Cabbages

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Cabbages (Round and Chinese types)
Recommendations for Maintaining Postharvest Quality

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General Information

Round hard cabbages and Chinese (also called Napa) cabbages are from the same genus (*Brassica*) but different species (*B. oleracea* var *capitata* = cabbage, *B. campestris* var. *pekinensis* = Chinese cabbage). Chinese cabbages may be cylindrical or rounded and may be less compact than round cabbages. Information mentioned here applies to both types unless stated otherwise.

Maturity Indices

Maturity is based on head compactness. A compact head can be only slightly compressed with moderate hand pressure. A very loose head is immature, and a very firm or hard head is mature.

Quality Indices

After trimming outer wrapper leaves, cabbage heads should be a color typical of the cultivar (green, red, or pale yellow-green), firm, heavy for the size and free of insect, decay, seed stalk development and other defects. Leaves should be crisp and turgid. For round cabbages, grades are U.S. no. 1 and U.S. commercial.

Optimum Temperature and Relative Humidity

Most cabbage is room cooled. Storage at 0°C (32°F) with >95% RH is required to optimize cabbage storage life. Early crop round cabbage can be stored 3-6 weeks, while late crop cultivars can be stored for up to 6 months. For the latter, storage at -0.5°C (31°F) is sometimes recommended. Chinese cabbage can be stored from 2 to 6 months, depending on cultivar, at 0° to 2.5°C (32° to 36°F). Deterioration of cabbage during storage is associated with stem or seed stalk growth (bolting), root growth, internal breakdown, leaf abscission, discoloration, decay and black speck. Long-term storage usually results in extensive trimming of heads to remove deteriorated leaves.

Freezing Injury

Freeze damage appears as darkened translucent or water-soaked areas that will deteriorate rapidly after thawing. Freeze damage can occur if round cabbages are stored below -0.9°C (30.4°F) and if Chinese cabbage is stored below -0.6°C (31°F).

Rates of Respiration

Round and Chinese cabbages have similar moderately low respiration rates:

Temperature	0°C (32°F)	5°C (41°F)	10°C (50°F)	15°C (59°F)	20°C (68°F)
ml CO_2/kg·hr	2 – 3	4 – 6	8 – 10	10 – 16	14 – 25

Respiration rates of shredded cabbage are 13-20 mL CO_2/kg·hr at 5°C (41°F).
To calculate heat production multiply mL CO_2/kg·hr by 440 to get Btu/ton/day or by 122 to get kcal/metric ton/day.

Rates of Ethylene Production

Ethylene production rates are generally very low: <0.1 µL/kg·hr at 20°C (68°F), although higher rates have been reported for Chinese cabbage.

Responses to Ethylene

Cabbages are sensitive to ethylene, which causes leaf abscission and leaf yellowing. Adequate ventilation during storage is important to maintain very low ethylene levels. Ethylene does not increase the disorder “black speck” or “pepper spot”.

Responses to Controlled Atmospheres (CA)

Some benefit to shelf-life can be obtained with low O_2 (2.5-5%) and high CO_2 (2.5-6%) atmospheres at temperatures of 0-5°C (32-41°F). CA storage will maintain color and flavor of cabbage, retard root and stem growth, and reduce leaf abscission. O_2 atmospheres below 2.5% for round cabbage and 1% for Chinese cabbage will cause fermentation, and CO_2 atmospheres >10% will cause internal discoloration.

Physiological Disorders

Black speck: Black leaf speck (also called pepper spot, petiole spot, gomasho) is a disorder that consists of very small to moderate size discolored lesions on the midrib and veins of the leaves. The symptoms can occur after low temperatures in the field and by harvesting overmature heads, but are usually associated with transit and storage conditions. Low storage temperatures followed by warmer temperatures enhance development. Ethylene does not promote development of black speck in Chinese cabbage. Both round and Chinese cabbage cultivars vary widely in their susceptibility to this disorder. Storage with high CO_2 atmospheres (10%) can reduce pepper spot development on round cabbage.
Chilling injury: in Chinese cabbage is purported to occur during storage at 0°C (32°F) after 3 months or longer. The main symptom is midrib discoloration, especially on outer leaves. Cultivars differ greatly in their susceptibility to develop midrib discoloration.

Physical Injury

Breakage of the midribs often occurs during field packing and causes increased browning and increased susceptibility to decay. Outer midribs of overmature heads will crack easily.

Pathological Disorders

The most common decays found in stored cabbage are watery soft rot (*Sclerotinia*), gray mold rot (*Botrytis cinerea*), alternaria leaf spot (*Alternaria* spp.), and bacterial soft rot

(caused by various bacterial species including *Erwinia, Pseudomonas, Xanthomonas*). Bacterial soft-rots result in a slimy breakdown of the infected tissue, and may follow fungal infections. Trimming outer leaves, rapid cooling and low temperature storage reduce development of these rots, although *Botrytis* and *Alternaria* will grow at low storage temperatures.

Special Considerations

Fresh-cut or shredded cabbage pieces brown during storage and atmospheres of 3-5% O_2 and 5-15% CO_2 retard discoloration. Too low oxygen levels lead to fermentation and package blow-up, especially if product is not held below 5°C (41°F).