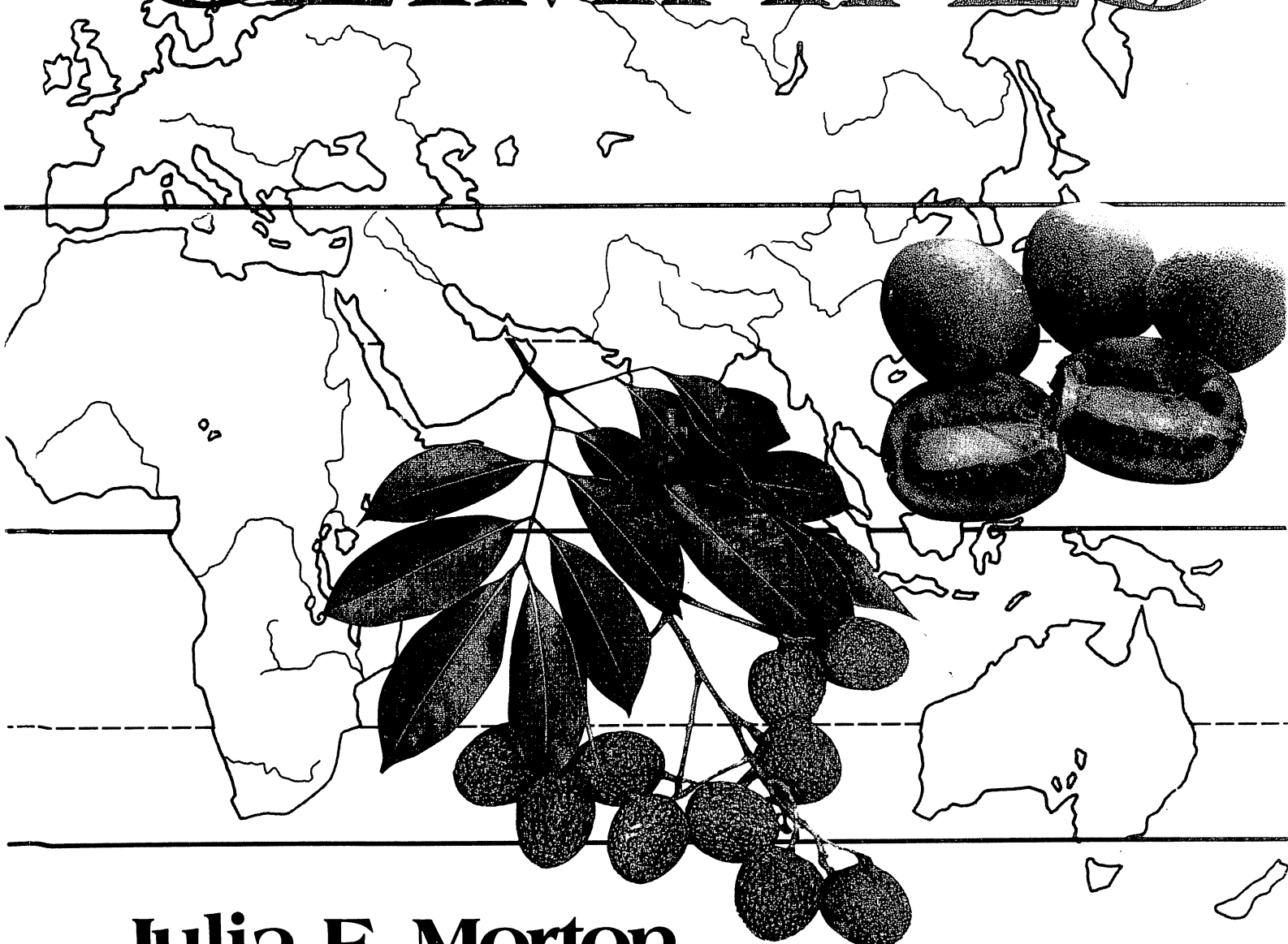


FRUITS OF WARM CLIMATES



Julia F. Morton

Cherimoya (Plate VII)

