Durian

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Scientific Name and Introduction

The durian (*Durio zibethinus* Murray [syn. *D. acuminatissina* Merr]) is often referred to as the "King of Fruits" in Southeast Asia. Its qualities promote considerable discussion because of its unique odor, which can be offensive to some people. (The fruit has a strong onion-garlic odor.) *"Zibethinus"* is derived from the word "zibetto," Italian for the civet, a catlike animal with a musky odor. This tropical tree is mainly cultivated in Sri Lanka, southern India, southern Burma, Thailand, Cambodia, Vietnam, Malaysia, Indonesia, Borneo, the Philippines (on Mindanao Island), and New Guinea. It has spread throughout the tropical world under the general name of "durian" (Indo-Malay) or variants thereof, such as "duren" (Indonesian), "duyin" (Burmese), "thureen" (Cambodian), "thurian" (Thai), "saurieng" (Vietnamese), "dulian" (Filipino), "stinkvrucht" (Dutch), and "kadu" (Sudan). Limited supplies are available from the Caribbean and Central and South America. Commercial supplies are available from Thailand and Malaysia.

Quality Characteristics and Criteria

Weighing up to 8 kg (18 lb), the oval or ellipsoid, green to brownish fruit can measure up to 30 cm (12 in) long and 20 cm (8 in) in diameter. It is densely covered with stout, sharp, pyramidal spines 1 cm (0.5 in) long on its thick, fibrous rind. Fruit are divided into 3 to 5 smooth-walled compartments, each containing 1 to 6 glossy, creamy to red-brown seeds 2 to 6 cm (0.8 to 2.4 in) long covered by a white to yellowish, soft, sweet pulp (aril). The pulp can be odorless or have a strong odor suggesting garlic, onion, or pungent cheese with a hint of fruitiness. The edible pulp (20 to 35% total mass) has a smooth, custardlike texture. In some fruit, seeds are rudimentary or small compared with wild types.

Quality criteria include a pulp with sweet flavor and good texture, few or small seeds, large aril percentage, and marketable weight of 1.5 to 3.5 kg (3.3 to 7.7 lb), elongated to round shape, good shelf-life, good rind color and thickness, reduced rind splitting, and freedom from disease and insects. Superior varieties have thick, yellow, fiberless, and custardlike pulp.

The Thai cultivar 'Chanee' has a stronger aroma and is smaller than the preferred 'Monthong' (Golden Pillow). Malaysian cultivars include D-2 'Dato Nina,' D-7 'Repok B-2,' D-10 'Durian Hyan,' and D-24 and D-98 'Katoi.'

Horticultural Maturity Indices

At maturity, the fruit naturally falls from the tree at the articulation of the fruit stem with the fruit, then ripens in 2 to 4 days, with the fruit normally splitting into segments of irregular widths at the stylar end. Ripening results in an increase in soluble sugars and a decrease in starch and pulp firmness that occurs before natural fruit splitting starts.

To prevent natural fruit fall, fruit may be tied to the limb or harvested at maturity. Maturity is judged by appearance (fruit stalk thickness and flexibility, abscission zone, or carpel sutures), number of days after flowering, and a hollow sound when tapped with a wood or rattan stick or knife. The number of days after flowering and tapping are the most reliable criteria (Siriphanich 1996). 'Chanee' durian takes 2 to 4 days, while 'Monthong' durian takes 4 to 6 days to ripen after harvest, depending on maturity. Fruit at 85% maturity, based on days from anthesis and rind characteristics, ripen to excellent quality in under 1 week at 28 to 31 °C (82 to

88 °F). Ripening takes longer than 1 week at 22 °C (72 °F). Fruit that are 95% mature when harvested have already commenced ripening, while 75% mature fruit may ripen with an inferior quality. Compared with fruit picked from the tree, fruit collected from the ground after falling are more subject to disease and fracture and have a shorter shelf-life (2 to 3 days instead of the 7 to 8 days for fruit picked from the tree). In Thailand, the fruit is harvested with the stem (peduncle) attached, and the stem is wrapped in a leaf or paper to reduce wilting and maintain the fresh appearance of the stem, since stem appearance is also used as a measure of freshness. 'Chanee' is at optimum eating stage for only a few days while 'Mon Tong' is at this stage for a longer period.

Grades, Sizes, and Packaging

Durian fruit are graded on weight, shape, size, and defects (Nanthachai 1994). Defects include disease, insects, mechanical injury, and flesh disorders. Grades vary with variety (Hiranpradit et al. 1992). The fruit is packed into cardboard cartons (4 to 6 fruit per carton) or in cartons fitted with fiberboard dividers.

