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Mango

Mango fruits – single and halved

A **mango** is an edible stone fruit produced by the tropical tree *Mangifera indica*. It originated from the region between northwestern Myanmar, Bangladesh, and northeastern India.[1][2] *M. indica* has been cultivated in South and Southeast Asia since ancient times resulting in two types of modern mango cultivars: the "Indian type" and the "Southeast Asian type".[1][2] Other species in the genus *Mangifera* also produce edible fruits that are also called "mangoes", the majority of which are found in the Malesian ecoregion.[3]

Worldwide, there are several hundred cultivars of mango. Depending on the cultivar, mango fruit varies in size, shape, sweetness, skin color, and flesh color, which may be pale yellow, gold, green, or orange.[4] Mango is the national fruit of India, Pakistan and the Philippines,[5][6] while the mango tree is the national tree of Bangladesh.[7]

Etymology

The English word *mango* (plural "mangoes" or "mangos") originated in the 16th century from the Portuguese word *manga*, from the Malay *mangga*, and ultimately from the Tamil *man* ("mango tree") + *kay* ("unripe fruit/vegetable").[8][9][10] The scientific name, *Mangifera indica*, refers to a plant bearing mangoes in India.[10]

Description

Mango trees grow to 30–40 metres (98–131 feet) tall, with a crown radius of 10–15 m (33–49 ft). The trees are long-lived, as some specimens still fruit after 300 years.[11]

In deep soil, the taproot descends to a depth of 6 m (20 ft), with profuse, wide-spreading feeder roots and anchor roots penetrating deeply into the soil.[4] The leaves are evergreen, alternate, simple, 15–35 centimetres (6–14 inches) long, and 6–16 cm ($2\frac{1}{2}$–$6\frac{1}{2}$ in) broad; when the leaves are young they are orange-pink, rapidly changing to a dark, glossy red, then dark green as they mature.[4] The flowers are produced in terminal panicles 10–40 cm (4–$15\frac{1}{2}$ in) long; each flower is small and white with five petals 5–10 millimetres ($\frac{3}{16}$–$\frac{3}{8}$ in) long, with a mild, sweet fragrance.[4] Over 500 varieties of mangoes are known,[4] many of which ripen in summer, while some give a double crop.[12] The fruit takes four to five months from flowering to ripening.[4]

The ripe fruit varies according to cultivar in size, shape, color, sweetness, and eating quality.[4] Depending on the cultivar, fruits are variously yellow, orange, red, or green.[4] The fruit has a single flat, oblong pit that can be fibrous or hairy on the surface and does not separate easily from the pulp.[4] The fruits may be somewhat round, oval, or kidney-shaped, ranging from 5–25 centimetres (2–10 in) in length and from 140 grams (5 oz) to 2 kilograms (5 lb) in weight per individual fruit.[4] The skin is leather-like, waxy, smooth, and fragrant, with colors ranging from green to yellow, yellow-orange, yellow-red, or blushed with various shades of red, purple, pink, or yellow when fully ripe.[4]

Ripe intact mangoes give off a distinctive resinous, sweet smell.[4] Inside the pit 1–2 mm (0.039–0.079 in) thick is a thin lining covering a single seed, 4–7 cm (1.6–2.8 in) long. Mangoes have recalcitrant seeds which do not survive freezing and drying.[13] Mango trees grow readily from seeds, with germination success highest when seeds are obtained from mature fruits.[4]

Flowers and immature fruits on an 'Alphonso' tree

Unripe mangos in Rincón, Puerto Rico

The seed inside of a mango pit

A mango stone

Taxonomy

Mangoes originated from the region between northwestern Myanmar, Bangladesh, and northeastern India.[1][2] The mango is considered an evolutionary anachronism, whereby seed dispersal was once accomplished by a now-extinct evolutionary forager, such as a megafauna mammal.[14]

'Carabao', a typical "Southeast Asian type" polyembryonic mango cultivar

From their center of origin, mangoes diverged into two genetically distinct populations: the subtropical Indian group and the tropical Southeast Asian group. The Indian group is characterized by having monoembryonic fruits, while polyembryonic fruits characterize the Southeast Asian group.[1][2]

'Langra', a typical "Indian type" monoembryonic mango cultivar

It was previously believed that mangoes originated from a single domestication event in South Asia before being spread to Southeast Asia, but a 2019 study found no evidence of a center of diversity in India. Instead, it identified a higher unique genetic diversity in Southeast Asian cultivars than in Indian cultivars, indicating that mangoes may have originally been domesticated first in Southeast Asia before being introduced to South Asia. However, the authors also cautioned that the diversity in Southeast Asian mangoes might be the result of other reasons (like interspecific hybridization with other *Mangifera* species native to the Malesian ecoregion). Nevertheless, the existence of two distinct genetic populations

also identified by the study indicates that the domestication of the mango is more complex than previously assumed and would at least indicate multiple domestication events in Southeast Asia and South Asia.[1][2]

