

Jujube: Chinese Date in New Mexico

Revised by Shengrui Yao¹

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ORIGIN

Jujube (*Ziziphus jujuba* Mill), also called Chinese date, red date, or Tsao, is native to China. It originated in the middle and lower reaches of the Yellow River and has been cultivated in China for more than 4,000 years. Botanically, it is derived from its wild relative sour jujube or wild jujube (*Z. spinosa* Hu). In ancient times, people selected and cultivated sour jujubes with bigger fruit, and it gradually became the cultivated modern jujube species (*Z. jujuba*). There are still semi-cultivated sour jujubes like 'Tiger Eye' big round sour jujube and 'Yanjishan' big sour jujube, which are popular in Beijing and Shandong Provinces, China, respectively.

Jujubes belong to the Rhamnaceae (buckthorn) family. The jujube can be easily confused with the Indian jujube (*Z. mauritiana* Lam), which is a tropical plant of the same genus, whereas the Chinese jujube is a cold-hardy deciduous plant. Although it varies with location, jujube usually starts to leaf out in March to April, blooms in May to July, and matures in August

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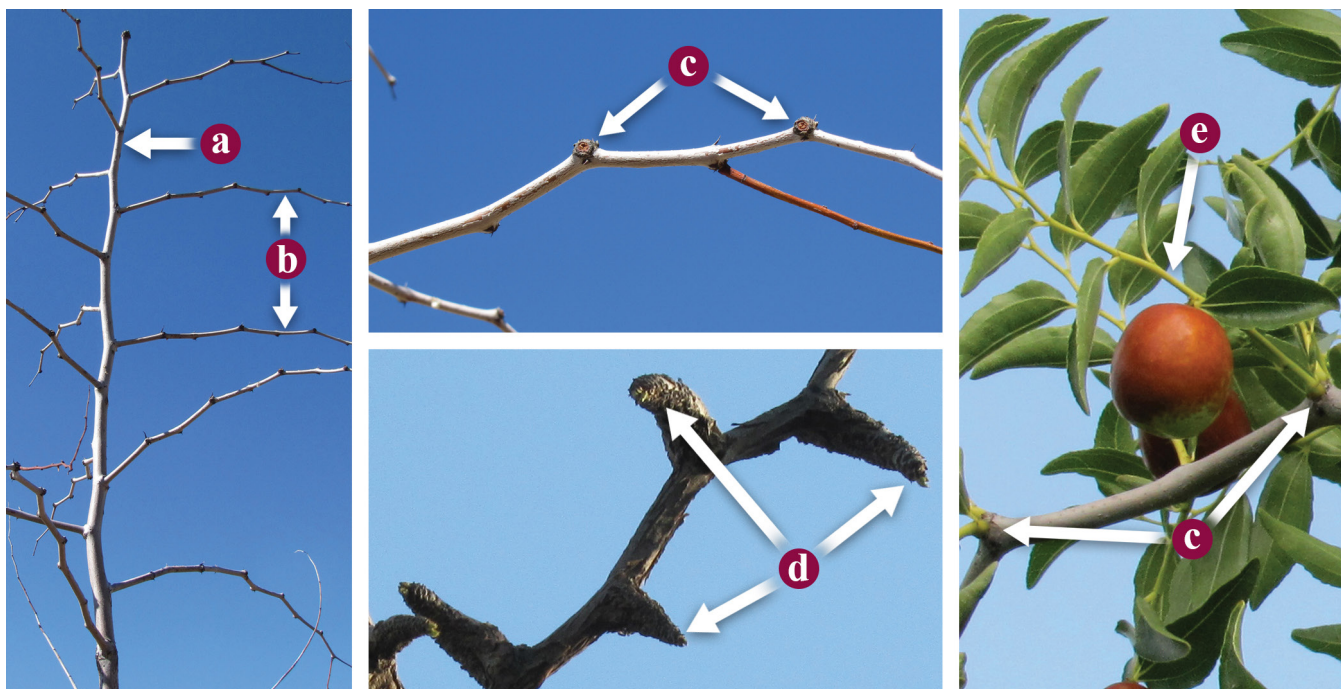


