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Standardization and Inspection of Fresh Fruits and Vegetables

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Grade standards identify the degrees of quality in a commodity that are the basis of its usability and value. Such standards are valuable tools in fresh produce marketing because they

- provide a common language for trade among growers, handlers, processors, and receivers at terminal markets
- help producers and handlers do better jobs of preparing and labeling fresh horticultural commodities for market
- provide a basis for incentive payments rewarding better quality
- serve as the basis for market reporting (prices and supplies quoted by the Federal-State Market News Service in different markets can only be meaningful if they are based on products of comparable quality)
- help settle damage claims and disputes between buyers and sellers

U.S. GRADE STANDARDS

U.S. standards for fresh fruit and vegetable grades are voluntary, except when required by state and local regulations, by industry marketing orders (federal or state), or for export marketing. They are also used by many private and government procurement agencies when purchasing fresh fruits and vegetables. The USDA Agricultural Marketing Service (AMS) is responsible for developing, amending, and implementing grade standards. For more information on the AMS, access their website at <http://www.ams.usda.gov>.

The first U.S. grade standards were developed for potatoes in 1917. Currently there are more than 150 standards covering 80 different commodities. The quality factors used in these standards for fresh fruits, vegetables, and tree nuts are summarized in tables 23.1 to 23.5 at the end of this chapter.

The number of grades and grade names included in the U.S. standards for a given commodity vary with the number of distinct quality gradations that the industry normally recognizes and with the established usage of grade names. Currently, grades include three or more of the following: U.S. Fancy, U.S. No. 1, U.S. No. 2, U.S. No. 3, U.S. Extra No. 1, U.S. Extra Fancy, U.S. Combination, U.S. Commercial, and so on. The AMS is gradually phasing in the first four grades as uniform grades for all fresh fruits and vegetables, to represent available levels of quality.

Steps to establish or change U.S. standards include:

1. Demonstration of need, interest, and support from the industry.
2. Study of physical characteristics and quality factors, and their normal ranges for the commodity in the main production areas.
3. Consultation among all interested parties as part of data collection.
4. Development of a proposal that is practical.
5. Publication of the proposal in the *Federal Register*, and publicizing it through various means with an invitation for comments. Public hearings may be held for the same purpose.
6. Amendment of the proposal on the basis of comments received.
7. Publication of the standards in their final form in the *Federal Register* with a specified date on which they become effective (at least 30 days after publication date).

APPLYING THE STANDARDS

USDA inspectors are located at most shipping points and at terminal markets. In many cases cooperative agreements between the USDA and the states are in place to allow federal-state grading by USDA-licensed state inspectors. Some inspectors are full-time employees, while others are seasonal employees hired during the peak production season in a given location.

METHODS OF INSPECTION

1. Continuous inspection. One or more inspectors are assigned to a packinghouse. They make frequent quality checks on the commodity along the packing lines and examine samples of the packed product to determine whether it meets the U.S. grade specifications for which it is being packed. The inspector gives oral and/or written reports to management so that they can correct problems.

2. Inspection on a sample basis. Representative samples of a prescribed number of boxes out of a given lot are randomly selected and inspected to determine the quality and condition of the commodity according to grade specifications. Automatic sampling systems are used for some commodities that are handled in bulk bins or trailers, such as tomatoes, grapes, and cling peaches destined for processing. When inspection is completed, certificates are issued by the inspector on the basis of the applicable official standards. USDA inspectors can also inspect quality or condition based on a state grade or other specifications agreed upon by the parties involved. The cost of inspection is paid by the party requesting the service.

Each grade allows for a percentage of individual units within a lot that do not meet the standard. This reflects the practical limitations in sorting perishable products accurately into grades within a limited time. Tolerances, or the number of defects allowed, are more restrictive in U.S. No. 1 grade than in U.S. No. 2. The penalty for noncompliance with the U.S. grade specified on a given container may be rejection, resorting and repacking, or reclassification to a lower grade.

To ensure uniformity of inspection, inspectors are trained to apply the standards; visual aids (color charts, models, diagrams, photographs, and the like) are used whenever possible; objective methods for determin-

ing quality and maturity are used whenever feasible and practical; and good working environments with proper lighting are provided.

Recently, the Fresh Products Branch of the AMS equipped inspectors in designated market offices with digital cameras and enhanced computer technology for taking and transmitting images of produce or containers. AMS is offering the images to applicants over the Internet as an additional resource in its fresh fruits and vegetable inspection service. Inspectors also use the imaging to confer with produce quality experts working in USDA headquarters in Washington, D.C.