Certainly the most esteemed of the fruits of the genus *Annona* (family Annonaceae), the cherimoya, *A. cherimola* Mill., because of its limited distribution, has acquired few colloquial names, and most are merely local variations in spelling, such as *chirimoya*, *cherimolia*, *chirimolla*, *cherimolier*, *cherimoyer*. In Venezuela, it is called *chirimorriñon*; in Brazil, *graveola*, *graviola*, or *grabiola*; and in Mexico, *pox* or *poox*; in Belize, *tukib*; in El Salvador it is sometimes known as *anona poshte*; and elsewhere merely as *anona*, or *anona blanca*. In France, it is *anone*; in Haiti, *cachiman la Chine*. Indian names in Guatemala include *pac*, *pap*, *tummy* and *tzumux*. The name, cherimoya, is sometimes misapplied to the less-esteemed custard apple, *A. reticulata* L. In Australia it is often applied to the atemoya (a cherimoya-sugar apple hybrid).

Description

The tree is erect but low-branched and somewhat shrubby or spreading; ranging from 16 to 30 ft (5 to 9 m) in height; and its young branchlets are rusty-hairy. The leaves are briefly deciduous (just before spring flowering), alternate, 2-ranked, with minutely hairy petioles $\frac{1}{4}$ to $\frac{1}{2}$ in (6 to 12.5 mm) long; ovate to elliptic or ovate-lanceolate, short blunt-pointed at the apex; slightly hairy on the upper surface, velvety on the underside; 3 to 6 in (7.5-15 cm) long, $1\frac{1}{2}$ to $3\frac{1}{2}$ in (3.8-8.9 cm) wide.

Fragrant flowers, solitary or in groups of 2 or 3, on short, hairy stalks along the branches, have 3 outer, greenish, fleshy, oblong, downy petals to $1\frac{1}{4}$ in (3 cm) long and 3 smaller, pinkish inner petals. A compound fruit, the cherimoya is conical or somewhat heart-shaped, 4 to 8 in (10 to 20 cm) long and up to 4 in (10 cm) in width, weighing on the average $5\frac{1}{2}$ to 18 oz (150-500 g) but extra large specimens may weigh 6 lbs (2.7 kg) or more. The skin, thin or thick, may be smooth with fingerprint-like markings or covered with conical or rounded protuberances. The fruit is easily broken or cut open, exposing the snow-white, juicy flesh, of pleasing aroma and delicious, subacid flavor; and containing numerous hard, brown or black, beanlike, glossy seeds, $\frac{1}{2}$ to $\frac{3}{4}$ in (1.25 to 2 cm) long.

Origin and Distribution

The cherimoya is believed indigenous to the inter-Andean valleys of Ecuador, Colombia and Bolivia. In

Bolivia, it flourishes best around Mizque and Ayopaya, in the Department of Cochabamba, and around Luribay, Sapahaqui and Rio Abajo in the Department of La Paz. Its cultivation must have spread in ancient times to Chile and Brazil for it has become naturalized in highlands throughout these countries. Many authors include Peru as a center of origin but others assert that the fruit was unknown in Peru until after seeds were sent by P. Bernabé Cobo from Guatemala in 1629 and that thirteen years after this introduction the cherimoya was observed in cultivation and sold in the markets of Lima. The often-cited representations of the cherimoya on ancient Peruvian pottery are actually images of the soursop, *A. muricata* L. Cobo sent seeds to Mexico also in 1629. There it thrives between 4,000 and 5,000 ft (1312-1640 m) elevations.

It is commonly grown and naturalized in temperate areas of Costa Rica and other countries of Central America. In Argentina, the cherimoya is mostly grown in the Province of Tucuman. In 1757, it was carried to Spain where it remained a dooryard tree until the 1940's and 1950's when it gained importance in the Province of Granada, in the Sierra Nevada mountains, as a replacement for the many orange trees that succumbed to disease and had to be taken out. By 1953, there were 262 acres (106 ha) of cherimoyas in this region.