Figure 1. Jujube shoot structures: a) primary shoot, b) secondary shoot, c) mother bearing shoot (young fruiting spur), d) old fruiting spur, e) fruit-bearing shoot (branchlet). (Photos by Shengrui Yao.)

to October. The dried fruit of the date palm (*Phoenix dactylifera*) looks similar to that of jujube, but botanically they are not related to each other.

JUJUBE HISTORY IN THE U.S.

Jujubes were first introduced to the U.S. from Europe by Robert Chisholm and planted in Beaufort, NC, in 1837. In 1876, G.P. Rixford brought jujubes from France and introduced them to California and nearby states. Most of the early imports were from seedlings. USDA Agricultural Explorer Frank N. Meyer introduced the first group of commercial cultivars to the Plant Introduction Field Station at Chico, CA, in 1908. Later, they were distributed to other USDA stations in Texas, New Mexico, Oklahoma, Georgia, and Florida. Scientists evaluated those jujube introductions until the 1960s, and a few selections were developed at Chico, CA. Shortly after the importation, Meyer and other scientists realized the potential of jujubes in the U.S., especially in the Southwest where sunshine is plentiful, summers are hot, and the climate is semiarid. In 1947, L.F. Locke from the Southern Great Plains Field Station at Woodward, OK, wrote, “This jujube is little known, but is highly dependable fruit of high food value.”

In New Mexico, jujube trees can be found growing in diverse locales around the state. There are 60-year-old sour jujube and regular jujube trees (cultivars un-

known) on the NMSU Las Cruces campus (Doña Ana County, elevation 4,000 ft). There are jujube trees in the South Valley area outside Albuquerque that were planted in 1928. A homeowner in Cliff, NM (Grant County, elevation 4,500 ft), has jujubes near his house, and they have been producing a prolific crop every year for the past 40 years. There are two jujube trees at the old LC Ranch headquarters at Gila, NM, which were planted around 1910, and they are still producing. Other scattered trees in Las Cruces, Los Lunas (Valencia County, elevation 4,856 ft), Albuquerque (Bernalillo County, elevation 5,312 ft), Tucumcari (Quay County, elevation 4,816 ft), and Española (Rio Arriba County, elevation 5,595 ft) are all growing and producing well.

DESCRIPTION

Tree

Jujube is a deciduous fruit/ornamental tree, 15 to 30 ft in height, with very hard, strong wood. Branches are zigzagged, with paired spines in young trees. Depending on the cultivar, tree growth habit varies from broad and spreading to very narrow and upright canopies.

Leaves

Leaves are shiny, ovate or oval in shapes, not branched, and grow on alternating sides of branches. Leaves are

1 to 2 inches (2.5–5.5 cm) long and 0.75 to 1.5 inches (2–4 cm) wide.

Buds and shoots

Jujube shoots are different from other fruit species. Vigorous new shoots of peach, apple, and grape can have branches in the same growing season, and the branches have a structure similar to the primary shoot. Jujube has four types of shoots: primary (extension) shoot, secondary shoot (side branches), mother bearing shoot (fruiting spur), and fruit-bearing shoot (branchlet) (Figure 1). There are three kinds of buds for jujubes: main buds, secondary buds, and dormant buds.

There are two buds—one main bud and one secondary bud—at each node of both primary and secondary shoots and at the apex of mother bearing shoots. The terminal main bud of the primary shoot will keep growing each season to expand the tree canopy, and the lateral main buds (at the base of each secondary shoot) normally do not sprout and instead become dormant except with strong stimulation. The secondary buds on each node of primary and secondary shoots are early maturing buds, which produce secondary shoots or fruit-bearing shoots.