CALIFORNIA STANDARDS

California is one of the few states that has quality standards for horticultural crops produced within the state. The standards for fresh fruits and vegetables in the California Agricultural Code (summarized in tables 23.1 to 23.5) are mandatory minimum standards enforced by the California Department of Food and Agriculture (CDFA) Division of Inspection Services, Fruit and Vegetable Quality Control, through each county agricultural commissioner's staff. The cost of this inspection is paid by taxpayers. Noncompliance results in destruction of the commodity or its resorting and repacking to meet minimum requirements.

Steps for establishing new standards or revising existing ones are similar to those mentioned above for U.S. grade standards, except that they are carried out at the state level by the same agency responsible for inspection. Uniformity of inspection is assured by methods similar to those mentioned above for U.S. grade standards.

INDUSTRY STANDARDS

Some industries establish their own quality standards or specifications for a given commodity; examples include apricots, clingstone peaches, processing tomatoes, and walnuts. The standards are established by agreement between producers and processors, who pay application costs. Inspection is performed by independent agencies such as the California Dried Fruit Association and the Federal-State Inspection Service.

Some companies, cooperatives, and other organizations have quality grades that are applied by their quality-control personnel. Examples include quality grades for bananas, papayas, pineapples, and fresh-cut (lightly processed) fruits and vegetables.

INTERNATIONAL STANDARDS

International standards for fruits and vegetables were defined by the European Economic Commission (EEC) in 1954. Many standards have since been introduced, mainly under the Organization for Economic Cooperation and Development (OECD) scheme drawn up for this purpose. The first European International Standards were promulgated in 1961 for apples and pears, and now there are standards for about 40 commodities. Each includes three quality classes with appropriate tolerances: Extra class = superior quality; Class I = good quality; and Class II = marketable quality. Class I covers the bulk of produce entering into international trade. These standards or their equivalents are mandatory in the European Union (EU)

countries for imported and exported fresh fruits and vegetables. Inspection and certification is done by exporting and/or importing EU countries.

REFERENCES

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1983. Fruit and vegetable quality control standardization. Extracts from the Administrative Code of California. Sacramento: CDFA. 154 pp.
- Organization for Economic Cooperation and Development. Various dates. International standardization of fruits and vegetables. Paris: OECD.
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Table 23.1. Quality factors for fresh fruits in the U.S. Standards for Grades (U.S.) and the California Food and Agricultural Code (CA)

Fruit	Standard (date*)	Quality factors		
Apple	US (1976)	Maturity, color (color charts) related to grade, firmness, shape, and size, and freedom from decay, internal browning, internal breakdown, scald, scab, bitter pit, Jonathan spot, freezing injury, water core, bruises, russetting, scars, insect damage, and other defects		
	CA (1990)	Maturity as determined by starch staining pattern and/or soluble solids content [SSC] and firmness tests		
		Cultivar	SSC (%)	Firmness (lbf)
		Red Delicious	11.0	18
		Golden Delicious	12.0	18
		Jonathan	12.0	19
		Rome	12.5	21
		Newtown Pippin	11.0	23
		McIntosh	11.5	19
		Gravenstein	10.5	—
	Size, color, flesh condition, and freedom from defect (such as scald, spot, internal breakdown, water core, bruises, sunburn, russetting) and decay			
Apricot	US (1994)	Maturity, size, and shape, and freedom from defect and decay		
	CA (1983)	Maturity (>¾ of external surface area has a color equal to No. 3 yellowish green of the CDFA standard color chart or at least ½ has attained No. 4 yellow), and freedom from insect injury, decay, and mechanical damage		
Avocado	US (1957)	For Florida avocados: maturity, shape, texture, skin and flesh color, and freedom from decay, anthracnose, freezing injury, bruises, russetting, scars, sunburn, mechanical damage, and other defects		
	CA (1990)	Maturity (18.4 to 21.9% dry weight of the flesh, depending on cultivar), size, and freedom from defect, insect damage, freezing injury, rancidity, and decay		
Blueberry	US (1995)	Maturity, color, size, and freedom from defect and decay		
Cherry, sweet	US (1971)	Maturity, color, size, shape, and freedom from cracks, hail damage, russetting, scars, insect damage, and decay		
	CA (1983)	Maturity (entire surface with at least a solid light red color and/or 14 to 16% soluble solids, depending on the cultivar), and freedom from bird pecks, insect injury, shriveling, growth cracks, other defects, and decay		
Citrus				
Grapefruit	US (1950)	California and Arizona: maturity, color, firmness, size, shape, skin thickness, smoothness, and freedom from defect and decay		
	US (1997)	Florida: maturity, color (color charts), firmness, size, smoothness, shape, and freedom from discoloration, defect, and decay		
	US (1969)	Texas and other states: maturity, color, firmness, size, shape, smoothness, and freedom from discoloration, defect, and decay		
	CA (1983)	Maturity (minimum soluble solids:acid ratio of 5.5 or 6 [desert areas] and >¾ of fruit surface showing yellow color—0.9 GY 6.40/5.7 Munsell color), and freedom from decay, freezing damage, scars, pitting, rind staining, and insect damage		
Lemon	US (1964)	Maturity (28 or 30% minimum juice content by volume, depending on grade), firmness, shape, color, size, smoothness, and freedom from discoloration, defect, and decay		
	CA (1983)	Maturity (30% or more juice by volume), size uniformity, and freedom from decay, freezing damage, drying, mechanical damage, rind stains, red blotch, shriveling, and other defects		
Lime	US (1958)	Color, shape, firmness, smoothness, and freedom from stylar end breakdown, bruises, dryness, other defects, and decay		
	CA (1983)	Maturity, and freedom from defect (freezing injury, drying, mechanical damage) and decay		
Orange	US (1957)	California and Arizona: maturity, color, firmness, smoothness, size, and freedom from defect and decay		
	US (1997)	Florida: maturity, color (color charts), firmness, size, shape, and freedom from discoloration, defect, and decay (used also for tangelos)		
	US (1969)	Texas and other states: maturity, color, firmness, shape, size, and freedom from discoloration, defect, and decay		
	CA (1983)	Maturity as indicated by soluble solids:acid ratio of 8 or higher and orange color on 25% of the fruit (7.5 Y 6/6 Munsell color) or soluble solids:acid ratio of 10 or higher and orange color on 25% of fruit (2.5 GY 5/6 Munsell color), size uniformity, and freedom from defect and decay		

