

Dragon Fruit

Robert E. Paull

Department of Tropical Plant and Soil Sciences
University of Hawaii at Manoa, Honolulu, HI

Scientific Name and Introduction: The dragon fruit (*Hylocereus spp.*), known as strawberry pear, thang loy (Vietnamese), pitaya roja (Spanish), and la pitahaya rouge (French), grows on a tropical climbing cacti. There is some confusion as to species being grown as they are all referred to as pitahaya in Spanish. The normally white-fleshed, *Hylocereus undatus* is grown commercially, as is the red or purple fleshed *H. costaricensis* (grown in Nicaragua and possibly Guatemala) and *H. polyhizus* (grown in Israel). There are yellow clones of *H. undatus* named pitaya ammarilla (yellow pitaya) in Mexico and other Latin American countries. Pitaya amarillia is a different species from the other yellow pitaya, *Selenicereus megalanthus* (Mizrahi et al., 1997). The dragon fruit is a self-compatible cultivar in Vietnam (Mizrahi et al., 1997; Nerd and Mizrahi, 1997).

Quality Characteristics and Criteria: The dragon fruit is a large, oblong fruit with a red peel and large green scales. The scales turn yellow upon ripening. Skin color begins to change 25 to 30 days from flowering in both *H. undatus* and *H. polyhizus*. At about the same time, flesh firmness approaches a minimum and eating quality approaches a maximum 33 to 37 days after flowering (Nerd et al., 1999). Fruit can be harvested from 25 to 45 days from flowering; 32 to 35 days was recommended by Nerd et al. (1999). Fruit size depends on seed number (Weiss et al., 1994).

The flesh of different species can vary from white to various hues of red to very dark red. As the fruit matures, acidity reaches a peak just as the skin color change occurs, then declines 25 to 30 days after flowering (Nerd et al., 1999; Le et al., 2000a). At this stage, SSC increases to about 14% (Nerd et al., 1999; Le et al., 2000a).

Horticultural Maturity Indices: A common index of maturity is skin color change to almost full red (Nerd et al., 1999). Harvesting indices include: color, SSC, TA and days-from-flowering (minimum 32 days). A SSC:TA of 40 has been suggested as a harvest index.

Grades, Sizes and Packaging: There are no U.S. or international standards. Fruit are generally graded by size and color. Size grades suggested for Vietnam are: Extra large fruit > 500 g (1.1 lb), large 380 to 500 g (0.84 to 1.1 lb), regular 300 to 380 g (0.66 to 0.84 lb), medium 260 to 300 g (0.57 to 0.66 lb), small < 260 g (Le et al., 2000a). Fruit exported from Israel to Europe are graded by number of fruits: 6, 8, 10, 12, 14, or 16 per 4 kg (8.8 lb) cardboard box.

Pre-cooling Conditions: There are no reported data. Room-cooling and hydro-cooling are possible.

Optimum Storage Conditions: The recommended storage temperature for dragon fruit is 10 °C (50 °F), since 6 °C (42.8 °F) can induce chilling injury (Nerd et al., 1999). The lower temperature (6 °C) has been recommended for the yellow pitaya *Selenicereus megalanthus* (Nerd and Mizrahi, 1999), and this agrees with minimum growth temperature of 7 °C (44.6 °F) for this species (Nerd and Mizrahi, 1998). Dragon fruit has a storage-life of about 14 days at 10 °C (50 °F), while at 5 °C (41 °F) and 90% RH a storage-life of 17 days can be achieved (Le et al., 2000a) if harvested 30 to 35 days from flowering. However, 5 °C (41 °F) may lead to chilling injury upon return to 20 °C (68 °F), indicated by deterioration of peel and flesh, and inferior taste (Nerd et al., 1999). Hence, 10 °C (50 °F) for a maximum of 14 days may be a better recommended storage temperature.