The jujube primary shoot is always accompanied by secondary shoots (side branches), or the secondary shoots are part of the primary shoot and later diverge in function. The primary shoot elongates every year to expand the tree canopy. The secondary shoot acts as a base for the fruiting structure, does not extend in length, and withers back after two or three years. At each node of the secondary shoot is a mother bearing shoot (fruiting spur), which is a compact spur that grows approximately 0.04 inch (1 mm) and produces two to five fruit-bearing shoots each year. The fruit-bearing shoot (branchlet) is thin, flexible, deciduous, and 4 to 8 inches (10–20 cm) long; it bears flowers and fruits at its axils. The primary shoot, secondary shoot, and branchlet are zigzagged and spiny.

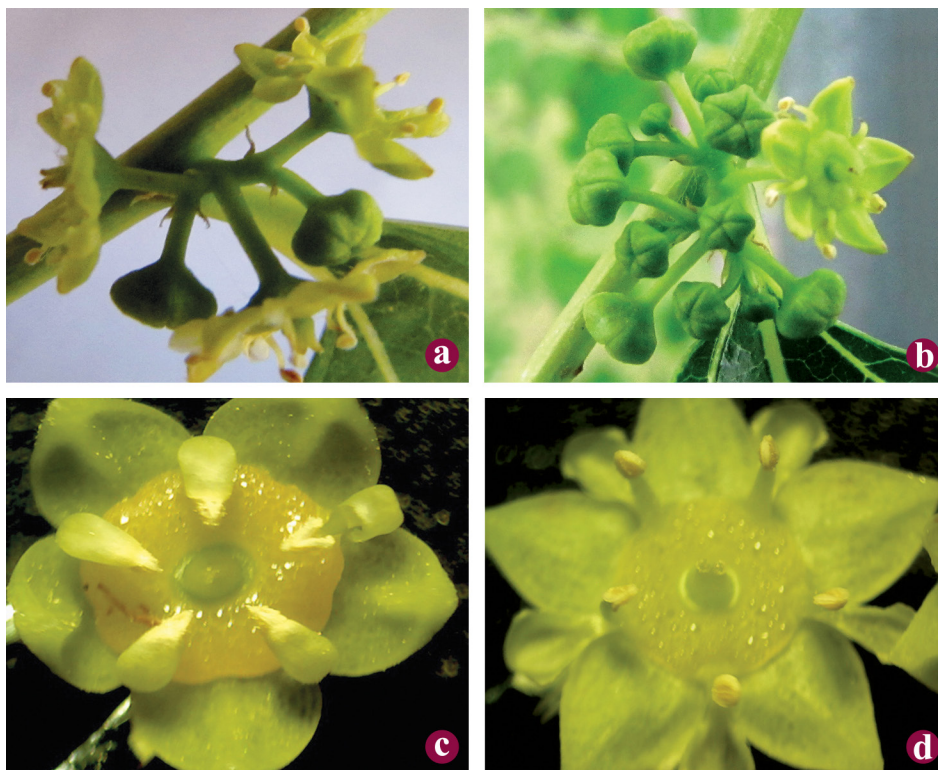


Figure 2. Jujube flowers: a) a simple cyme, b) a large cyme, c) a half-opened flower, d) a fully opened flower. (Photos by Shengrui Yao.)

Flowers and fruits

Unlike apples or peaches, jujubes do not have big, showy flowers. The flowers are fragrant, pale greenish-yellow in color, and small, with diameters ranging from 0.2 to 0.3 inch (5–8 mm) (Figure 2). Flowers can appear singly or in a cluster at each leaf axil. Jujube's flower cluster (inflorescence) is a cyme (Figure 2) with up to 13 flowers, depending on the cultivar and its position on the branchlet. Jujube flower buds initiate, bloom, and develop into mature fruit within one growing season, which is unique and different from other tree fruit crops. Jujube bloom lasts for two months or longer, making jujubes good nectar plants.

