beetles, leaf-feeding caterpillars, bagworms, mealybugs and scale insects. The bruchid beetle *Caryedon serratus*, is a significant pest of *T. indica* seeds, and can cause up to 100% damage in stored seeds. Sap-suckers are the worst pests on the young shoots and fresh foliage. The most destructive of these are coccids, aphids, white flies and thrips. In some

seasons, fruit borers can cause considerable damage to fruits, resulting in a significant reduction in economic returns. Control measures targeted at eliminating the hairy caterpillar *Euproctis lunata*, have included flame cultivators, insecticidal dusting, and catch and eradicate strategies. Host resistance, use of solar heat, and insecticidal essential oils have been evaluated as potential control measures against *C. serratus* (Rojas-Sandoval, 2018).

Seed oil and kernel powder: Tamarind seed oil is made from the kernel of tamarind seeds. The kernel is difficult to isolate from its thin but tough shell (or *testa*). It has a similar consistency to linseed oil, and can be used to make paint or varnish. Tamarind kernel powder is used as sizing material for textile and jute processing, and in the manufacture of industrial gums and adhesives. It is de-oiled to stabilize its colour and odor on storage. Tamarind seeds are used in the production of tamarind kernel powder which is used as a sizing agent in the textile industry because of its ability to absorb water and swell up, in India, tamarind kernel powder has also been used as a sizing agent in the production of cotton. In Bengal, tamarind seeds are used in the production of an oil used in varnishes. leaves and flowers are used as a setting agent for dyes (Wikipedia, 2025). Woodworking: Tamarind wood is used to make furniture, boats (as per Rumphius) carvings, turned objects such as mortars and pestles, chopping blocks, and other small specialty wood items like krises. Tamarind heartwood is reddish brown, sometimes with a purplish hue. The heartwood in tamarind tends to be narrow and is usually only present in older and larger trees. The pale yellow sapwood is sharply demarcated from the heartwood. Heartwood is said to be durable to very durable in decay resistance, and is also resistant to insects. Its sapwood is not durable and is prone to attack by insects and fungi as well as spalting. Due to its density and interlocked grain, tamarind is considered difficult to work. Heartwood has a pronounced blunting effect on cutting edges. Tamarind turns, glues, and finishes well. The heartwood is able to take a high natural polish (Wikipedia, 2025).

Metal polish: In homes and temples, especially in Buddhist Asian countries including Myanmar, the fruit pulp is used to polish brass shrine statues and lamps, and copper, brass, and bronze utensils. Tamarind contains tartaric acid, a weak acid that can remove tarnish. Lime, another acidic fruit, is used similarly (Wikipedia, 2025).

Storage: Tamarind can be stored after removing the seed. Tamarind pulp absorbs more moisture from air there by the reducing sugars and amino acid present in pulp get changed and gives dark colour to the pulp. Therefore it should be stored in air tight constrainers. Pulp and salt can be mixed and packed in palmyrah leaf before sending to market. In West Indies sugar is mixed with pulp and is being exported to Europe (Admin, 2021).

Value added products of tamarind: The CFTRI Mysore in Karnataka has developed a process for the manufacture of tamarind concentrate which is free from fibre, seeds, foreign matter, etc., and is very hygienic. Of late, there has been a growing demand for it from abroad. It is almost of jam consistency. It is easily despensible in hot water at the time of its use and is being exported to other countries. Tamarind seed consists of 30% testa (outer skin) and 70% endosperm. The testa contains 40% of water-solubles, 80% of seed kernel is moisture 8.1%; protein:17%; fat 7%; crude fibre: 5.6%; non-fiber carbohydrates: 65% other components: 5.4% and mineral matter: 2.8%. A powder made from the kernel of tamarind seeds is also being exported from India. The only factors in tamarind pulp and kernel having food value are carbohydrates and protein. They also have small amounts of vitamins, carotene, vit. B_1 and nicotinic acid. An integrated process has also been developed at CFTRI, Mysore for the manufacture of tamarind powder, beverages, pectin, tartarates and ethanol (alcohol) from tamarind pulp (Admin, 2021).

Possibly Effective for: Dry eye. Using eye drops containing tamarind seed extract, alone or with other ingredients, seems to help relieve dry eye. A condition caused by ingestion of too much fluoride (fluorosis). Taking tamarind by mouth increases the amount of fluoride removed from the body in the urine. But it's not clear if this reduces symptoms of fluorosis (Webmd, 2025).