Table 23.1. Cont.

Fruit	Standard (date*)	Quality factors
Pineapple	US (1990)	Maturity, firmness, uniformity of size and shape, and freedom from decay, sunburn, sunscald, bruising, internal breakdown, gummosis, insect damage, and cracks; tops: color, length, and straightness
Plum and fresh prune	US (1973)	Maturity, color, shape, size, and freedom from decay, sunscald, split pits, hail damage, mechanical damage, scars, russetting, and other defects
	CA (1983)	Maturity as indicating by surface color (minimum color requirements are described for 56 cultivars), and freedom from decay, insect damage, bruises, sunburn, hail damage, gum spot, growth cracks, and other defects
Pomegranate	CA (1983)	Maturity (<1.85% acid content in juice and red juice color equal to or darker than Munsell color 5 R 5/12), and freedom from sunburn, growth cracks, cuts or bruises, and decay
Quince	CA (1983)	Maturity and freedom from insect damage, mechanical damage, and decay
Raspberry	US (1931)	Maturity, color, shape, and freedom from defect and decay
	CA (1983)	Maturity and freedom from decay and damage due to insects, sun, frost, bruising, or other causes
Strawberry	US (1965)	Maturity (>1/2 or >3/4 of surface showing red or pink color, depending on grade), firmness, attached calyx, size, and freedom from defect and decay
	CA (1983)	Maturity (>2/3 of fruit surface showing a pink or red color) and freedom from defect and decay

Note: *Date when standard was issued or revised.

Table 23.2. Quality factors for fresh vegetables in the U.S. Standards for Grades (U.S.) and the California Food and Agricultural Code (CA)