Controlled Atmospheres (CA) Consideration: No reported CA data are available. Fruit harvested 28 to 30 days after flowering and stored in a modified atmosphere (MA) bag (O_2 transmission rate $4000 \text{ mL m}^{-2} \text{ day}^{-1}$) can be held for 35 days at $10 \text{ }^\circ\text{C}$ ($50 \text{ }^\circ\text{F}$), versus 14 days for air controls (Le et al., 2000b). More mature fruit (40 days from flowering) in the same MA bag had 50% of the shelf-life.

Retail Outlet Display Considerations: Display at $10 \text{ }^\circ\text{C}$ ($50 \text{ }^\circ\text{F}$). Do not mist.

Chilling Sensitivity: Flesh translucency is a symptom of chilling injury. Other symptoms include softening, wilting, darkening of scales, browning of outer flesh and poor flavor. These symptoms rapidly develop on *H. undatus* and *H. polyhizus* fruit held at $6 \text{ }^\circ\text{C}$ ($42.8 \text{ }^\circ\text{F}$) for 2 weeks then transferred to $20 \text{ }^\circ\text{C}$ ($68 \text{ }^\circ\text{F}$) (Nerd et al., 1999). Fruit harvested 25 days from flowering are more sensitive to chilling ($6 \text{ }^\circ\text{C}$, 7 days); sensitivity is significantly reduced when fruit are harvested 30 to 35 days from flowering ($6 \text{ }^\circ\text{C}$, 17 days).

Ethylene Production and Sensitivity: Non-climacteric, with ethylene production rates of 0.025 to $0.091 \mu\text{L kg}^{-1} \text{ h}^{-1}$ (Nerd et al., 1999). Ethylene treatment does not initiate color development (Le et al., 2000b).

Respiration Rates: The maximum respiration rate of these non-climacteric fruit (*H. undatus* and *H. polyhizus*) occurs during early fruit growth (Nerd et al., 1999; Le et al., 2000a). The rate for mature fruit:

Temperature	$\text{mg CO}_2 \text{ kg}^{-1} \text{ h}^{-1}$
$20 \text{ }^\circ\text{C}$	95 to 144 (Nerd et al., 1999)
$23 \text{ }^\circ\text{C}$	75 to 100 (Le et al., 2000a)

To get $\text{mL kg}^{-1} \text{ h}^{-1}$, divide the $\text{mg kg}^{-1} \text{ h}^{-1}$ rate by 2.0 at $0 \text{ }^\circ\text{C}$ ($32 \text{ }^\circ\text{F}$), 1.9 at $10 \text{ }^\circ\text{C}$ ($50 \text{ }^\circ\text{F}$), and 1.8 at $20 \text{ }^\circ\text{C}$ ($68 \text{ }^\circ\text{F}$). To calculate heat production, multiply $\text{mg kg}^{-1} \text{ h}^{-1}$ by 220 to get BTU per ton per day or by 61 to get kcal per metric ton per day.

Physiological Disorders: Chilling injury, mechanical injury and water loss are the three major disorders. Mechanical injury leads to development of sunken areas. More mature fruit are more susceptible to mechanical injury (Le et al., 2000a). Splitting is a problem in fruit > 35 days from flowering, that have received rainfall or excessive irrigation during ripening (Le et al., 2000a).

Postharvest Pathology: Bacterial (*Xanthomonas campestris*) and *Dothiorella* spp. diseases have been reported (Barbeau, 1990). Postharvest disease has been associated with *Fusarium lateritium*, *Aspergillus riger*, and *Aspergillus flavus* (Le et al., 2000a). No commercially significant bacterial or fungal diseases have been experienced in Israel.

Quarantine Issues: Dragon fruit are a fruit fly host. Irradiation at 300 Grays may have potential for disinfestation. In Israel, no insect problems have been observed in commercial production, and the fruit's status as a fruit fly host may need to be re-evaluated.

Suitability as Fresh-cut Product: Dragon fruit are often available as a fresh-cut product in South East Asian markets in trays with over-wrap. There is some potential, as fresh-cut fruit can be stored at $4 \text{ }^\circ\text{C}$ ($39.2 \text{ }^\circ\text{F}$) for 8 days (Le et al., 2000b).

Special Considerations: Fruit are very low in vitamin C, but rich in potassium (Le et al., 2000a).

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