Possibly Ineffective for: Early orgasm (premature ejaculation). Taking tamarind seed powder by mouth does not seem to improve early orgasm or satisfaction during intercourse. There is interest in using tamarind for a number of other purposes, but there isn't enough reliable information to say whether it might be helpful (Webmd, 2025).

Side Effects (Webmd, 2025): When taken by mouth: Tamarind is commonly consumed in foods. There isn't enough reliable information to know if tamarind is safe when used in larger amounts as medicine.

When placed into the eyes: Tamarind seed extract is possibly safe when used in eye drops.

A Fruit Ripe with Possibilities: There is a Buddhist parable about the tamarind tree in which its seeds are said to be symbols of faithfulness and forbearance. While the story doesn't say much about the tamarind as food, it does illuminate a little bit about the history of this venerable plant and its incredible sweet and sour fruit. Originating in Africa, the tamarind tree spread all over the world and was widely known in Buddha's time. In the early 1600s, the tree and its delicious fruit were introduced to the Western Hemisphere, specifically, Mexico and the Caribbean. This widespread importation and trade of the tamarind over so many years is a testament to both its usefulness and its possibilities for today's chefs (Ciachef, 2025).

Making Inroads in North America: Tamarind is very popular in the cuisines of the tropics but is still widely unknown in the United States. However, like many products that have assimilated themselves into the dining culture of North America, tamarind has been gaining in use and popularity due to he influx of immigrants. Tamarind comes in many forms and is used differently by different cultures. In Mexico, it is a popular additive in beverages and in sweet and sour candies. In Southeast Asia, where it is used in sauces, soups, and noodle dishes, tamarind is called by many names, including "asam," which is a Malay word that

translates to "sour." And you may be surprised to discover where tamarind can be found in the U.S.—it is one of the main flavorings of the popular Lea & Perrins Worcestershire sauce (Ciachef, 2025).

From Pod to Pulp: The fruit of the tamarind tree is a three- to eight-inchlong brown, irregularly curved pod. Borne in abundance along the new branches, the pods fill out somewhat as they mature, and the juicy, acidulous pulp turns brown. When fully ripe, the shells are brittle and easily broken. The pulp dehydrates to a sticky paste enclosed by a few coarse strands of fiber. The pods may contain from one to 12 large, flat, glossy brown seeds embedded in the brown, edible pulp. The pulp has a pleasing sweet/sour flavor and is high in both acid and sugar. It is also rich in vitamin B and high in calcium. There are wide differences in fruit size and flavor depending upon the terroir of the trees. Indian varieties have longer pods with six to 12 seeds, while the West Indian fruits have shorter pods containing only three to six seeds. Most tamarinds in the Americas are of the shorter, more acidic variety. Tamarind fruits mature in late spring to early summer, and they may be left on the tree for as long as six months after maturity. Fruits destined for immediate processing are often harvested by pulling the pod away from the stalk. Mature trees are capable of producing 350 pounds of fruit a year (Ciachef, 2025).

Spicy Tamarind Marinade: Combining the tamarind's natural sweet and sour balance with the heat from chiles, this unique marinade is ideal for grilling chicken, shrimp, pork, or fish. Mix your own tamarind paste or substitute premade tamarind purée, which has the advantage of being seedless (Ciachef, 2025).

How to try tamarind: Tamarind is sold in a few forms, and which is right for you depends on how you want to use it. "If you want to eat tamarind raw, you can just break open the pod and eat the pulp from around the seed," Peart explains. As with edamame, the pods themselves are inedible (but they're compostable!). You can also make your own tamarind paste by boiling and straining the pulp, which can then be used as a dip or added to other dishes. "To make a paste in its pure form, the only thing you should add to the tamarind is water," Peart says. "It's as nutrient-rich as the raw plant." If that sounds like too much work and you want to use tamarind as an ingredient in cooking, you can also buy it in various forms like: Paste. Powder. Concentrate. Compressed block (a thick slab of packed pulp with the seeds and pods removed). Just be sure to steer clear of any variety made with added sugar. "If you buy ready-made paste or concentrate, other ingredients may be added," Peart warns, "so be sure to check the ingredient label first." The tree normally yields about 150 kg pods/year, but this can be as high as 200-300 kg (Heuzé and Tran, 2015). Because of its deep roots, the tamarind is suitable to stabilize soils and to make windbreaks. It is also a firebreak since grass does not grow under its dense crown (Heuzé and Tran, 2015).

Different forms of tamarind: Tamarind is available in prepared forms, such as candy and sweetened syrup. You can also find the pure fruit in three main forms (Jennings, 2023):

Raw pods: These pods are the least processed form of tamarind. They're still intact and can be easily opened to remove the pulp.