Vegetable	Standard (date*)	Quality factors
Anise, sweet	US (1973)	Firmness, tenderness, trimming, blanching, and freedom from decay and damage caused by growth cracks, pithy branches, wilting, freezing, seedstems, insects, and mechanical means
Artichoke	US (1969) CA (1983)	Stem length, shape, overmaturity, uniformity of size, compactness, and freedom from decay and defects Freedom from decay, insect damage, and freezing injury
Asparagus	US (1966) CA (1983)	Freshness (turgidity), trimming, straightness, and freedom from damage and decay, diameter of stalks, percent green color Turgidity, straightness, percent showing white color, stalk diameter, and freedom from decay, mechanical damage, and insect injury
Bean, lima	US (1938)	Uniformity, maturity, freshness, shape, and freedom from damage (defect) and decay
Bean, snap	US (1990)	Uniformity, size, maturity (not overmature = woody or fibrous), firmness (not wilted or flabby), and freedom from defect and decay
Beet, bunched, or topped	US (1955)	Root shape, trimming of rootlets, firmness (turgidity), smoothness, cleanness, minimum size (diameter), and freedom from defect
Beet, greens	US (1959)	Freshness, cleanness, tenderness, and freedom from decay, other kinds of leaves, discoloration, insects, mechanical injury, and freezing injury
Broccoli	US (1943) CA (1983)	Color, maturity, stalk diameter and length, compactness, base cut, and freedom from defects and decay Freedom from decay and damage due to overmaturity, insects, or other causes
Brussels sprouts	US (1954) CA (1983)	Color, maturity (firmness), no seedstems, size (diameter and length), and freedom from defect and decay Freedom from decay, from burst, soft, or spongy heads, and from insect damage
Cabbage	US (1945) CA (1983)	Uniformity, solidity (maturity or firmness), no seedstems, trimming, color, and freedom from defect and decay Conform to U.S. commercial grade or better
Cantaloupe	US (1968) CA (1983)	Soluble solids (>9%), uniformity of size, shape, ground color and netting; maturity and turgidity; and freedom from "wet slip," sunscald, and other defects Maturity (soluble solids >8%) and freedom from insect injury, bruises, sunburn, growth cracks, and decay
Carrot, bunched	US (1954) CA (1983)	Shape, color, cleanness, smoothness, freedom from defects, freshness, length of tops, and root diameter Number, size, and weight per bunch, freshness, and freedom from defect and decay (tops)
Carrot, topped	US (1965) CA (1983)	Uniformity, turgidity, color, shape, size, cleanness, smoothness, and freedom from defect (growth cracks, pithiness, woodiness, internal discoloration) Freedom from defect (growth cracks, doubles, mechanical injury, green discoloration, objectionable flavor or odor) and decay
Carrots with short rimmed tops	US (1954)	Roots: firmness, color, smoothness; freedom from defect (sunburn, pithiness, woodiness, internal discoloration, and insect and mechanical injuries) and decay; leaves (cut to <4 inches); freedom from yellowing or other discoloration, disease, insects, and seedstems
Cauliflower	US (1968) CA (1983)	Curd cleanness, compactness, white color, size (diameter), freshness and trimming of jacket leaves, and freedom from defect and decay Freedom from insect injury, decay, freezing injury, and sunburn
Celery	US (1959) CA (1983)	Stalk form, compactness, color, trimming, length of stalk and midribs, width and thickness of midribs, no seedstems, and freedom from defect and decay Freedom from pink rot and other decay, blackheart, seedstems, pithy condition, and insect damage
Collard green and broccoli greens	US (1953)	Freshness, tenderness, cleanness, and freedom from seedstems, discoloration, freezing injury, insects, and diseases
Corn, sweet	US (1992) CA (1983)	Uniformity of color and size, freshness, plump and milky kernels, cob length, and freedom from insect injury, discoloration, and other defects, coverage with fresh husks Milky, plump, well-developed kernels, and freedom from insect injury, mechanical damage, and decay

Table 23.2. Cont.

