

# Greens for Cooking

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## Scientific Name and Introduction

Leafy greens that are normally eaten cooked include collards and kale (*Brassica oleraceae* L. var. *Acephala* DC.), rape (*Brassica napus* L. var. *napus*), spinach (*Spinacia oleraceae* L.), mustard (*Brassica juncea* [L.] Czerniak), and turnip (*Brassica rapa* L. var. [DC.] Metzg. *utilis*) (Maynard and Hochmuth 1997). Since the intended use is either cooking at a later date or immediate processing (canning or freezing) for later sale, some handlers do not give the attention to quality maintenance that would normally be given to fresh salad greens. However, managers should recognize that quality at the point of sale is of primary concern for all vegetables, whether they are to be cooked or eaten raw.

## Quality Characteristics and Criteria

Leaves should be of similar varietal characteristics, fresh, fairly tender and clean, well-trimmed, of characteristic color for the variety or type of greens, and free from decay, discoloration, freezing injury, foreign material, disease, insects, and damage caused by coarse stalks or other mechanical means (AMS 1953a,b, Hurst 2000)

## Horticultural Maturity Indices

Spinach leaves are typically harvested at about mid maturity, while other types of greens may be allowed to grow until the leaves have reached nearly full size but have not begun to senesce. Hand-harvesting allows a greater degree of selection of leaf size, whereas in mechanical harvesting every leaf large enough to reach the cutting blade is taken.

## Grades, Sizes, and Packaging

All greens for cooking, except spinach, are classified as either U.S. No. 1 or unclassified. The term “unclassified” is not an official U.S. standard; it simply means that no specific grade has been assigned (AMS 1953a,b). Since spinach is often consumed uncooked, greater flexibility is included in its classification than for other leafy greens. Thus, the grades for spinach are U.S. Extra No. 1, U.S. No. 1, and U.S. Commercial (AMS 1946). The leaf size of the various types of greens offered for sale depends primarily on the requirements of the buyer and the physiological condition of the product. Obviously, large, overmature leaves would not be marketed.

Leaf collards, kale, turnip greens, and mustard are commonly bunched using rubberbands or twist ties. The size of the bunch may vary but is generally approximately 0.5 kg (1 lb). Direct packing of loose leaves may be done at the request of the buyer. Head collards are packed loose into cartons with 8 to 16 bunches per container. Waxed fiberboard cartons or wire-bound crates are commonly used (Hurst 1999, Sanders et al. 1999). Spinach leaves, which are smaller and more tender, may be packed loose or bunched, but they require greater care to avoid handling

injury (Suslow and Cantwell 2002).

### **Precooling Conditions**

Field heat should be removed from greens as quickly as possible. Hydrocooling, hydrovac-cooling, liquid-icing, package-icing, and top-icing all have been used. Water that is used for washing or cooling should contain approximately  $200 \mu\text{L L}^{-1}$  chlorine (Kasmire and Cantwell 1999). When package-iced, approximately 1 kg (2.2 lb) of ice is recommended per 1.8 kg (4 lb) of product (Hurst 2000; Boyhan et al. 2004).

### **Optimum Storage Conditions**

Greens should be stored near  $0\text{ }^{\circ}\text{C}$  ( $32\text{ }^{\circ}\text{F}$ ) with 95 to 98% RH. Crushed ice may be placed in baskets or boxes to help maintain low temperature and high RH. When properly handled, greens in general may be kept for about 2 weeks (Hardenburg et al. 1986, Sanders et al. 1999, Suslow and Cantwell 2002). Turnip greens are particularly perishable, in contrast to kale, which has been kept in excellent condition for up to 3 weeks under ideal storage conditions (Hardenburg et al. 1986).

### **Controlled Atmosphere (CA) Considerations**

Spinach benefits slightly from storage at 7 to 10%  $\text{O}_2$  combined with 5 to 10%  $\text{CO}_2$  (Saltveit 1997). When prepackaged in plastic bags, films should allow the generation of 1 to 3%  $\text{O}_2$  and 8 to 10%  $\text{CO}_2$  (Suslow and Cantwell 2002). Neither CA nor modified atmosphere packaging (MAP) is commonly used commercially for leafy greens other than spinach.

### **Retail Outlet Display Considerations**

Though greens are sometimes displayed on unrefrigerated counters, they should be placed on ice or on refrigerated counters. Intermittent misting minimizes water loss and wilting.

### **Chilling Sensitivity**

Leafy greens are not sensitive to chilling temperatures and should be stored as cold as possible without freezing.

### **Ethylene Production and Sensitivity**

The ethylene production rate for fresh spinach is  $<0.1 \mu\text{L kg}^{-1} \text{h}^{-1}$  at  $20\text{ }^{\circ}\text{C}$  ( $68\text{ }^{\circ}\text{F}$ ) (Suslow and Cantwell 2002). Similar data are not available for other greens, but their ethylene production rates could reasonably be expected to be in the same general range as that of spinach (Kader 1992). All leafy greens are sensitive to ethylene in the postharvest environment, which accelerates senescence and leaf yellowing (Suslow and Cantwell 2002).

### **Respiration Rates**

The data provided below are for spinach. Similar data are not available for other types of leafy greens.

Temperature	mg CO <sub>2</sub> kg <sup>-1</sup> h <sup>-1</sup>
0 °C	19 to 22
5 °C	32 to 58
10 °C	82 to 138
15 °C	134 to 223
20 °C	172 to 287

Data from Hardenburg et al. (1986).

To get mL CO<sub>2</sub> kg<sup>-1</sup> h<sup>-1</sup>, divide the mg kg<sup>-1</sup> h<sup>-1</sup> 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<sup>-1</sup> h<sup>-1</sup> by 220 to get BTU per ton per day or by 61 to get kcal per tonne per day.

### **Physiological Disorders**

Freezing injury, which results in water-soaked tissue and decay, is the most common physiological disorder. Temperatures slightly below 0 °C (32 °F) can result in freezing (Suslow and Cantwell 2002).

### **Postharvest Pathology**

Bacterial soft rots, primarily caused by *Erwinina* and *Pseudomonas*, are the most common types of postharvest decay (Suslow and Cantwell 2002). Other market diseases may be found, but in general these are not of serious concern if appropriate disease control has been implemented during production and if greens are properly handled.

### **Quarantine Issues**

There are no current issues. However, anyone exporting fresh produce should check with the appropriate agency in the importing country to ensure that all regulations are met.

### **Suitability as Fresh-Cut Product**

All leafy greens have potential for fresh-cut marketing.

### **Special Considerations**

Harvest workers should sanitize cutting tools periodically to avoid the spread of decay-causing microorganisms.

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