Precooling Conditions

Use forced-air or room cooling to 15 °C (59 °F).

Optimum Storage Conditions

This climacteric fruit, when stored at 15 °C (59 °F), has extended shelf-life (Brooncherm and Siriphanich 1991); RH of 85 to 95% is best (Ketsa and Pangkool 1994, Sriyook et al. 1994). Fruit can be waxed to reduce water loss (Sriyook et al. 1994). Fruit ripened at a lower RH (75%) have a better eating quality and are less juicy and easier to dehusk than fruit ripened at a higher RH (Ketsa and Pangkool 1994).

Controlled Atmosphere (CA) Considerations

Ripening is inhibited by 2% O_2, and fruit fail to ripen when removed to air. Fruit stored in up to 20% CO_2 in air were not affected in terms of ripening or quality (Tongdee et al. 1990). Low O_2 (10%) reduces respiration rate and ethylene production but does not affect the onset of ripening, and ripe fruit quality is not affected. The aril remains hard in less mature fruit stored in 10% O_2 and 15 or 20% CO_2. The commercial potential of CA or MA is still unclear (Siriphanich 1996).

Retail Outlet Display Considerations

Display at ambient temperature or hold at 15 to 18 °C (59 to 64 °F), if available. Do not mist or ice. Avoid mixing with other produce during storage. The husk can be removed and the whole pulp and seed segment can be removed and sold in trays with a plastic overwrap. Remove the husk as soon as the fruit starts to produce aroma or is half-ripe and the pulp is still firm. If fruit splitting has started, the pulp is generally too soft and has a very short shelf-life.

Chilling Sensitivity

The pulp of half-ripe or nearly fully ripe fruit is much less sensitive to chilling injury than the peel, and the pulp can be stored for 4 weeks at 5 °C (41 °F). Whole fruit stored at under 15 °C (59 °F) develop chilling injury shown by the peel turning black or dark brown starting at the groove between the spines (Brooncherm and Siriphanich 1991). Chilling-injured pulp suffers a loss of aroma, does not soften, and may develop sunken areas on the surface (Siriphanich 1996).

Ethylene Production and Sensitivity

Production of ethylene varies from near zero in immature fruit up to 40 µL kg^{-1} hr^{-1} at the climacteric peak and varies with cultivar (Tongdee et al. 1987a,b). Most of the ethylene production is associated with the husk, as the pulp has a very low rate (Siriphanich 1996). Durian can be ripened with ethylene gas (Ketsa and Pangkool 1995) or ethephon (Atantee 1995). The husk of ripened durians will turn yellow or brown if ethylene concentration is too high. Thai consumers prefer to buy naturally ripened durians since the husk remains light green or olive. Durians with a yellowish or brownish husk are not regarded as fresh.

Respiration Rates

The respiration rate for durian is 80 to 450 mg (45 to 254 µL) CO_2 kg^{-1} h^{-1} at 22 °C. To calculate heat production, multiply mg kg^{-1} h^{-1} by 220 to get BTU per ton per day or by 61 to get kcal per tonne per day. The peel has a much higher respiration rate and ethylene production than the pulp (Brooncherm and Siriphanich 1991). The climacteric rise seems to occur first in the pulp. In 'Chanee' and 'Kan Yao,' the respiration and ethylene production increase during ripening but decline when the fruit is overripe, while in 'Mon Tong,' the climacteric peak does not occur until the fruit is overripe (Tongdee et al. 1987b).

Physiological Disorders

Failure of the aril to soften, or the aril softening unevenly, is a frequently observed disorder. Another disorder, which occurs especially during the rainy season, results in a watery aril that has a dull, flat taste. The cause of both disorders is unknown (Nanthachai 1994).

Postharvest Pathology

Phytophthora spp. are a major cause of rot in immature and mature fruit that leads to high losses during rainy weather and if fruit come in contact with soil. Another major cause of fruit rot is *Lasiodiplodia* spp. (Tongdee et al. 1987a). Fruit on the ground can also be attacked by *Sclerotum rolfsii*. Fruit diseases due to *Phomopsis*, *Collectrichum*, *Fusarium*, and *Rhizopus* can sometimes be severe (Siriphanich 1996). Sanitation, avoidance of mechanical injury, and fungicide can be used for control (Lim 1990).

Quarantine Issues

If the skin is not broken or split, durian is not a fruit fly host. The skin must be free of other insects such as scales.