Vegetable	Standard (date*)	Quality factors
Cucumber	US (1958)	Color, shape, turgidity, maturity, size (diameter and length), and freedom from defect and decay
Cucumber, greenhouse	US (1985)	Freshness, shape, firmness, color, size (length of 11 inches or longer), and freedom from decay, cuts, bruises, scars, insect injury and other defects
Dandelion greens	US (1955)	Freshness, cleanness, tenderness; freedom from damage caused by seed stems, discoloration, freezing, diseases, insects, and mechanical injury
Eggplant	US (1953)	Color, turgidity, shape, size; freedom from defect and decay
Endive, escarole or chicory	US (1964)	Freshness, trimming, color (blanching), no seed stems, and freedom from defect and decay
Garlic	US (1944) CA (1983)	Maturity, curing, compactness, well-filled cloves, bulb size, and freedom from defect Size (bulb diameter)
Honeydew and honey ball melons	US (1967) CA (1983)	Maturity, firmness, shape, and freedom from decay and defect (sunburn, bruising, hail spots, and mechanical injuries) Maturity, soluble solids (>10%), and freedom from decay, sunscald, bruises, and growth cracks; honey ball melons should be netted and should have pink flesh
Horseradish roots	US (1936)	Uniformity of shape and size, firmness, smoothness, and freedom from hollow heart, other defects, and decay
Kale	US (1934)	Uniformity of growth and color, trimming, freshness, and freedom from defect and decay
Lettuce, crisp-head	US (1975) CA (1983)	Turgidity, color, maturity (firmness), trimming (number of wrapper leaves), and freedom from tip burn, other physiological disorders, mechanical damage, seedstems, other defects, and decay Freedom from insect damage, decay, seedstems, tip burn, freezing injury, broken midribs, and bursting; for sectioned, chopped, or shredded lettuce: same as intact heads plus freedom from discoloration and excessive moisture
Lettuce, greenhouse leaf	US (1964)	Well-developed, well-trimmed, and freedom from coarse stems, bleached or discolored leaves, wilting, freezing, insects, and decay
Lettuce, romaine	US (1960)	Freshness, trimming, and freedom from decay and damage caused by seedstems, broken, bruised, or discolored leaves, tip burn, and wilting
Melon, casaba and Persian	CA (1983)	Maturity and freedom from growth cracks, decay, mechanical injury, and sunburn
Mushroom	US (1966) CA(1983)	Maturity, shape, trimming, size, and freedom from open veils, disease, spots, insect injury, and decay Freedom from insect injury
Mustard greens and turnip greens	US (1953)	Fresh, tenderness, cleanness, and freedom from damage caused by seedstems, discoloration, freezing, disease, insects, or mechanical means; roots (if attached): firmness and freedom from damage
Okra	US (1928)	Freshness, uniformity of shape and color, and freedom from defect and decay
Onion, dry		
Creole	US (1943)	Maturity, firmness, shape, size (diameter), and freedom from decay, wet sunscald, doubles, bottlenecks, sprouting, and other defects
Bermuda-Granex	US (1995)	
Grano	US (1995)	
Other cultivars		
Onion, dry	CA (1983)	Freedom from insect injury, decay, sunscald, freezing injury, sprouting, and other defects
Onion, green	US (1947)	Turgidity, color, form, cleanness, bulb trimming, no seedstems, and freedom from defect and decay
Onion sets	US (1940)	Maturity, firmness, size, and freedom from decay and damage caused by tops, sprouting, freezing, mold, moisture, dirt, disease, insects, or mechanical means
Parsley	US (1930)	Freshness, green color, and freedom from defects, seedstems, and decay

Table 23.2. Cont.

Vegetable	Standard (date*)	Quality factors
Parsnip	US (1945)	Turgidity, trimming, cleanness, smoothness, shape, size (diameter), and freedom from defects and decay,
Pea, fresh	US (1942)	Maturity, size, shape, freshness, and freedom from defects and decay
	CA (1983)	Maturity, and freedom from mechanical damage, insect damage, decay, yellowing, and shriveling
Pea, Southern (Cowpea)	US (1956)	Maturity, pod shape, and freedom from discoloration and other defects
Pepper, sweet	US (1989)	Maturity, color, shape, size, firmness, and freedom from defects (sunburn, sunscald, freezing injury, hail, scars, insects, mechanical damage) and decay
	CA (1983)	Freedom from insect damage, bacterial spot, and decay
Potato	US (1991)	Uniformity, maturity, firmness, cleanness, shape, size, intactness of the skin, and freedom from sprouts, scabs, growth cracks, hollow heart, blackheart, greening, and other defects
	CA (1983)	A minimum equivalent of U.S. No. 2 grade; maturity is described in terms of extent of skin missing or feathered
Radish (topped)	US (1968)	Tenderness, cleanness, smoothness, shape, size, and freedom from pithiness and other defects
Rhubarb	US (1966)	Color, freshness, straightness, trimming, cleanness, stalk diameter and length, and freedom from defect
Shallot, bunched	US (1946)	Firmness, form, tenderness, trimming, cleanness, and freedom from decay and damage caused by seed stems, disease, insects, mechanical and other means; tops: freshness, green color, and no mechanical damage
Spinach, bunches	US (1987)	Freshness, cleanness, trimming, and freedom from decay and damage caused by coarse stalks or seedstems, discoloration, insects, and mechanical means
Spinach, leaves	US (1946)	Color, turgidity, cleanness, trimming, and freedom from seedstems, coarse stalks, and other defects
Squash, summer	US (1984)	Immaturity, tenderness, shape, firmness, and freedom from decay, cuts, bruises, scars, and other defects
Squash, winter and pumpkin	US (1983)	Maturity, firmness, uniformity of size, and freedom from discoloration, cracking, dry rot, insect damage, and other defects
Sweet potato	US (1963)	Firmness, smoothness, cleanness, shape, size, and freedom from mechanical damage, growth cracks, internal breakdown, insect damage, other defects, and decay
	CA (1983)	Freedom from decay, mechanical damage, insect injury, growth cracks, and freezing injury
Tomato	US (1991)	Maturity and ripeness (color chart), firmness, shape, size, and freedom from defect (puffiness, freezing injury, sunscald, scars, catfaces, growth cracks, insect injury, and other defects) and decay
	CA (1983)	Freedom from insect and freezing damage, sunburn, mechanical damage, blossom-end rot, catfaces, growth cracks, and other defects
Tomato, greenhouse	US (1966)	Maturity, firmness, shape, size, and freedom from decay, sunscald, freezing injury, bruises, cuts, shriveling, puffiness, catfaces, growth cracks, scars, disease, and insects
Turnip and rutabaga	US (1955)	Uniformity of root color, size, and shape, trimming, freshness, and freedom from defects (cuts, growth cracks, pithiness, woodiness, water core, dry rot)
Watermelon	US (1978)	Maturity and ripeness (optional internal quality criteria: soluble solids content = >10% very good, >8% good), shape, uniformity of size (weight), and freedom from anthracnose, decay, sunscald, and whiteheart
	CA (1983)	Maturity (arils around the seeds have been absorbed and flesh color is >75% red), and freedom from decay, sunburn, flesh discoloration, and mechanical damage