Cultivars

There are many hundreds of named mango cultivars. In mango orchards, several cultivars are often grown to improve pollination. Many desired cultivars are monoembryonic and must be propagated by grafting, or they do not breed true. A common monoembryonic cultivar is 'Alphonso', an important export product, considered "the king of mangoes."[15]

Cultivars that excel in one climate may fail elsewhere. For example, Indian cultivars such as 'Julie,' a prolific cultivar in Jamaica, require annual fungicide treatments to escape the lethal fungal disease anthracnose in Florida. Asian mangoes are resistant to anthracnose.[16]

The current world market is dominated by the cultivar 'Tommy Atkins', a seedling of 'Haden' that first fruited in 1940 in southern Florida and was initially rejected commercially by Florida researchers.[17] Growers and importers worldwide have embraced the cultivar for its excellent productivity and disease resistance, shelf life, transportability, size, and appealing color.[18] Although the Tommy Atkins cultivar is commercially successful, other cultivars may be preferred by consumers for eating pleasure, such as Alphonso.[15][18]

Generally, ripe mangoes have an orange-yellow or reddish peel and are juicy for eating, while exported fruit are often picked while underripe with green peels. Although producing ethylene while ripening, unripened exported mangoes do not have the same juiciness or flavor as fresh fruit.

Distribution and habitat

From tropical Asia, mangoes were introduced to East Africa by Arab and Persian traders in the ninth to tenth centuries.[19] The 14th-century Moroccan traveler Ibn Battuta reported it at Mogadishu.[20] It was spread further into other areas around the world during the Colonial Era. The Portuguese Empire spread the mango from their colony in Goa to East and West Africa. From West Africa, they introduced it to Brazil from the 16th to the 17th centuries. From Brazil, it spread northwards to the Caribbean and eastern Mexico by the mid to late 18th century. The Spanish Empire also introduced mangoes directly from the Philippines to western Mexico via the Manila galleons from at least the 16th century. Mangoes were only introduced to Florida by 1833.[2][21]

Mango tree in Palestine

Cultivation

The mango is now cultivated in most frost-free tropical and warmer subtropical climates. It is cultivated extensively in South Asia, Southeast Asia, East and West Africa, the tropical and subtropical Americas, and the Caribbean.[22] Mangoes are also grown in Andalusia, Spain (mainly in Málaga province), as its coastal subtropical climate is one of the few

places in mainland Europe that permits the growth of tropical plants and fruit trees. The Canary Islands are another notable Spanish producer of the fruit. Other minor cultivators include North America (in South Florida and the California Coachella Valley), Hawai'i, and Australia.[23]

Many commercial cultivars are grafted onto the cold-hardy rootstock of the *Gomera-1* mango cultivar, originally from Cuba. Its root system is well adapted to a coastal Mediterranean climate.[24] Many of the 1,000+ mango cultivars are easily cultivated using grafted saplings, ranging from the "turpentine mango" (named for its strong taste of turpentine[25]) to the Bullock's Heart. Dwarf or semidwarf varieties serve as ornamental plants and can be grown in containers. A wide variety of diseases can afflict mangoes.

A breakthrough in mango cultivation was the use of potassium nitrate and ethrel to induce flowering in mangoes. The discovery was made by Filipino horticulturist Ramon Barba in 1974 and was developed from the unique traditional method of inducing mango flowering using smoke in the Philippines. It allowed mango plantations to induce regular flowering and fruiting year-round. Previously, mangoes were seasonal because they only flowered every 16 to 18 months. The method is now used in most mango-producing countries.[27][28]

Mango* production – 2022

Country	millions of tonnes
India	26.3
Indonesia	4.1
China	3.8
Pakistan	2.8
Mexico	2.5
Brazil	2.1
World	**59.2**

* includes mangosteens and guavas reported to FAOSTAT
Source: FAOSTAT of the United Nations[26]

Production

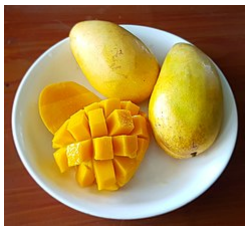
In 2022, world production of mangoes (report includes mangosteens and guavas) was 59 million tonnes, led by India with 44% of the total (table).