In 1790 the cherimoya was introduced into Hawaii by Don Francisco de Paulo Marin. It is still casually grown in the islands and naturalized in dry upland forests. In 1785, it reached Jamaica, where it is cultivated and occurs as an escape on hillsides between 3,500 and 5,000 ft (1,066-1,524 m). It found its way to Haiti sometime later. The first planting in Italy was in 1797 and it became a favored crop in the Province of Reggio Calabria. The tree has been tried several times in the Botanic Gardens, Singapore—first around 1878—but has always failed to survive because of the tropical climate. In the Philippines, it does well in the Mountain Province at an altitude above 2,460 ft (750 m). It was introduced into India and Ceylon in 1880 and there is small-scale culture in both countries at elevations between 1,500 and 7,000 ft (457-2,134 m). The tree was planted in Madeira in 1897, then in the Canary Islands, Algiers, Egypt and, probably via Italy, in Libya, Eritrea and Somalia.

The United States Department of Agriculture imported a number of lots of cherimoya seeds from Madeira

in 1907 (S.P.I. Nos. 19853, 19854, 19855, 19898, 19901, 19904, 19905).

Seeds from Mexico were planted in California in 1871. There were 9,000 trees in that state in 1936 but many of them were killed by a freeze in 1937. Several small commercial orchards were established in the 1940's. At present there may be less than 100 acres (42 ha) in the milder parts of San Diego County. Seeds, seedlings and grafted trees from California and elsewhere have been planted in Florida many times but none has done well. Any fruits produced have been of poor quality.

Varieties

In Peru, cherimoyas are classed according to degree of surface irregularity, as: 'Lisa', almost smooth; 'Impresa', with "fingerprint" depressions; 'Umbonada', with rounded protrusions; 'Papilonado', or 'Tetilado', with fleshy, nipple-like protrusions; 'Tuberculada', with conical protrusions having wartlike tips. At the Agricultural Experiment Station "La Molina", several named and unnamed selections collected in northern Peru are maintained and evaluated. Among the more important are: #1, 'Chavez', fruits up to 3.3 lbs (1½ kg); February to May; #2, 'Ñamas', fruits January to April; #3, 'Sander', fruits with moderate number of seeds; July and early August; #4, fruit nearly smooth, not many seeds, 1.1 to 2.2 lbs (½-1 kg), June to August; #5, nearly smooth, very sweet, 2.2 lbs (1 kg), March to June; #6, fruit with small protuberances, 1.1 to 2.2 lbs (½-1 kg), not many seeds; #7 fruit small, very sweet, many seeds, March to May; #8, fruit very sweet, 1.1 to 2.2 lbs (½-1 kg), with very few seeds, February to April.

In the Department of Antioquia, Colombia, a cultivar called 'Rio Negro' has heart-shaped fruits weighing 1¾ to 2.2 lbs (0.8-1 kg). The cherimoyas of Mizque, Cochabamba, Bolivia, are locally famed for their size and quality. 'Concha Lisa' and 'Bronceada' are grown commercially in Chile. Other cultivars mentioned in Chilean literature are 'Concha Picuda' and 'Terciopelo'.

Dr. Ernesto Saavedra, University of Chile, after experimenting with growth regulators for 4 years, developed a super cherimoya, 4 to 6 in (10-15 cm) wide and weighing up to 4 lbs (1.8 kg); symmetrical, easy to peel and seedless, hence having 25% more flesh than an ordinary cherimoya. However, the larger fruits are subject to cracking.

The leading commercial cultivars in Spain are 'Pinchua' (thin-skinned) and 'Basta' (thick-skinned.)

Named cultivars in California include:

'Bays' - rounded, fingerprinted, light green, medium to large, of excellent flavor; good bearer; early.