Note: *Date when standard was issued or revised.

Table 23.3. Quality factors for processing fruits in the U.S. Standards for Grades (US) and the California Food and Agricultural Code (CA)

Fruit	Standard (date*)	Quality factors
Apple	US (1961)	Ripeness (not overripe, mealy, or soft), and freedom from decay, worm holes, freezing injury, internal breakdown, and other defects that would cause a loss of >5% (U.S. No. 1) or >12% (U.S. No. 2) by weight
Berries	US (1947)	Color, and freedom from caps (calyxes), decay, and defect (dried, undeveloped and immature berries, crushing, shriveling, sunscald, insect damage, and mechanical injury)
Blueberry	US (1950)	Freedom from other kinds of berries, clusters, large stems, leaves and other foreign material, and freedom from damage caused by decay, shriveling, dirt, overmaturity, or other means
Cherry, red sour	US (1941)	Color uniformity, and freedom from decay, pulled pits, attached stems, hail marks, windwhips, scars, sunscald, shriveling, disease, and insect damage
Cherry, sweet for canning or freezing	US (1946)	Maturity, shape; freedom from decay, worms, pulled pits, doubles, insect and bird damage, and mechanical injury; freedom from damage caused by freezing softness, shriveling, cracks and skin breaks, scars, and sunscald; tolerance is 7% (U.S. No. 1) or 12% (U.S. No. 2) by count
Cherry, sweet for sulfur brining	US (1940)	Maturity (ease of pit separation), firmness, shape, and freedom from decay and defect (bruises, bird and insect damage, skin breaks, russeting, shriveling, scars, sunscald, and lim rubs)
Cranberry, red sour	US (1957)	Maturity, color, firmness, size, and freedom from defect (insect damage, bruises, scars, sunscald, freezing injury, and mechanical injury) and decay
Currant	US (1952)	Color, stem attached, and freedom from decay and damage caused by crushing, drying, shriveling, insects, and mechanical means
Grape, American type for processing and freezing	US (1943)	Maturity (>15.5% soluble solids), color; freedom from shattered, split, crushed, or wet berries, and freedom from decay; freedom from damage caused by freezing, heat, sunburn, disease, insects, or other means
Grape, juice (European or vinifera type)	US (1939)	Maturity (>16 to 18% soluble solids, depending on cultivar); freedom from crushed, split, wet, waterberry and redberry; freedom from defect (insect, disease, mechanical injury, sunburn, and freezing damage)
	CA (1983)	Maturity (minimum soluble solids content of 14 to 17.5%, depending on cultivar or soluble solids:acid ratio of 20 or higher), and freedom from decay, freezing injury, waterberry, redberry, and other defects
Grape for processing and freezing	US (1977)	Maturity (>15.5% soluble solids content), and freedom from decay and defect (dried berries, discoloration, sunburn, insect damage, and immature berries)
Peach, freestone for canning or pulping	US (1966)	Maturity, color (not greener than yellowish green), shape, firmness, and freedom from decay, worms and worm holes, split pits, scab, bacterial spot, insects, and bruises; grade is based on the severity of defects with 10% tolerance
Pear for processing	US (1970)	Maturity, color (less than yellowish green), shape, firmness, and freedom from scald, hard end, black end, internal breakdown, decay, worms and worm holes, scars, sunburn, bruises, and other defects; grade is based on the severity of defects with 10% tolerance
Raspberry	US (1952)	Color, and freedom from decay and defect (dried berries, crushing, shriveling, sunscald, scars, bird and insect damage, discoloration, or mechanical injury)
Strawberry, growers' stock for manufacture	US (1935)	Color, size and cap removal, freedom from decay and defect (crushed, split, dried or undeveloped berries, sunscald, and bird or insect damage)
Strawberry, washed and sorted for freezing	US (1935)	Color, cleanness, size, cap removal, and freedom from decay and defect (crushed, split, dried or undeveloped berries, bird and insect damage, mechanical injury)

Note: *Date when standard was issued or revised.