Jujube fruit is a drupe with one pit (stone) in the middle that contains up to two seeds. Its fruit derives from its ovary and the nectar disk. Fruit size varies from thumb-sized to golf ball-sized, depending on the cultivar. The fruit shape can be round, oblong, oval, ovate, obovate, oblate, apple-like, or abnormal shapes.

CULTIVARS

Currently, there are over 800 jujube cultivars in China, including fresh eating, drying, multipurpose (good for both drying and fresh eating), candied, and ornamental.

Cultivars for drying (including multipurpose cultivars) formerly dominated and accounted for 90% of the jujube production in China. Now, with the selection and introduction of new fresh eating cultivars, plus the abundance of cold storage facilities, fresh eating cultivars are gaining popularity in China.

In the U.S., jujube cultivars include Frank Meyer's cultivars, cultivars recently imported from China or other jujube-growing countries, those released from the USDA Chico breeding program, and a few selections from seedlings across the country. Commercially available cultivars are limited. Research from China indicated that quite a few regionally dominant cultivars are self-fertile, with no need for additional pollination; some cultivars can self-pollinate and set fruit, but cross pollination will improve the fruit set and fruit yield. A few cultivars are sterile without pollen, and a pollenizer cultivar and pollinating insect activity are required for these. Common pollinating insects include ants, honey bees, wild bees, hover flies, houseflies, ladybugs, and similar species. As for cultivars in the U.S., several tested cultivars are self-fertile, like 'Li', 'Alcalde #1', and 'Shanxi Li', but cross pollination also increased fruit set and fruit size. For this reason, it is best to plant two or more cultivars instead of a single cultivar.

The following are descriptions of jujube cultivars that may be encountered in the U.S., and they are roughly arranged by their maturation order from early to late.

- **'Alcalde #1' aka 'Qiyuexian'**: An early cultivar, suitable for marginal regions. Large fruit and very good fresh eating fruit quality; can also be used for drying. Relatively small tree size.
- **'Honey Jar'**: An importation from China by Roger Meyer (no relation to Frank Meyer). Small, round fruit with excellent quality; very sweet and crisp, and excellent for fresh eating. Tree is precocious and fruits during planting year or grafting year.
- **'Maya'**: An early to mid-season cultivar. Small, football-shaped fruit with excellent fresh eating quality. Very suitable for home gardeners.
- **'Russian 2' aka 'Black Sea'**: A cultivar imported from Ukraine. Trees are productive. Small fruit mature early to mid-season and have excellent fresh eating quality. Suitable for home gardeners.
- **'Sugarcane'**: Small- to medium-sized, round to elongated fruit with very good quality. Good for fresh eating and drying. Fruit is sweet and crunchy on a spiny tree. Recent jujube genotyping data indicated that it is not directly related to 'Jinsi' series cultivars. Pollenizer cultivars and bee activity are necessary to ensure good fruit set.
- **'So'**: Frank Meyer's cultivar. Beautiful four-season ornamental tree with zigzagged branches. Medium-sized, round fruit with balanced sweet/tart flavor. Good for fresh eating and drying. Suitable for landscaping and home gardeners.
- **'Li'**: Popular commercial cultivar imported directly from China by Frank Meyer. Large, round fruit up to 3 ounces each, which mature mid-season. A good fresh eating cultivar, with good fruit quality.
- **'Shanxi Li'**: Was popular in the late 1980s and early 1990s in China, and used to be one of the major fresh eating cultivars in China. Large-sized fruit with good eating quality, which mature mid-season. Tree is precocious and productive. Similar to 'Li'.
- **'Lang'**: Popular commercial cultivar imported directly from China by Frank Meyer. Fruit is big and pear-shaped, and good for drying. Some fruit may split if it rains during fruit maturity.
- **'Kongfucui' (KFC)**: Mid-season cultivar that is very productive across New Mexico. Shiny fruit skin and excellent fresh eating quality. Can also be used for drying.
- **'Sihong'**: An importation from China by Roger Meyer. Firm texture. Good for fresh eating and excellent for drying. When dried, fruit has fine wrinkles on its surface. Mid-season maturity.
- **'Dongzao'**: Based on recent jujube genotyping data, there are two types of 'Dongzao' from Shandong and Hebei provinces, China. Medium-sized fruit; super fresh eating quality with thin skin and fine texture. Mid- to late-season maturity. It is not very productive in early years. This is the number one fresh eating cultivar in China. Cultural practices like gibberellin spray or girdling are commonly used to increase fruit set in China. It is predicted that it will also become popular in the U.S. in warmer regions. Central and southern New Mexico are suitable for 'Dongzao' production.
- **'GA866'**: From USDA Chico Plant Introduction Station's jujube breeding program in California. Excellent fruit quality with very high sugar content. Fruit is elongated and pointed at the far end. Neither precocious nor productive in early years

