

Cassava

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Scientific Name and Introduction

Cassava (*Manihot esculenta* Crantz) is a woody perennial shrub of the Euphorbiaceae family and is native to the Amazon region and Central America. It is widely grown throughout the tropics for its starchy root (Rubatsky and Yamaguchi 1997). Cassava is called “yuca” in Spanish, “mandioca” in Portuguese, “cassave” in Haitian Creole, and “manioc” in French. It is consumed in a variety of ways, but only after some form of processing. Cultivars are classified into two groups based on the amounts of hydrogen cyanide present. Sweet types contain less than 50 mg kg⁻¹ HCN (fresh weight) and are generally sold as fresh roots, whereas bitter types have higher amounts of HCN along with higher yields and starch content (da Conceição 1980). These latter types are processed into products including flour (from coarse to finely textured), tapioca starch, and fermented starch. In 2002, 184 million tonnes of cassava was produced worldwide; major producers were Africa (Nigeria) (99 million tonnes), Asia (52 million tonnes), and Latin America and the Caribbean (32 million tonnes). Cassava is adapted to semiarid climates and has been a traditional crop for subsistence farmers, though it is increasingly cultivated as an agronomic crop.

Quality Characteristics and Criteria

Fresh cassava roots are highly perishable under ambient conditions, becoming unmarketable in 3 days or less. However, with proper handling, fresh roots can be stored up to 30 days, permitting export by marine container. The roots should be firm, turgid, fairly straight, and free from mechanical injury, decay, and vascular streaking. The pulp of most common cultivars varies from white to light yellow. Principal causes for loss are vascular streaking and decay. Extended storage can have two adverse effects on quality: starches are converted to sugars, and roots become fibrous, lengthening cooking time (Booth et al. 1976).

Horticultural Maturity Indices

Harvest maturity is based on the root size desired by the market and ranges from 6 to 18 mo after the stem sections are planted. Sweet types usually grow faster than bitter types. The main stem is often trimmed to approximately 1 m (39 in) in height a few days before harvest. Plants are manually pulled, or the root zone mechanically undercut to facilitate plant removal, and individual roots are cut. Cassava roots are turgid at harvest and must be handled carefully to avoid splitting the periderm. Harvest may be delayed until market, processing, or other conditions are favorable, since cassava roots can be stored in the ground for up to 24 mo.

Grades, Sizes, and Packaging

There are no U.S. grade standards for cassava. However, shippers should consult with buyers to define quality expectations. For example, root lengths in excess of 30 cm (11.8 in) are undesirable to many importers. Commercially, roots are cleaned by brushing, rinsing in water,

surface-drying, and coating with paraffin wax prior to packing in corrugated cartons.

Precooling Conditions

Room cooling is generally sufficient, provided that the roots are not held too long at ambient temperatures prior to or after packing.

Optimum Storage Conditions

Cassava is very sensitive to water loss, and methods used to maintain high RH during storage include moist sawdust and plastic films (Booth 1976). Paraffin wax is applied to roots exported to the United States. Waxing and holding at 0 to 5 °C (32 to 41 °F) extends shipping time to over 30 days with minimal vascular streaking. A water-based carnauba wax maintained postharvest quality equivalent to paraffin wax (Sargent et al. 1995).

Controlled Atmosphere (CA) Considerations

No commercial-scale CA recommendations have been reported. Vascular streaking during storage in air was reduced in unwaxed cassava roots by an initial 3-day exposure to 1% O₂ at 25 °C (77 °F) (Aracena 1993).

Retail Outlet Display Considerations

Cassava is normally displayed in bulk and should be held in refrigerated display cases.

Chilling Sensitivity

Cassava is chilling sensitive, but it can be stored at 0 to 5 °C (32 to 41 °F) with minimal symptom development, as long as immediately consumed when removed from storage before symptoms have had time to develop (Ingram and Humphries 1972).

Ethylene Production and Sensitivity

Cassava roots ('Valencia') stored in air at 25 °C (77 °F) and 98% RH produced about 1.2 μL kg⁻¹ h⁻¹ of ethylene; however, ethylene production doubled at 65% RH (Aracena 1993). Ethylene production was 2.1 μL kg⁻¹ h⁻¹ for unwaxed roots after 4 days at 25 °C (77 °F) and 1.1 μL kg⁻¹ h⁻¹ for roots coated with paraffin wax. Exposure to ethylene promotes vascular streaking.

Respiration Rates

After 1 day of storage in air at 25 °C (77 °F) with 98% RH, unwaxed roots respired at a rate of 23 μL CO₂ kg⁻¹ h⁻¹, whereas those treated with 75 μL L⁻¹ ethylene respired at a rate of 32 μL kg⁻¹ h⁻¹. After 4 days under the same conditions, internal CO₂ production was 8 and 11 μL kg⁻¹ h⁻¹, while O₂ levels were 9 and 11.5 μL kg⁻¹ h⁻¹ for unwaxed and waxed roots, respectively (Aracena 1993).

Physiological Disorders

Vascular streaking appears as blue or purple spots when the root is cut transversely and is the result of oxidative processes in the vascular bundles. It typically develops at wound sites, such as at the apical end where the root is cut at harvest or under breaks in the peel that can occur during careless handling. Vascular streaking is related to oxidation of scopoletin, a phenolic compound (Wheatley and Schwabe 1985). Storage of unwaxed cassava roots in 1% O₂ at 25 °C (77 °F) for 3 days significantly reduced vascular streaking during storage in air (Aracena 1993). Exposure to 75 µL L⁻¹ ethylene increased vascular streaking, and ethylene induced by wounding or water stress may be the immediate cause of vascular streaking.

Postharvest Pathology

There are two major postharvest fungal diseases of cassava. Botryodiplodia rot (*Botryodiplodia theobromae* Pat.) invades the pulp beneath the skin, initially developing white mold that later becomes dark grey (Snowdon 1992). Fusarium rot (*Fusarium solani*, Mart., Sacc.) also grows on the pulp, causing a brown discoloration. Other pathogens reported by Snowdon (1992) include aspergillus rot (*Aspergillus flavus*), bacterial soft rot (*Erwinia carotovora* ssp. *carotovora*), mucor rot (*Mucor hiemalis*), phytophthora rot (*Phytophthora cryptogea*), rhizopus rot (*Rhizopus oryzae*), sclerotium rot (*Corticium rolfsii*), and trichoderma rot (*Trichoderma harzianum* Rifai).

Quarantine Issues

There are no restrictions on imports from the major production areas.

Suitability as Fresh-Cut Product

There is potential for peeled intact or sliced roots, but shelf-life is currently limited to 2 or 3 days under ideal storage conditions due to vascular streaking.

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