Pressed block: To make these, the shell and seeds are removed and the pulp is compressed into a block. These blocks are one step away from raw tamarind.

Concentrate. Tamarind concentrate is pulp that has been boiled down. Preservatives may also be added.

General Characteristics (WDRA, 2025)

(i) Tamarind (with seed) shall have the colour and characteristics of the commodity.
(ii) Tamarind (with seed) shall be,-
- (a) matured and ripe;
- (b) clean;
- (c) free from deleterious substances;
- (d) free from obnoxious odour;
- (e) free from any external moisture;
- (f) free from any inorganic extraneous matters.

(iii) Tamarind (with seed) shall not give rancid taste and musty odour.
(iv) Tamarind (with seed) shall be free from insect infestation, live or dead insects, mould growth rodent hair and excreta, added colouring matter, dirt or any other impurities of animal origin.
(v) Tamarind (with seed) shall comply with residual levels of heavy metals, pesticides and other food safety parameters laid down by the Codex Alimentarius Commission for exports.
(vi) Tamarind (with seed) shall comply with residual levels of heavy metals, insecticides and pesticides, crop contaminants, naturally occurring toxic substances and other food safety parameters as prescribed under the FSSAI Regulations, 2011.

How to Eat Tamarind: The pulp from tamarind can be consumed fresh or made into juice or brine. It is often added to foods such as curries and sauces or made into jams and sweets. Tamarind pulp is brown and sticky and may be added to drinks and foods to give them a tart or tangy flavor.16 Before being added to recipes, tamarind is usually softened into a paste. Tamarind paste can be bought in grocery stores, particularly specialty Latin, Indian, or Asian grocery stores. Tamarind is used in many traditional cuisines including the following: 1) In countries such as India, Nigeria, Nepal, Bangladesh, and Sudan, the leaves and flower of tamarind may be eaten raw or cooked in soups, stews, curries, and salad dressings. 2) In most African countries, tamarind can be made into a popular beverage. 3) In Eastern Uganda, tamarind fruit is often eaten as a snack. It may also be made into a

concentrate for flavoring porridge, millet bread, and potatoes. 4) In Mexico, tamarind is used to make a sweet and spicy candy. 5) In India, tamarind is used in curries and spicy dishes, often mixed with spices such as ginger, coriander, turmeric, or garam masala and paired with coconut milk. 6) In some Caribbean countries, tamarind seeds are roasted and eaten, or ground up and used in Indian cakes. Tamarind balls are a popular dessert in the Caribbean Islands (Jones, 2025).

Lead Concerns With Tamarind

Some foods with tamarind imported from Mexico, including candy, have been found to contain high levels of lead. There is no safe level of lead. It can impact children's neurodevelopment, harm those who are pregnant, and cause other health issues. To avoid potential exposure to lead, avoid candy and other tamarind foods imported from Mexico (Jones, 2025).

How to Make Tamarind Paste from Tamarind Pulp

For every 1 cup of paste desired, place 4 ounces of pulp in a bowl, cover with 1 cup boiling water, and break it up with a spatula. Let soak for 10 minutes, then push it through a fine-mesh strainer to remove the seeds and fibers and extract as much pulp as possible. The leftover paste can be frozen indefinitely (Vaughn and Dunn, 2024).

What Is Tamarind Concentrate?

Commercially produced tamarind "concentrate" comes in two distinct styles: Thai/Indonesian-style tamarind concentrate: Despite labels that state "tamarind concentrate" and "nuoc me chua," the Thai and Indonesian products aren't concentrates at all, but rather tamarind pastes made by thinning pulp with water as described above. Indian-style concentrate: Jars of tamarind concentrate from the Indian subcontinent, on the other hand, contain paste cooked down into a true concentrate. This tamarind concentrate is almost black, with a thick, molasses-like consistency and a flavor that is more intense than Thai, Indonesian, or homemade tamarind paste while tasting less fruity and more "cooked." Indian and Thai/Indonesian tamarind concentrates are thus not interchangeable, so be sure to know which type your recipe calls for (Vaughn and Dunn, 2024).

Seed oil and kernel powder

Tamarind seed oil is made from the kernel of tamarind seeds. The kernel is difficult to isolate from its thin but tough shell (or *testa*). It has a similar consistency to linseed oil, and can be used to make paint or varnish. Tamarind kernel powder is used as sizing material for textile and jute processing, and in the manufacture of industrial gums and adhesives. It is de-oiled to stabilize its colour and odor on storage. Tamarind seeds are used in the production of tamarind kernel powder which is used as a sizing agent in the textile industry because of its ability to absorb water and swell up, in India, tamarind kernel powder has also been used as a sizing agent in the production of cotton. In Bengal, tamarind seeds are used in the production of an oil used in varnishes. leaves and flowers are used as a setting agent for dyes (Wikiwand, 2025).