after planting. Upright growth habit with few branches. Mid- to late-season maturity.

- **‘Sherwood’:** A seedling from Louisiana. Firm fruit with good quality. Good for both fresh eating and drying. Young trees are upright and narrow, and they will spread out as crop load increases. Late-maturing cultivar. Good for areas with long growing seasons.

There are many more cultivars that have not been listed here, such as ‘Jinsi’ series multipurpose cultivars and drying cultivar ‘Jixin’. For more cultivar information, please visit <https://jujube.nmsu.edu/>. This website includes information on around 50 cultivars in four categories: fresh eating, drying, multipurpose, and ornamental. The site also includes publications on jujube cultivar performance in southern (Las Cruces), central (Los Lunas), and northern (Alcalde) New Mexico.

In general, growers in southern New Mexico have more choices from early to late-maturing and from fresh eating to drying cultivars. In northern New Mexico, growers/home gardeners need to be more careful with their cultivar selection; no drying cultivars are suitable for commercial production, and only early to mid-season cultivars grow and mature well in this region. Avoid late-maturing cultivars in northern New Mexico. Central New Mexico is in the middle, and most cultivars will grow and produce well, except for very late-maturing drying cultivars.

CULTURE

Propagation

Most commercial jujube trees are grafted onto sour jujube (*Z. spinosa* Hu) because of its seed availability and stress tolerance. Tongue-whip grafting, bark grafting, and cleft grafting are popular methods of jujube propagation. Please see NMSU Extension Guide H-335, *Jujube (Ziziphus jujuba) Grafting* (https://pubs.nmsu.edu/_h/H335.pdf), for more details about jujube grafting, along with a YouTube video at <https://www.youtube.com/watch?v=fFLwOWe0KQ4>.

Jujubes can also be propagated through root suckers if the mother plants are from root suckers. If the mother plants are grafted trees, the suckers are only good as rootstocks. Softwood cutting is also possible for jujubes in a moist environment. Jujube cultivar tissue culture is under testing and will be available soon to customers.

Precocity and tree life span

Jujube trees are very precocious. They bear flowers the same year as planting or grafting, and some cultivars can even bear some fruit. Most cultivars will produce a few fruits in the second year. After four to five years, jujubes will have a reasonable yield. A mature jujube tree can have 40 to 100 lb or more of fruit, depending on cultivar, tree size, cultural management, and location. Jujube trees can keep producing in commercial orchards for 50 years or more. The ‘Jujube King’ is over 1,000 years old and is still producing fruit annually in Shandong Province, China.

Soil requirements

Jujubes can grow and set fruit well in a wide range of soil conditions, from sandy to loam to clay, and from acidic to alkaline (pH 5.0–8.5). Jujubes can survive in barren soils. Most New Mexico soils should be suitable for jujube production.

Irrigation and fertilization

Jujube plants are quite tolerant to drought. For a premium fruit set and yield, though, jujube trees need to be irrigated in New Mexico’s semiarid climate. Jujube in general is a tough tree and easy to care for, but newly planted trees desire care similar to other fruit trees.