Suitability as Fresh-Cut Product

The fruit is most frequently eaten fresh. The aril contains 64% water, 2.7% protein, 3.4% fat, 27.9% carbohydrate, and 23 mg per 1,000 g vitamin C. Choice varieties fetch higher prices than others. Roadside and market stalls in Southeast Asia may cut open the fruit and package the soft aril and seed in a shrink-wrapped or stretch-wrapped tray. Ripe fruit and soft arils are also frozen for export. Partially ripe fruit are difficult to open without damaging the pulp.

Special Considerations

Thailand is the largest producer, followed by Indonesia and the Malaysian Peninsula. Durian is highly prized in Southeast Asia. Consumers in Singapore prefer fully ripe fruit with no splitting, while Thais prefer the firmer pulp of less ripe fruit with less volatiles. Others may prefer the strong-flavored durian over the milder cultivars. There is a demand among ethnic groups familiar with the fruit in large temperate cities.

The pulp is dehydrated and sold as “durian cake” boiled with sugar, fermented, or salted. Dried aril is used as flavoring in ice cream, confectionery, pastry, and soft drinks (Nakasone and Paull 1998). Boiled or roasted seeds are eaten as snacks. Durian chips can be made from the immature and unripe durian pulp, as the lighter-colored flesh makes more attractive chips. Durian should not be shipped in mixed loads.

References

Atantee, S. 1995. Effect of ethephon on ripening and quality of durians. Graduate Special Problem, Department of Horticulture, Kasetsart University, Bangkok, Thailand.

Brooncherm, P., and J. Siriphanich. 1991. Postharvest physiology of durian pulp and husk. Kasetsart J. (Natural Sci.) 25:119-125.

Hiranpradit, H., N. Lee-Ungulasatian, S. Chandraparnik, and S. Jantigoo. 1992. Quality standardization of Thai durian, *Durio zibethinus* Murr. Acta Hort. 321:695-704.

Ketsa, S., and S. Pangkool. 1994. The effect of humidity on ripening of durians. Postharv. Biol. Technol. 4:159-165.

Ketsa, S., and S. Pongkool. 2001. Effect of maturity stages and ethylene treatment on ripening of durian fruits. *In* C. Frisina, K. Mason, and J. Faragher, eds., Proceedings of the Australasian Postharvest Horticulture Conference, held at Monash University, Melbourne, Australia, 18 September to 22 September, 1995, pp. 67-72. Department of Natural Resources and Environment, Institute for Horticultural Development, Knoxfield, Victoria, Australia.

Lim, T.K. 1990. Durian—Diseases and Disorders, pp. 60-72. Tropical Press, Kuala Lumpur, Malaysia.

Nakasone, H.Y., and R.E. Paull. 1998. Tropical Fruits. CAB Intl., Wallingford, U.K.

Nanthachai, S., ed. 1994. Durian: Fruit Development, Postharvest Physiology, Handling and Marketing in ASEAN. ASEAN Food Handling Bureau, Kuala Lumpur, Malaysia.

Salakpetch, S., S. Chandraparnik, H. Hiranpradit, and U. Punnachit. 1992. Source-sink relationship affecting fruit development and fruit quality in durian, *Durio zibethinus* Murr. Acta Hort. 321:691-694.

Siriphanich, J. 1996. Storage and transportation of tropical fruits: a case study on durian. *In* S. Vijaysegaran, M. Pauziah, M.S. Mohamed, and S. Ahmed Tarmizi, Proceedings of the International Conference on Tropical Fruits, 23-26 July 1996, Kuala Lumpur, Malaysia, vol. 1, pp. 439-451. MARDI, Kuala Lumpur, Malaysia.

Sriyook, S., S. Siriatiwat, and J. Siriphanich. 1994. Durian fruit dehiscence—water status and ethylene. HortScience 29:1195-1198.

Tongdee, S.C., A. Chayasombat, and S. Neamprem. 1987a. Effects of harvest maturity on respiration, ethylene production, and composition of internal atmospheres of Durian (*Durio zibethinus*, Murray). Proceedings of the Durian Workshop, Bangkok, Thailand, pp. 31-36. Thailand Institute of Scientific and Technological Research, Bangkok, Thailand.

Tongdee, S.C., S. Neamprem, and A. Chayasombat. 1987b. Control of postharvest infection of phytophthora fruit rot in durian with fosetyl-Al and residue levels in fruit. Proceedings of the Durian Workshop, Bangkok, Thailand, pp. 55-66. Thailand Institute of Scientific and Technological Research, Bangkok, Thailand.

Tongdee, S.C., A. Suwanagul, S. Neamprem, and U. Bunruengsri. 1990. Effect of surface coatings on weight loss and internal atmosphere of durian (*Durio zibethinus* Murray) fruit. ASEAN Food J. 5:103-107.

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