'Whaley' - long conical, sometimes shouldered at the base, slightly and irregularly tuberculate, with fairly thick, downy skin. Of good flavor, but membranous sac around each seed may adhere to flesh. Bears well; grown commercially; early.

'Deliciosa' - long conical, prominently papillate; skin thin, slightly downy; variable in flavor; only fair in quality; generally bears well but doesn't ship well; cold resistant. Midseason.

'Booth' - short conical, fingerprinted, medium to large; of good flavor; next to 'Deliciosa' in hardness. Late.

'McPherson' - short conical, fingerprinted but umbonate at the base; medium to large; of high quality; bears well. Midseason.

'Carter' - long conical, but not shouldered; smooth or faintly fingerprinted; skin green to bronze; bears well. Late. Leaves wavy or twisted.

'Ryerson' - long conical, smooth or fingerprinted, with thick, tough, green or yellow-green skin; of fair quality; ships well. Leaves wavy or twisted.

'White' - short conical with rounded apex; slightly papillate to umbonate; medium to large; skin medium thick; of good flavor; doesn't bear well near the coast.

'Chaffey' - introduced in 1940's; rounded, short, fingerprinted; of medium size; excellent quality; bears well, even without hand pollination.

'Ott' (Patent #656) - introduced in 1940's; long conical to heart-shaped, slightly tuberculate; of excellent flavor; ships well.

Among others that have been planted in California but considered inferior are: 'Horton', 'Golden Russet', 'Loma', 'Mira Vista', 'Sallmon'.

Pollination

A problem with the cherimoya is inadequate natural pollination because the male and female structures of each flower do not mature simultaneously. Few insects visit the flowers. Therefore, hand-pollination is highly desirable and must be done in a 6- to 8-hour period when the stigmas are white and sticky. It has been found in Chile that in the first flowers to open the pollen grains are loaded with starch, whereas flowers that open later have more abundant pollen, no starch grains, and the pollen germinates readily. Partly-opened flowers are collected in the afternoon and kept in a paper bag overnight. The next morning the shed pollen is put, together with moist paper, in a vial and transferred by brush to the receptive stigmas. Usually only a few of the flowers on a tree are pollinated each time, the operation being repeated every 4 or 5 days in order to extend the season of ripening. The closely related *A. senegalensis* Pers., if available, is a good source of abundant pollen for pollinating the cherimoya. The pollen of the sugar apple is not satisfactory. Fruits from hand-pollinated flowers will be superior in form and size.

Climate

The cherimoya is subtropical or mild-temperate and does not succeed in the lowland tropics. It requires long days. In Colombia and Ecuador, it grows naturally at elevations between 4,600 and 6,600 ft (1,400-2,000 m) where the temperature ranges between 62.6° and 68°F (17°-20°C). In Peru, the ideal climate for the cherimoya is said to lie between 64.5° and 77°F (18°-25°C) in the summer and 64.5° and 41°F (18°-5°C) in winter. In Guatemala, naturalized trees are common between 4,000 and 8,200 ft (1,200-2,500 m) though the tree produces best between 4,000 and 5,900 ft (1,200-1,800 m) and can be grown at elevations as low as 2,950 ft (900 m). The tree cannot survive the cold in the Valle de Mexico at 7,200 ft (2,195 m). In Argentina, young trees are wrapped

with dry grass or burlap during the winter. The cherimoya can tolerate light frosts. Young trees can withstand a temperature of 26°F (-3.33°C), but a few degrees lower will severely injure or kill mature trees. In February 1949, a small-scale commercial grower (B. E. Needham) in Glendora, California, reported that most of his crop was lost because of frost and snow, the cherimoya suffering more cold damage than his avocados, oranges or lemons.

The tree prefers a rather dry environment as in southern Guatemala where the rainfall is 50 in (127 cm) and there is a long dry season. It is not adaptable to northern Guatemala where the 100-inch (254-cm) rainfall is spread throughout the year.

