

Radish

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Scientific Name and Introduction

The radish, *Raphanus sativus*, is a member of the Cruciferae family, native to Europe or Asia. It was once grown on a small scale in all areas of the United States and also as a greenhouse vegetable. However, mechanization of harvesting and handling has resulted in more centralized production. The word “raphanus” comes from a Greek word meaning “quick-appearing” or “easily grown.”

The roots are of many shapes, sizes and colors—round, turnip-shaped, oval, olive-shaped, half-long, long. Colors include white, pink-red, purple, yellow, or even black. However, the most common radish is oval with a dark red skin and white flesh (Thompson and Kelly 1957, Maynard and Hochmuth 1997).

Quality Characteristics and Criteria

Radishes should be fresh, well-colored, tender, firm, crisp, smooth with no ridges, free from dirt or other foreign material, and free from harvest cuts, abrasions, and insect damage. They should not be stringy or woody, soft, flabby, or wilted. Bunched radishes should have fully intact tops that are dark-green with no yellowing; they may be slightly wilted. Size varies depending on market demand, but larger roots are more likely to be pithy (Thompson and Kelly 1957, Carione and Lucas 1972, USDA 1975).

Horticultural Maturity Indices

Harvest maturity is based on size and market demand. The diameter of oval types should be between 2 and 3 cm (0.75 to 1.25 in). Bunched radishes are harvested in either regular or big bunch size, and roots for cello packages are pulled at regular or jumbo size (Nonnecke 1989).

Grades, Sizes, and Packaging

There are two USDA grades for topped and bunched radishes: U.S. No. 1 and U.S. Commercial. Bunched radishes have full-length tops tied in bunches, while topped radishes have clipped tops no more than 1 cm (0.38 in) long. Root diameter is termed Small, 1.9 cm (0.75 in); Medium, 1.9 to 2.5 cm (0.75 to 1.0 in); Large, 2.5 to 3.2 cm (1 to 1.25 in); and Very Large, 3.2 cm (>1.25 in). U.S. No.1 roots have similar varietal characteristics and are clean, well formed, smooth, firm, and tender. They are also free from decay, cuts, pithiness, disease, and damage caused by freezing, growth cracks, insects, or other means. Bunched radishes have tops that are fresh and free from decay and damage caused by freezing, seed stem, yellowing or other discoloration, diseases, insects, or other means. In order to allow for variation in grading and handling, a 5 to 10% variation by count is acceptable tolerance for a U.S. No. 1 grade product. If the variation is >10% but <20%, they are designated U.S. Commercial (AMS 1968, Maynard and Hochmuth 1997).

Radishes are available in many sizes of container. Topped radishes are packed in perforated plastic bags holding 168 g (6 oz), 224 g (8 oz), 454 g (1 lb), 2.3 kg (5 lb), 11 kg (25 lb), or 18 kg (40 lb). Commonly, 30 168-g (6-oz), 24 224-g (8-oz), or 14 454-g (1-lb) bags are boxed together for retail, while 11-kg (25-lb) bags are used for the foodservice industry (L. Buurma, 1999, personal communication).

Radishes are first graded according to diameter to eliminate spikes that are <1.9 cm (0.75 in) and to accumulate Jumbos that are >3.8 cm (1.25 in). The radishes are then conveyed over grading tables to remove products below acceptable grade standards. After being graded, they are packaged in cellos using vertical form fill machines. These machines form the breathable poly bag, weigh the specific amount of desired radishes, and seal the bag or provide a zipper locking system. These bags are then hand-packed into wax cartons and temporarily stored at 2 °C (36 °F) until shipment.

Precooling Conditions

Hydrocooling at 0 to 4.5 °C (32 to 40 °F) is the preferred method. Cello packs are hydrocooled to restore crispness, bulk stored in bins, and then placed in refrigerated coolers before grading. Bunched radishes are dipped in chlorinated water at 2 °C (26 °F) to restore crispness and freshness to the tops and roots, as well as to remove field debris. They are then packed into cartons, usually 24 bunches per carton, and hydrocooled; and the carton is topped with an ice slurry before shipping (Brooker and Pearson 1970, Ryall and Lipton 1972a).

Optimum Storage Conditions

Topped radishes can be held 3 to 4 weeks at 0 °C (32 °F) with 90 to 95% RH and at least 7 days at 7 °C (45 °F). Bunch radishes are harder to keep fresh due to the perishability of the tops. However, they can be held at 0 °C (32 °F) and 90 to 95% RH for 1 to 2 weeks. Winter or black radishes can be stored under the same conditions for 2 to 4 mo. Addition of top ice aids in keeping the tops fresh (Ryall and Lipton 1972b).

Controlled Atmosphere (CA) Conditions

An atmosphere of 1 to 2% O₂ and 2 to 3% CO₂ at 0 to 5 °C (32 to 41 °F) slightly extends storage life (Ryall and Lipton 1972a, Saltveit 1997).

Retail Outlet Display Considerations

Packaged radishes should be placed in a refrigerated rack. Bunch radishes should be refrigerated and can be iced or misted to help preserve quality.

Chilling Sensitivity

Radishes are not sensitive to chilling. Store them as cold as possible without freezing.

Ethylene Production and Sensitivity

Radishes produce small amounts of ethylene and are not particularly sensitive to ethylene exposure.

Respiration Rates

Temperature °C	Topped Roots -----mg CO ₂ kg ⁻¹ h ⁻¹ -----	Bunched Roots with Tops -----mg CO ₂ kg ⁻¹ h ⁻¹ -----
0	14 to 17	3 to 9
4 to 5	19 to 21	6 to 13
10	31 to 36	15 to 16
15 to 16	70 to 78	22 to 42
20 to 21	124 to 136	44 to 58
25 to 27	158 to 193	60 to 89

Data from Hardenburg et al. (1986).

To get mL CO₂ 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 ton⁻¹ day⁻¹ or by 61 to get kcal tonne⁻¹ day⁻¹.

Physiological Disorders

Freezing injury can cause softening and shriveling, as well as leakage of pigment for red radishes. Growth cracks or air cracks reduce quality when they are >6 mm (0.25 in) deep and associated with discolored tissue. Overmaturity or stress during growth can induce dry, cottony voids, called pithiness, in roots. Yellowing of tops can result from overmaturity, exposure to ethylene, or elevated storage temperature (Murry 1977, Nonnecke 1989).

Postharvest Pathology

The initial lesions of bacterial black spot (*Xanthomonas vesicatoria*) are brown and have a diameter of 1.0 to 2.5 mm (0.04 to 0.1 in). They eventually turn black and coalesce. Protective measures include washing in water with 100 to 200 µL L⁻¹ of chlorine. Downy mildew (*Peronospora parasitica*) produces purplish-red to brown surface lesions that become rough and cracked in advanced cases, while the internal tissue can become grayish brown to black. Rhizoctonia root rot (*Rhizoctonia solani*) produces lesions that are initially round and light brown and can become slightly sunken. The tissue can become spongy. This disease favors high RH. Avoid bruising, hydrocool to 4 °C (40 °F), and store at 0 to 2 °C (32 to 35 °F) to control these diseases (Ryall and Lipton 1972a).

Quarantine Issues

There are no known quarantine issues.

Suitability as Fresh-Cut Product

Currently radishes are cut or diced in packaged salad mixes and for food service, particularly for incorporation into salad bars.

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