The dragon fruit, known as strawberry pear, thang loy (Vietnamese), pitaya roja (Spanish), and la pitahaya rouge (French), grows on a tropical climbing cacti. 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 is often some confusion as to the precise species being grown (Paull and Duarte 2012). There are yellow clones of *H. undatus* named pitaya amarilla (yellow pitaya) in Mexico and other Latin American countries. Pitaya amarilla is a different species from the other yellow pitaya, *Selecnicereus megalanthus* (Mizrahi et al. 1997). One type of dragon fruit grown in Vietnam is a self-compatible cultivar (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, 33 to 37 days after flowering, flesh firmness approaches a minimum and eating quality approaches a maximum (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 through 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 sug-
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 (O2 transmission rate 4000 mL m⁻² day⁻¹) can be held for 35 days at 10°C (50°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°C (50°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°C (42.8°F) for 2 weeks then transferred to 20°C (68°F) (Nerd et al. 1999). Fruit harvested 25 days from flowering are more sensitive to chilling (6°C, 7 days); sensitivity is significantly reduced when fruit are harvested 30 to 35 days from flowering (6°C, 17 days).

Ethylene Production and Sensitivity
Non-climacteric, with ethylene production rates of 0.025 to 0.091 μL kg⁻¹ 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). See Table 1 for the respiration rate for mature fruit.

To get mL kg⁻¹ h⁻¹, divide the mg kg⁻¹ h⁻¹ rate by 2.0 at 0°C (32°F), 1.9 at 10°C (50°F), and 1.8 at 20°C (68°F). 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 metric ton per day.

Pre-Cooling Conditions
There are no reported data. Room-cooling and hydrocooling 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% relative humidity a storage-life of 17 days can be achieved (Le et al. 2000a) if the fruit is harvested 30 to 35 days from flowering. However, 5°C (41°F) may lead to

gested for Vietnam are the following: Extra large fruit greater than 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 less than 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.

Dragon fruit on display.
Physiological Disorders
Chilling injury, mechanical injury, and water loss are the three major disorders of dragon fruit. 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 more than 35 days irrigation during ripening (Le et al. 2000a).

Postharvest Pathology
Bacterial (Xanthomonas campestris) and fungal (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°C (39.2°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).

Table 1. Respiration Rates

<table>
<thead>
<tr>
<th>Temperature</th>
<th>mg CO₂ kg⁻¹ h⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>20°C</td>
<td>95 to 144 (Nerd et al. 1999)</td>
</tr>
<tr>
<td>23°C</td>
<td>75 to 100 (Le et al. 2000a)</td>
</tr>
</tbody>
</table>

An earlier version of this article was originally published at the USDA’s website: www.ba.ars.usda.gov/hb66/contents.html

References