Sources, processing and preservation: A full-grown tamarind tree is reported to yield about 180–225 kg of fruits per season. In India, the average production of tamarind pods per tree is 175 kg and of processed pulp is 70 kg/tree. Tamarind fruits begin to ripen during the months of February–March. It was reported that by mixing the shelled tamarind fruits with a small amount of water and passing them through a pulper, the residual seeds, fibre and other extraneous materials can be removed. Mechanical methods of extracting pulp have been reported and a tamarind dehuller has also been designed and developed in UAS, Bangalore, India (Saideswara Rao and Mary Mathew, 2012). The machine has a hulling capacity of 500 kg/hour, with hulling effi ciency of 80 % for large fruits and 58 % for small fruits. Based on observations on post-harvest physiological and chemical changes in tamarind fruit, maximum yield from tamarind might be achieved by processing within one week of harvest. Tamarind pulp/concentrate is one of the essential components in Indian culinary habits. It is a common article of trade and is preserved and stored for marketing in a number of ways. In most of the tamarind-growing countries, pulp is pressed and preserved in large masses and sold in small shops and markets by weight. It was reported that, the pulp, freed from fibre and seed, is commonly mixed with 10 % salt and beaten down with mallets so as to exclude air and packed in gunny bags, lined with palm leaf matting. In India, the pulp is covered with salt, rolled into balls, exposed to dew and stored in earthenware jars, whereas in Java, the salted pulp is rolled into balls, steamed and sun dried, then exposed to dew for a week before packing in stone jars. In Thailand, the pulp is mixed with salt and compressed and packed in plastic bags to exclude air for storage (Saideswara Rao and Mary Mathew, 2012). In Sri Lanka, the harvested pods are dried in the sun for 5–7 days to bring all fruits, including the half-mature fruit, to the fully ripe stage. The separated pulp along with the seed is dried in the sun for 3–4 days to remove excess moisture and prevent the growth of moulds, mixed with salt and packed in clay pots for storage. The freshly prepared pulp is light brown in colour. According to the research fi ndings of CFTRI (Central Food Technological Research Institute), Mysore, India, pulp can be preserved well for 6–8 months, without any treatment, if it is packed in airtight containers and stored in a cool dry place (Saideswara Rao and Mary Mathew, 2012). Continuous storage for long periods under extremes of temperature and humidity is a problem because of changes in colour which take place from brown or yellowish brown to black. In the Sri Lankan storage method outlined above, for example, the tamarind could be stored for about a year; however, the colour changed to dark brown or black and changes in fl avour occurred. Studies on factors related to colour change of tamarind pulp from brown to black to yellow in storage and recommended mixing of 10 % powdered salt and cold storage to prevent this (Saideswara Rao and Mary Mathew, 2012). Pulp loss during storage was very low in black polyethylene (0.18 %) and plastic (0.17 %) compared to phoenix mat (1.35 %) and metal (1.53 %). CFTRI developed an improved process for preparation of tamarind paste from good-quality tamarind, free from seeds, fi brous and extraneous matter. The cleaned pulp was subjected to heat processing followed by coarse grinding and was reprocessed to reduce the moisture level to obtain optimum quality tamarind paste. Preservation methods of sweet tamarind fruits and pulp in Thailand have been documented wherein tamarind fruits were steamed for fi ve minutes, followed by drying in a hot air oven at 80 °C for 2 hours and storing in plastic bags at room temperature. Using this method, the fruits were stored for four months without any deterioration in quality. It was found that cold storage of tamarind pulp at various temperatures increased

shelf-life. It was reported that the freshly harvested deseeded tamarind pulp can be stored for up to 330 days under refrigeration at 4 ± 2 °C when vacuum packed in 800 gauge poly bags without any colour change in the pulp right from the initial stage of storage (Saideswara Rao and Mary Mathew, 2012).

Food colourant: Tamarind brown, the natural food colour from tamarind, is widely used in Japan as a food colourant. Leucoanthocyanidin and anthocyanin are the main pigments of the tamarind colour. It was reported that the red pigment (anthocyanin) from the half-matured red variety tamarind could be used to impart a natural and attractive red colour to curries, jam, jelly and that there is ample scope for red tamarind to be used as a source of natural red food colourant in the near future (Saideswara Rao and Mary Mathew, 2012).