Uses

Culinary

Mangoes are generally sweet, although the taste and texture of the flesh vary across cultivars; some, such as Alphonso, have a soft, pulpy, juicy texture similar to an overripe plum, while others, such as Tommy Atkins, are firmer with a fibrous texture.[29]

The skin of unripe, pickled, or cooked mango can be eaten, but it has the potential to cause contact dermatitis of the lips, gingiva, or tongue in susceptible people.[30]



The "hedgehog" style of preparation on Carabao mangoes

Alphonso mango chunks

Sliced Ataulfo mangoes

A glass of mango juice

Mango chutney

Sour unripe mangoes eaten with shrimp paste, salt, chili, vinegar or soy sauce in the Philippines

Many varieties of Mango from India

Mangoes are used in many cuisines. Sour, unripe mangoes are used in chutneys (i.e., mango chutney), pickles, daals and other side dishes in Indian cuisine. A summer drink called *aam panna* is made with mangoes. Mango pulp made into jelly or cooked with red gram *dhal* and green chilies may be served with cooked rice. Mango lassi is consumed throughout South Asia, prepared by mixing ripe mangoes or mango pulp with buttermilk and sugar. Ripe mangoes are also used to make curries. *Aamras* is a thick juice made of mangoes with sugar or milk and is consumed with *chapatis* or *pooris*. The pulp from ripe mangoes is also used to make jam called *mangada*. *Andhra aavakaaya* is a pickle made from raw, unripe, pulpy, and sour mango mixed with chili powder, fenugreek seeds, mustard powder, salt, and groundnut oil. Mango is also used to make *dahl* and *chunda* (a sweet and spicy, grated mango delicacy).

Mangoes are used to make *murabba* (fruit preserves), *muramba* (a sweet, grated mango delicacy), *amchur* (dried and powdered unripe mango), and pickles, including a spicy mustard-oil pickle and alcohol. Ripe mangoes are cut into thin layers, desiccated, folded and then cut. The fruit is also added to cereal products such as muesli and oat granola.

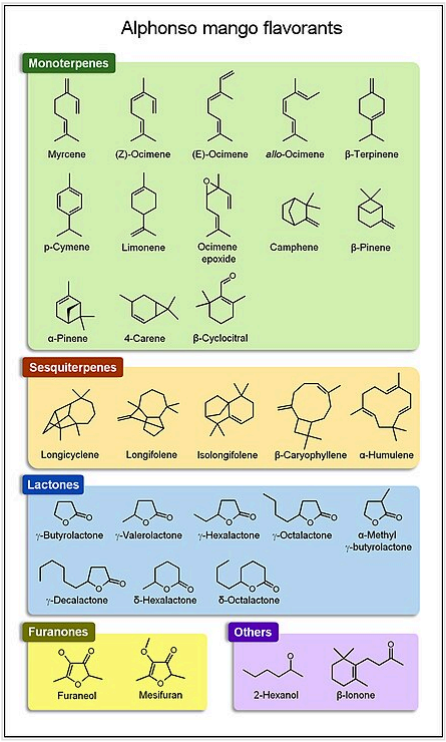
Mango is used to make juices, smoothies, ice cream, fruit bars, *raspados*, *aguas frescas*, pies, and sweet chili sauce, or mixed with *chamoy*, a sweet and spicy chili paste. In Central America, mango is either eaten green, mixed with salt, vinegar, black pepper, and hot sauce, or ripe in various forms.

Pieces of mango can be mashed and used as a topping on ice cream or blended with milk and ice as milkshakes. Sweet glutinous rice is flavored with coconut, then served with sliced mango as mango sticky rice. In other parts of Southeast Asia, mangoes are pickled with fish sauce and rice vinegar.

Green mangoes can be used in mango salad with fish sauce and dried shrimp. Mango with condensed milk may be used as a topping for shaved ice.

Raw green mangoes can be sliced and eaten like a salad.[31] In most parts of Southeast Asia, they are commonly eaten with fish sauce, vinegar, soy sauce, or with a dash of salt (plain or spicy) – a combination usually known as "mango salad" in English.[32]

In the Philippines, green mangoes are also commonly eaten with *bagoong* (salty fish or shrimp paste), salt, soy sauce, vinegar or chilis.[33][34] Mango float and mango cake, which use slices of ripe mangoes, are eaten in the Philippines.[35][36] Dried strips of sweet, ripe mango (sometimes combined with seedless tamarind to form *mangorind*) are also consumed. Mangoes may be used to make juices, mango nectar, and as a flavoring and major ingredient in mango ice cream and *sorbetes*.