Table 23.4. Quality factors for processing vegetables in the U.S. Standards for Grades (US)

Vegetable	Standard (date*)	Quality factors
Asparagus, green	US (1972)	Freshness, shape, green color, size (spear length), and freedom from defect (freezing damage, dirt, disease, insect injury, and mechanical injuries) and decay
Bean, shelled lima	US (1953)	Tenderness, green color, freedom from decay and from injury caused by discoloration, shriveling, sunscald, freezing, heating, disease, insects, or other means
Bean, snap	US (1985)	Freshness, tenderness, shape, size, and freedom from decay and from damage caused by scars, rust, disease, insects, bruises, punctures, broken ends, or other means
Beet	US (1945)	Firmness, tenderness, shape, size, and freedom from soft rot, cull material, growth cracks, internal discoloration, white zoning, rodent damage, disease, insects, and mechanical injury
Broccoli	US (1959)	Freshness, tenderness, green color, compactness, trimming, and freedom from decay and damage caused by discoloration, freezing, pithiness, scars, dirt, or mechanical means
Cabbage	US (1944)	Firmness, trimming, and freedom from soft rot, seedstems, and damage caused by bursting, discoloration, freezing, disease, birds, insects, or mechanical or other means
Carrot	US (1984)	Firmness, color, shape, size (root length), smoothness, not woody, and freedom from soft rot, cull material, and from damage caused by growth cracks, sunburn, green core, pithy core, water core, internal discoloration, disease, or mechanical means
Cauliflower	US (1959)	Freshness, compactness, color, and freedom from jacket leaves, stalks, and other cull material, decay, and damage caused by discoloration, bruising, fuzziness, enlarged bracts, dirt, freezing, hail, or mechanical means
Corn, sweet	US (1962)	Maturity, freshness, and freedom from damage by freezing, insects, birds, disease, cross-pollination, or fermentation
Cucumber, pickling	US (1936)	Color, shape, freshness, firmness, maturity, and freedom from decay and from damage caused by dirt, freezing, sunburn, disease, insects, or mechanical or other means
Mushroom	US (1964)	Freshness, firmness, shape, and freedom from decay, disease spots, and insects, and from damage caused by insects, bruising, discoloration, or feathering
Okra	US (1965)	Freshness, tenderness, color, shape, and freedom from decay, insects, and damage caused by scars, bruises, cuts, punctures, discoloration, dirt, or other means
Onion	US (1944)	Maturity, firmness, and freedom from decay, sprouts, bottlenecks, scallions, seedstems, sunscald, roots, insects, and mechanical injury
Pea, fresh shelled for canning/freezing	US (1946)	Tenderness, succulence, color, and freedom from decay, scald, rust, shriveling, heating, disease, and insects
Pea, Southern	US (1965)	Pods: maturity, freshness, and freedom from decay; seeds: freedom from scars, insects, decay, discoloration, splits, cracked skin, and other defects
Pepper, sweet	US (1948)	Firmness, color, shape, and freedom from decay, insects, and damage by any means that results in 5 to 20% trimming (by weight), depending on grade
Potato	US (1983)	Shape, smoothness, size, specific gravity, glucose content, fry color, and freedom from decay and defect (freezing injury, blackheart, sprouts)
Potato for chipping	US (1978)	Firmness, cleanness, shape; freedom from defect (freezing, blackheart decay, insect injury, and mechanical injury); size; optional tests for specific gravity and fry color are included
Spinach	US (1956)	Freshness; freedom from decay, grass weeds, and other foreign material; freedom from damage caused by seedstems, discoloration, coarse stalks, insects, dirt, or mechanical means
Sweet potato for canning/freezing	US (1959)	Firmness, shape, color, size, and freedom from decay and defect (freezing injury, scald, cork, internal discoloration, bruises, cuts, growth cracks, pithiness, stringiness, and insect injury)
Sweet potato for dicing/pulping	US (1951)	Firmness, shape, size, and freedom from decay and defect (scald, freezing injury, cork, internal discoloration, pithiness, growth cracks, insect damage, and stringiness)

Table 23.4. Cont.