There is limited research on jujube fertilization. Trees will survive with little or no fertilizer, but for commercial production, fertilizer applications are necessary. Do not fertilize newly planted trees until they are leafing out.

Pruning

In general, jujube’s training and pruning are simple, but there are some basic rules to follow. “One cut stops, two cuts sprout” is a saying unique to jujubes. Unlike apple and peach, if you give a one-year-old jujube shoot just one cut in the middle, no bud will grow under that cut. To force a main bud to sprout below a cut, the secondary shoot must be removed below the cut. Jujubes are light-demanding (full sunshine) plants. Pruning them annually will benefit the tree and improve the fruit set and fruit quality. For more details, please refer to NMSU Extension Guide H-337, *Jujube Training and Pruning Basics* (https://pubs.nmsu.edu/_h/H337.pdf).

Harvest

As the fruit begins to mature, fruit color changes from dark green to yellow-green, known as the creamy,

white mature stage. As maturation continues, brown/red spots develop at the petiole end (where the fruit joins the stem) or randomly in the middle of the fruit. The color further changes to half red/half creamy, and eventually becomes fully red/brown, known as the fully mature stage. People often compare firm jujube fruit texture to that of a crisp apple. Several days after fully red, fruit texture starts to soften and wrinkles appear on the surface.

Jujube fruit maturity is not uniform. Fresh eating cultivars can be marketed from the creamy stage until they are fully red but still firm. Fresh fruit harvested when first ripe can be stored at 40°F (4°C) for two weeks or more without losing quality. The best time to harvest drying cultivars is when they are fully red. In New Mexico's semiarid climate, fruits can be harvested when they start to wrinkle, or can be left hanging on the trees for a while after wrinkling. In humid areas, fruits must be harvested when they are fully red in color and dried as soon as possible to avoid yeast or mold infection. Manual harvest is preferable for fresh eating cultivars. For drying cultivars, growers in China lay tarps below trees and then shake the trees or use long poles to dislodge fruits. Mechanical harvest using trunk shakers may be applicable for production of large acreages of drying cultivars.

Pests, diseases, and disorders

In China, the dominant diseases for jujube are witch's broom and fruit splitting. Witch's broom is caused by a type of phytoplasma bacteria (*Candidatus Phytoplasma ziziphi*) and can destroy an entire orchard. The worst fruit splitting, resulting from heavy rainfall near harvest time, can ruin the entire season's crop. Peach fruit moth (*Carposina niponensis*) used to be the number one pest for jujubes in China.

It is easy to produce jujubes organically in New Mexico because, so far, jujubes are almost disease- and pest-free in the state. Over the past 12 years, we occasionally noticed peach fruit moth damage on fruit at Las Cruces, NM, and a leaf spot disease at Los Lunas, NM, caused by *Alternaria alternata*. Fruit cracking is sometimes observed in some cultivars at all testing sites across New Mexico if it rains during the fruit maturation stage. Cracking severity depends on cultivar, fruit maturation stage, location, and time and amount of precipitation. Most of the time in this climate, though, cracks will remain dry without developing yeast or fungal infection.

FRUIT NUTRITION AND USES

Jujube fruit is recognized as a nutritious food and important traditional medicine in China, Korea, Japan, and Southeast Asia. Jujubes are richer in vitamin C, sugar, bioflavonoids, edible cellulose, cyclic adenosine monophosphate (cAMP), antioxidants, and minerals than many other fruit species. Soluble solids content ranges from 20 to 40% in fresh mature fruit. Carbohydrate content in dried jujubes can reach as high as 70 to 85%. Fresh jujube fruit contains 200 to 600 mg of vitamin C per 100 g fresh weight, while apple, pear, and peach have 1 to 8 mg of vitamin C per 100 g fresh weight. Jujubes are also rich in cyclic adenosine monophosphate (cAMP), which is an important "second messenger" in many biological processes in the human body.