Major flavor chemicals of 'Alphonso' mango from India

Phytochemistry

Numerous phytochemicals are present in mango peel and pulp, such as the triterpene lupeol.[39] Mango peel pigments under study include carotenoids, such as the provitamin A compound, beta-carotene, lutein and alpha-carotene,[40][41] and polyphenols, such as quercetin, kaempferol, gallic acid, caffeic acid, catechins and tannins.[42][43] Mango contains a unique xanthonoid called mangiferin.[44]

Phytochemical and nutrient content appears to vary across mango cultivars.[45] Up to 25 different carotenoids have been isolated from mango pulp, the densest of which was beta-carotene, which accounts for the yellow-orange pigmentation of most mango cultivars.[46] Mango leaves also have significant polyphenol content, including xanthonoids, mangiferin and gallic acid.[47]

Mango

Nutritional value per 100 g (3.5 oz)		
Energy	250 kJ (60 kcal)	
Carbohydrates	15 g	
Sugars	13.7	
Dietary fiber	1.6 g	
Fat	0.38 g	
Saturated	0.092 g	
Monounsaturated	0.14 g	
Polyunsaturated	0.071 g	
omega-3	0.051 g	
omega-6	0.019 g	
Protein	0.82 g	
Vitamins	**Quantity**	**%DV†**
Vitamin A equiv.	54 µg	6%
beta-Carotene	640 µg	6%
lutein zeaxanthin	23 µg	
Thiamine (B_1)	0.028 mg	2%
Riboflavin (B_2)	0.038 mg	3%

Flavor

The flavor of mango fruits is conferred by several volatile organic chemicals mainly belonging to terpene, furanone, lactone, and ester classes. Different varieties or cultivars of mangoes can have flavors made up of different volatile chemicals or the same volatile chemicals in different quantities.[48] In general, New World mango cultivars are characterized by the dominance of δ-3-carene, a monoterpene flavorant; whereas, high concentration of other monoterpenes such as (Z)-ocimene and myrcene, as well as the presence of lactones and furanones, is the unique feature of Old World cultivars.[49][50][51] In India, 'Alphonso' is one of the most popular cultivars. In 'Alphonso' mango, the lactones and furanones are

synthesized during ripening, whereas terpenes and the other flavorants are present in both the developing (immature) and ripening fruits.[52][53][54] Ethylene, a ripening-related hormone well known to be involved in ripening of mango fruits, causes changes in the flavor composition of mango fruits upon exogenous application, as well.[55][56] In contrast to the huge amount of information available on the chemical composition of mango flavor, the biosynthesis of these chemicals has not been studied in depth; only a handful of genes encoding the enzymes of flavor biosynthetic pathways have been characterized to date.[57][58][59][60]

Toxicity

Contact with oils in mango leaves, stems, sap, and skin can cause dermatitis and anaphylaxis in susceptible individuals.[4][30][61] Those with a history of contact dermatitis induced by urushiol (an allergen found in poison ivy, poison oak, or poison sumac) may be most at risk for mango contact dermatitis.[62] Other mango compounds potentially responsible for dermatitis or allergic reactions include mangiferin.[4] Cross-reactions may occur between mango allergens and urushiol.[63] Sensitized individuals may not be able to eat peeled mangos or drink mango juice safely.[4]

When mango trees are flowering in spring, local people with allergies may experience breathing difficulty, itching of the eyes, or facial swelling, even before flower pollen becomes airborne.[4] In this case, the irritant is likely to be the vaporized essential oil from flowers.[4] During the primary ripening season of mangoes, contact with mango plant parts – primarily sap, leaves, and fruit skin[4] – is the most common cause of plant dermatitis in Hawaii.[64]

Niacin (B_3)	0.669 mg	4%
Pantothenic acid (B_5)	0.197 mg	4%
Vitamin B_6	0.119 mg	7%
Folate (B_9)	43 µg	11%
Choline	7.6 mg	1%
Vitamin C	36.4 mg	40%
Vitamin E	0.9 mg	6%
Vitamin K	4.2 µg	4%
Minerals	**Quantity**	**%DV†**
Calcium	11 mg	1%
Copper	0.111 mg	12%
Iron	0.16 mg	1%
Magnesium	10 mg	2%
Manganese	0.063 mg	3%
Phosphorus	14 mg	1%
Potassium	168 mg	6%
Selenium	0.6 µg	1%
Sodium	1 mg	0%
Zinc	0.09 mg	1%
Other constituents	**Quantity**	
Water	83.5 g	

Link to USDA Database entry (https://fdc.nal.usda.gov/fdc-app.html#/food-details/1102670/nutrients)

†Percentages estimated using US recommendations for adults,[37] except for potassium, which is estimated based on expert recommendation from the National Academies.[38]

Nutrition

A raw mango is 84% water, 15% carbohydrates, 1% protein, and has negligible fat (table). The energy value per 100g (3.5oz) serving of raw mango is 250 kJ (60 calories). Fresh mango contains only vitamin C and folate in significant amounts of the Daily Value as 44% and 11%, respectively (table).

Culture

The mango is the national fruit of India.[65][66] It is also the national tree of Bangladesh.[67][68] In India, harvest and sale of mangoes is during March–May and this is annually covered by news agencies.[15]