Finally, the tree should be protected from strong winds which interfere with pollination and fruit set.

Soil

The cherimoya tree performs well on a wide range of soil types from light to heavy, but seems to do best on a medium soil of moderate fertility. In Argentina, it makes excellent growth on rockstrewn, loose, sandy loam 2 to 3 ft (0.6-0.9 m) above a gravel subsoil. The optimum pH ranges from 6.5 to 7.6. A greenhouse trial in sand has demonstrated that the first nutritional deficiency evoked in such soil is lack of calcium.

Propagation

Cherimoya seeds, if kept dry, will remain viable for several years. While the tree is traditionally grown from seed in Latin America, the tendency of seedlings to produce inferior fruits has given impetus to vegetative propagation.

Seeds for rootstocks are first soaked in water for 1 to 4 days and those that float are discarded. Then planting is done directly in the nursery row unless the soil is too cool, in which case the seeds must be placed in sand-peat seedbeds, covered with 1 in (2.5 cm) of soil and kept in a greenhouse. They will germinate in 3 to 5 weeks and when the plants are 3 to 4 in (7.5-10 cm) high, they are transplanted to pots or the nursery plot with 20 in (50 cm) between rows. When 12 to 24 months old and dormant, they are budded or grafted and then allowed to grow to 3 or 4 ft (0.9-1.2 m) high before setting out in the field. Large seedlings and old trees can be topworked by cleft-grafting. It is necessary to protect the trunk of topped trees to avoid sunburn.

The cherimoya can also be grafted onto the custard apple (*A. reticulata*). In India this rootstock has given 90% success. Cuttings of mature wood of healthy cherimoya trees have rooted in coral sand with bottom heat in 28 days.

Fig. 19: Cherimoyas (*Annona cherimola*) from the highlands are sold at fruit stands along Venezuelan roadways.



Culture

The young trees should be spaced 25 to 30 ft (7.5-9 m) apart each way in pits 20 to 24 in (50-60 cm) wide, enriched with organic material. In Colombia, corn (maize), vegetables, ornamental foliage plants, roses or annual flowers for market are interplanted during the first few years. In Spain, the trees are originally spaced 16.5 ft (5 m) apart with the intention of later thinning them out. Thinning is not always done and around the village of Jete, where the finest cherimoyas are produced, the trees have grown so close together as to form a forest. In the early years they are interplanted with corn, beans and potatoes.

Pruning to eliminate low branches, providing a clean trunk up to 32 in (80 cm), to improve form, and open up to sunlight and pesticide control, is done preferably during dormancy. After 6 months, fertilizer (10-8-6 N,P,K) is applied at the rate of ½ lb (227 g) per tree and again 6 months later at 1 lb (454 g) per tree. In the 3rd year, the fertilizer formula is changed to 6-10-8 N,P,K and each year thereafter the amount per tree is increased by 1 lb (454 g) until the level of 5 lbs (2.27 kg) is reached. Thenceforth this amount is continued each year per tree. The fertilizer is applied in trenches 6 in (15 cm) deep and 8 in (20 cm) wide dug around each tree at a distance of 5 ft (1.5 m) from the base, at first; later, at an appropriately greater distance.

Young trees are irrigated every 15 to 20 days for the first few years except during the winter when they must be allowed to go dormant—ideally for 4 months. When the first leafbuds appear, irrigation is resumed. With bearing trees, watering is discontinued as soon as the fruits are full-grown.

In Chile, attempts to increase fruit set with chemical growth regulators have been disappointing. Spraying flowers with gibberellic acid has increased fruit set and improved form and size but induces deep cracking prior to full maturity, far beyond the normal rate of cracking in fruits from natural- or hand-pollinated flowers.

Cropping and Yield

The cherimoya begins to bear when 3½ to 5 years old and production steadily increases from the 5th to the 10th year, when there should be a yield of 25 fruits per tree—2,024 per acre (5,000 per ha). Yields of individual trees have been reported by eyewitnesses as a dozen, 85, or even 300 fruits annually. In Colombia, the average yield is 25 fruits; as many as 80 is exceptional. In Italy, trees 30 to 35 years old produce 230 to 280 fruits annually.