Vegetable	Standard (date*)	Quality factors
Tomato	US (1983)	Firmness, ripeness (color as determined by a photoelectric instrument), and freedom from insect damage, freezing, mechanical damage, decay, growth cracks, sunscald, gray wall, and blossom-end rot
Tomato, green	US (1950)	Firmness, color (green), and freedom from decay and defect (growth cracks, scars, catfaces, sunscald, disease, insects, or mechanical damage)
Tomato, Italian type for canning	US (1957)	Firmness, color uniformity, and freedom from decay and defect (growth cracks, sunscald, freezing, disease, insects, or mechanical injury)

Note: *Date when standard was issued or revised.

Table 23.5. Quality factors for tree nuts in the U.S. Standards for grades (US) and the California Food and Agricultural Code (CA)

Nut	Standard (date*)	Quality factors
Almond, shelled	US (1997)	Similar varietal characteristics (shape, appearance), size (count per ounce), degree of dryness, cleanness (freedom from dust, particles, and foreign materials), and freedom from decay and defect (rancidity, insect injury, doubles, split or broken kernels, shriveling, brown spot, or gumminess)
Almond, in-shell	US (1997)	Shell: similar varietal characteristics (shape, hardness), cleanness (freedom from loose extraneous and foreign materials), size (thickness), brightness and uniformity of color, and freedom from discoloration, insect infestation, adhering hulls, and broken shells; kernel: degree of dryness, and freedom from decay and defect (rancidity, insect damage, shriveling, brown spot, gumminess, and skin discoloration)
Brazil nut, in-shell	US (1966)	Shell: degree of dryness, cleanness (freedom from dirt, extraneous, and adhering foreign materials), size (diameter), and freedom from damage caused by splits, breaks, punctures, oil stains, and mold; kernel: degree of development (must fill more than 50% of the shell capacity) and freedom from decay and defect (rancidity, insect damage, and discoloration)
Filbert, in-shell	US (1970)	Shell: shape, size (diameter), cleanness, brightness, and freedom from defect (blanks, broken or split shells, stains, and adhering husk); kernel: degree of dryness (less than 10% moisture content), development (must fill more than 50% of the shell capacity), shape, and freedom from decay and defect (insect injury, shriveling, rancidity, and discoloration)
Mixed nuts, in-shell	US (1981)	Each species of nut must conform to a minimum size and grade (same quality criteria used for that species); grade of the mix is also determined by percent allowable for each component (almonds, brazils, filberts, pecans, walnuts)
Pecan, shelled	US (1969)	Degree of dryness, degree of development (amount of meat in proportion to width and length), color (plastic models for color standards are available), color uniformity, size (number of halves per pound or diameter of pieces), cleanness (freedom from dust, dirt, and adhering material), and freedom from decay and defect (shriveling, insect damage, internal discoloration, dark spots, skin discoloration, and rancidity)
Pecan, in-shell	US (1976)	Shell: color uniformity, size (number of nuts per pound), cleanness, and freedom from decay and defect (insect damage, dark stains, split or cracked shells, and broken shells); kernel: same for shelled pecans (above)
Pistachio, shelled	US (1990)	Degree of dryness; freedom from foreign material and damage caused by mold, insects, spotting, rancidity, and other defects; and size (whole kernels, broken kernels)
Pistachio, in-shell	US (1992)	Freedom from foreign material, loose kernels, shell pieces, particles and dust, and blanks; freedom from non-split shells, shells not split on suture, adhering hull material, and staining; nut size; degree of kernel dryness and freedom from defects
Walnut, shelled	US (1968)	Color (USDA color chart), degree of dryness, cleanness (freedom from shells, dirt, dust, and foreign material), size (diameter of halves or pieces), and freedom from decay and defect (insect injury, rancidity, shriveling, and meat discoloration)
Walnut, in-shell	US (1976)	Shell: dryness, cleanness, brightness, freedom from decay and defect (splits, discoloration, broken shells, perforated shells, and adhering hulls), and size (diameter); kernel: same as for shelled walnuts (above)
	CA (1983)	Shell: dryness, size, and freedom from blanks, decay, and defect (insect damage, adhering hulls, and perforations affecting more than $\frac{1}{8}$ of the surface); kernel: size and freedom from decay and defect (insect damage, shriveling, and rancidity)

Note: *Date when standard was issued or revised.