Quality issues: There are many problems associated with the quality of tamarind products due to their high moisture level and seed, fi bre and rind contents. Tamarind is reported to have been adulterated with foreign matter which is both organic and inorganic in nature. Adulteration is considered to be due to poor post-harvest management practices including processing. General quality requirements of tamarind have been detailed. The Directorate of Marketing and Inspection and Bureau of Indian Standards have prescribed quality specifi cations for seedless tamarind (Table 1), dry tamarind (Table 2) and tamarind seed (Table 3). Indian standard specifications are available for tamarind juice concentrate, pulp, kernel oil, for kernel powder and for seed testa (Saideswara Rao and Mary Mathew, 2012).

Table 1. Agmark specications (%/wt max)- Tamarind seedless

Character/grade	Special	A	B	C
Moisture	15	17	20	20
Seed content	5	10	15	20
Foreign matter (organic)	4	6	8	10
Foreign matter (inorganic)	1	1.5	2	2

Table 2. Agmark specications (%/wt max)- Tamarind dry

Character/grade	Special	A	B
Seed content	35	40	45
Fibres	6	8	10
Rind	3	4	6
Insect damage	2	3	5
Moisture	15	20	25

Table 3. Agmark specications (%/wt max)- Tamarind seed

Character/grade	Special	A
Extraneous matter	1	2
Damaged and discoloured	2	5
Wt/lit	900	800
Moisture	9	10

How to Buy Tamarind (Gollin, 2025): Tamarind comes in several forms, and can be enjoyed raw, as is—or as an ingredient.
Raw Pods: The raw pods are the least processed form, and the pulp can be easily removed. "I usually like eating it in raw form, breaking open the pods, just like eating shelled peanuts," Joshi says. "You can also boil it after opening up the pods to make juice or paste." (Consuming the shell and seeds isn't recommended.)

Pressed blocks: Blocks of pressed pulp, compacted with or without seeds, are the closest thing to raw tamarind. "To use the blocks, they must be soaked in hot water for 10–15 minutes before cooking, using your hands to massage and then extract the pulp with a strainer," Vilkhu explains. At that point, it can be reduced and seasoned.

Concentrate: The pulp is also boiled down and sold as a concentrate. Joshi notes that several brands of tamarind paste, pulp, and purée are available in the marketplace. Some are frozen, or packaged in jars or plastic tubs, and may contain preservatives or added sugar. To use it, take a spoonful and dissolve it in hot water, which makes it easier to mash or blend into a paste.

Savory (Gollin, 2025)

Chutneys: Tamarind's flavors hit just the right note for chutneys. At his restaurant, Saffron, Vilkhu makes a lentil pancake dish called Crab Pudha, with lump crab meat, mint chutney, and date-tamarind chutney. Both chutneys also top his savory chickpea masala snack, Potato Nest Chaat. Joshi pairs tamarind-spiked chutney with samosas or sandwiches. Tweak our Quick Pear Chutney with a spoonful and serve it with our Shrimp Tikka Masala.

Rice: Some cultures add tamarind to rice, Joshi notes. A South Indian dish called puliyogare, for instance, is made by tempering white rice with spices like asafoetida, mustard seeds, fenugreek, and curry leaves, plus tamarind paste or juice, in oil. Our recipe for Madhur's Spiced Basmati Rice could be your starting point.

Marinades: Tamarind amps up marinades for meat, Joshi says. It's pitch-perfect in our Worcestershire-boosted

Marinated Beef Tenderloin

Salad Dressings: Tamarind enlivens salads, too. At Saffron, Vilkhu serves a mango and tomato salad with a tamarind dressing. Make our Sesame-Soy Vinaigrette sing by adding a hint of tamarind paste.

Sweet (Gollin, 2025)

Jams: Jellies, jams, and spreads also take flight with a touch of tamarind. Add a dollop to our Fig Spread, a transcendent topper for crostini, or a stack of toast.

Confections: Tamarind's multi-faceted flavors also satisfy sweet tooths. Soft, chewy tamarind balls made from pulp and sugar are popular in Mexico and the Caribbean. Vilkhu says he grew up eating tamarind candies made from pods coated in granular sugar. "Sometimes I get a craving for it, that flavor never leaves you as you get older," he says.

Desserts: Tamarind paste pairs well with dates and chocolate in cakes and sweets. Blend a dab into our Dark Chocolate-Walnut Bar—or to add a caramel-like lift to our Fudgy Double-Chocolate Brownies.

Ice cream: Tamarind's tanginess can offset the sweetness of condensed milk when you add a little to our No-Churn Vanilla Ice Cream.

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