The fruits must be picked when full-grown but still firm and just beginning to show a slight hint of yellowish-green and perhaps a bronze cast. Bolivians judge that a fruit is at full maturity by shaking it and listening for the sound of loose seeds. Italians usually wait for the yellowish hue and the sweet aroma noticeable at a distance, picking the fruits only 24 to 28 hours prior to consumption. However, if the fruits must travel to markets in central Italy, they are harvested when the skin turns from dark-green to lighter green.

In harvesting, the fruits must be clipped from the branch so as to leave only a very short stem attached to the fruit to avoid stem-caused damage to the fruits in handling, packing and shipping.

Keeping Quality and Storage

Firm fruits should be held at a temperature of 50°F (10°C) to retard softening. When transferred to normal room temperature, they will become soft and ready to eat in 3 to 4 days. Then they can be kept chilled in the home refrigerator if not to be consumed immediately. A California grower has shipped cherimoyas ('Deliciosa' and 'Booth') packed in excelsior in 12-lb (5.5-kg) boxes to Boston and New York quite satisfactorily. And the fruit has been shipped from Madeira to London for many years.

In Bolivia, fruits for home use are wrapped in woollen cloth as soon as picked and kept at room temperature so that they can be eaten 3 days later.

Pests and Diseases

The cherimoya tree is resistant to nematodes. Very few problems have been noted in California except for infestations of mealybugs, especially at the base of the fruit, and these can be flushed off. In Colombia, on the other hand, it is said that a perfectly healthy tree is a rarity. In the Valle de Tenza, formerly an important center of production, lack of control of pests greatly reduced the plantations before 1960 when programs were launched to improve cherimoya culture here and in various other regions of the country.

Caterpillars (*Thecla* sp. and *Oiketicus kubeyi*) may defoliate the tree. A scale insect, *Conchaspis angraeci* attacks the trunk and branches. Prime enemies are reported to be fruit flies (*Anastrepha* sp.); leaf miners (*Leucoptera* sp.), particularly in the Valle de Tenza, which necessitate the collection and burning of affected leaves plus the application of systemic insecticides; and the seed borer (*Bephrata maculicollis*). The latter pest deposits eggs on the surface of the developing fruits, the larvae invade the fruit and consume the seeds, causing premature and defective ripening and rendering the fruits susceptible to fungal diseases. This pest is difficult to combat. Borers attack the tree in Argentina reducing its life span from 60 to 30 years.

The coccid, *Pseudococcus filamentosus* attacks the fruit in Hawaii, and *Aulacaspis miranda* and *Ceropute yuccae* in Mexico. In Spain, the thin-skinned cultivar 'Pinchua' is subject to attack by the Mediterranean fruit-fly, *Ceratitis capitata*.

Stored seeds for planting are subject to attack by weevils. To avoid damping-off of young seedlings, dusting of seeds with fungicide is recommended. The tree may succumb to root-rot in clay soils or where there is too much moisture and insufficient drainage. Sooty mold may occur on leaves and fruits where ants, aphids and other insects have deposited honeydew.

Food Uses

The flesh of the ripe cherimoya is most commonly eaten out-of-hand or scooped with a spoon from the cut-

Food Value Per 100 g of Edible Portion

Analysis of cherimoyas in Ecuador

| | |
|---------------|----------|
| Moisture | 74.6 g |
| Ether Extract | 0.45 g |
| Crude Fiber | 1.5 g |
| Nitrogen | .227 g |
| Ash | 0.61 g |
| Calcium | 21.7 g |
| Phosphorus | 30.2 mg |
| Iron | 0.80 mg |
| Carotene | 0.000 mg |
| Thiamine | 0.117 mg |
| Riboflavin | 0.112 mg |
| Niacin | 1.02 mg |
| Ascorbic Acid | 16.8 mg |