Thus far in the U.S., jujubes have been considered more of a novelty than a specialty crop, with fresh and dried production mainly for home and local markets. However, the fruit can be used in many different ways. Dried jujubes are a nutritious snack and can replace raisins and dates in baking. Recipes have been created for jujube cake, jujube butter, candied jujubes, and jujube syrup, and some of these can be found below in the **RECIPES** section. In China and Southeast Asia, besides being eaten fresh and dried, jujubes are also processed as candied fruit, black jujube, smoked fruit, juice, jam, wine, mixed beverages, powders, and tea. Dried fruits are also cooked in porridge or broth and are further processed into a paste filling like mooncake. We imported basic types of a jujube pitter and a slicer in 2018, which can de-pit the dry fruit and slice them to pieces, and the resulting product can be marketed directly. As jujubes become more familiar and popular in the U.S., many value-added products with jujubes will be created.

RECIPES

Jujube fruit in salad

Fresh mature jujube fruit can be added to salads. Just remove the pit, cut the fruit into pieces, and add it to your favorite fruit salad or regular salad!

Jujube or jujube/apple pie

Jujube fruit can be used as the sole ingredient or mixed in equal parts with apples to make pie. Since jujube is high in sugar content, no extra sugar is needed when using only jujubes in pie—just follow the apple pie recipe. For half jujube/half apple pie, the sugar amount can be reduced by 1/3 or 1/2 of the regular amount.

Use large-sized mature jujube fruit like ‘Li’ or ‘Shanxi Li’ at the half red or fully red stage of maturity. Cut each fruit into 5 to 8 pieces. In the final product, jujube fruit is not as tender as apple, but has its own texture and good taste.

Jujube butter

- 12 cups jujube pulp (about 2.5–3 lb of dry fruit)
- 1 teaspoon nutmeg
- 1/2 teaspoon cloves
- 2 teaspoons cinnamon
- 10 cups sugar
- 1/2 cup vinegar
- Juice of 1 lemon

To remove the pits from the dry fruit, use scissors to cut them open and remove the pit, or smash them with a mallet to separate and remove the pit, then chop the pulp into small pieces. Place fruit in a pot and add enough water to cover. Boil fruit until tender. Drain, then run cooked fruit through a sieve or colander to remove the skin and seeds. Add remaining ingredients and cook slowly until thick. If you want to can the mixture, please follow safe canning procedures (see the *USDA Complete Guide to Home Canning*, available at http://nchfp.uga.edu/publications/publications_usda.html).

Jujube cake

- 1 cup sugar
- 1/2 cup butter
- 2 cups dried, minced jujube
- 1 cup water
- 2 cups all-purpose flour
- 1 teaspoon soda
- 1/2 teaspoon salt

Preheat oven to 325°F. Combine sugar, butter, minced jujube, and water in a pot. Bring these to a boil, then set aside to cool.

Sift together dry ingredients, then add to the wet ingredient mixture and stir to combine. Bake in your favorite cake pan at 325°F for around 20 minutes until a toothpick inserted into the cake comes out clean.

Sliced dry jujube pieces can also be used to replace raisins, pecans, or walnuts in baking.

Jujube paste

Cook dried jujubes in water for 10 minutes or until soft. Make sure to not overcook the fruit, which might turn sour if overcooked. Puree in a food processor, then sweeten with sugar to taste. Mix the puree into a smooth paste. The paste can be used as a spread or as filling for confections such as cookies, desserts, and steamed buns.

CONCLUSION

Late-season startup, precocity, reliable crops, nutritional benefits, and mild flavors make jujube an excellent fruit for commercial production, backyard trees, or as edible landscape trees. More and more home gardeners have planted jujubes in their yards, and some growers are planting them at a commercial level in New Mexico. Growers can start with small acreage and expand their operation to a bigger size with more diversified cultivars as the market grows.

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