Colombian Analysis

| | |
|----------------------|----------|
| Moisture | 77.1 g |
| Protein | 1.9 g |
| Fat | 0.1 g |
| Carbohydrates | 18.2 g |
| Fiber | 2.0 g |
| Ash | 0.7 g |
| Calcium | 32.0 mg |
| Phosphorus | 37.0 mg |
| Iron | 0.5 mg |
| Vitamin A (Carotene) | 0.0 I.U. |
| Thiamine | 0.10 mg |
| Riboflavin | 0.14 mg |
| Niacin | 0.9 mg |
| Ascorbic Acid | 5.0 mg |

open fruit. It really needs no embellishment but some people in Mexico like to add a few drops of lime juice. Occasionally it is seeded and added to fruit salads or used for making sherbet or ice cream. Colombians strain out the juice, add a slice of lemon and dilute with ice-water to make a refreshing soft drink. The fruit has been fermented to produce an alcoholic beverage.

Toxicity

The seeds, like those of other *Annona* species, are crushed and used as insecticide. Paul Allen, in his *Poisonous and Injurious Plants of Panama*, (see Bibliography), implies personal knowledge of a case of blindness resulting from "the juice of the crushed seeds coming in contact with the eyes." The seeds contain several alkaloids: caffeine, (+)-reticuline, (-)-anonaine, liriodenine, and lanuginosine.

Human ingestion of 0.15 g of the dark-yellow resin isolated from the seeds produces dilated pupils, intense photophobia, vomiting, nausea, dryness of the mouth, burning in the throat, flatulence, and other symptoms

resembling the effects of atropine. A dose of 0.5 g, injected into a medium-sized dog, caused profuse vomiting.

Wilson Popenoe wrote that hogs feed on the fallen fruits in southern Ecuador where there are many cherimoya trees and few people. One wonders whether the hogs swallow the hard seeds whole and avoid injury.

The twigs possess the same alkaloids as the seeds plus michelalbine. A team of pharmacognosists in Spain and France has reported 8 alkaloids in the leaves: (+)-isoboldine, (-)-stepholidine, (+)-corytuberine, (+)-nornantenine, (+)-reticuline, (-)-anonaine, liriodenine, and lanuginosine.

Other Uses

In Jamaica, the dried flowers have been used as flavoring for snuff.

Medicinal Uses: In Mexico, rural people toast, peel and pulverize 1 or 2 seeds and take the powder with water or milk as a potent emetic and cathartic. Mixed with grease, the powder is used to kill lice and is applied on parasitic skin disorders. A decoction of the skin of the fruit is taken to relieve pneumonia.

Sugar Apple (Plate VIII)

The most widely grown of all the species of *Annona*, the sugar apple, *A. squamosa* L., has acquired various regional names: *anon* (Bolivia, Costa Rica, Cuba, Panama); *anon de azúcar*, *anon domestico*, *hanon*, *mocuyo* (Colombia); *anona blanca* (Honduras, Guatemala, Dominican Republic); *anona de castilla* (El Salvador); *anona de Guatemala* (Nicaragua); applebush (Grenadines); *ata*, *fruta do conde*, *fruta de condessa*, *frutiera de*

conde, *pinha*, *araticutitaia*, or *ati* (Brazil); *ates* or *atis* (Philippines); *atte* (Gabon); *chirimoya* (Guatemala, Ecuador); *cachiman* (Argentina); *cachiman cannelle* (Haiti); *kaneelappel* (Surinam); *pomme cannelle* (Guadeloupe, French Guiana, French West Africa); *riñon* (Venezuela); *saramulla*, *saramuya*, *ahate* (Mexico); *scopappel* (Netherlands Antilles); sweetsop (Jamaica, Bahamas); *ata*, *luna*, *meba*, *sharifa*, *sarifa*, *sitaphal*, *sita pandu*,