Sweet Corn

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Scientific Name and Introduction

Sweet corn (*Zea mays* L. var. *rugosa* Bonaf.) is an annual grass of the Poaceae (grass) family. Traditional varieties are *su1* (*sugary1*) mutants that contain about twice the sugar (primarily sucrose) content of field corn, as well as 8 to 10 times more water-soluble polysaccharide. The latter imparts a creamy consistency to *su1* sweet corn. Other mutants with increased sugar content have more recently been used, primarily *sh2 (shrunken 2),* which has at least double the sugar content of *su1* but almost no water-soluble polysaccharide. Less commonly used is *su1/se (sugary-enhancer); se* modifies *su1* to also double the sugar content, but with no loss of water-soluble polysaccharide content (Wann et al. 1997). The *sh2* mutation inhibits starch biosynthesis while *se* does not. These newer varieties are referred to as “supersweet” and have become the dominant type in all major U.S. sweet corn production regions. The high initial sugar content, coupled with inhibited starch synthesis in *sh2* varieties, doubles the potential postharvest life of sweet corn. However, all supersweet varieties remain extremely perishable.

Quality Characteristics and Criteria

High-quality sweet corn has uniform size and color (yellow, white, or bicolor); sweet, plump, tender, well-developed kernels; and fresh, tight, green husks. It is free from insect injury, mechanical damage, and decay. Sweetness is the most important factor in consumer satisfaction (Evensen and Boyer 1986). All sweet corn varieties lose sweetness and aroma during storage, but the taste of *su1* and *su1/se* varieties becomes starchy while *sh2* varieties eventually taste watery and bland.

Horticultural Maturity Indices

Sweet corn harvest maturity is determined by a combination of ear fill, silk drying, kernel development, kernel sweetness, and kernel tenderness. The appearance of the juice, or endosperm, is a good indicator of maturity for *su1* and *se* varieties, in which a milky (not watery or doughy) consistency represents proper maturity, but not for *sh2* varieties, which always have a watery endosperm.

Grades, Sizes, and Packaging

Grades include U.S. Fancy; U.S. Fancy, Husked; U.S. No. 1; U.S. No. 1, Husked; and U.S. No. 2. Grade is based primarily on maturity, freshness, and cob length, as well as freedom from various injuries and decay. Sweet corn is commonly handled in wire-bound wooden crates and less commonly in waxed fiberboard cartons or in returnable plastic containers. All contain 54 to 60 ears with a weight of about 19 kg (42 lb). Some is prepackaged in polyvinylchloride (PVC) film-wrapped trays (Risse and McDonald 1990, Aharoni et al. 1996) with the ends of ears trimmed and husks partially removed to expose some kernels. PVC film is highly permeable to O_2 and CO_2 while acting as a moisture barrier.

Precooling Conditions

Sweet corn is often >30 °C (86 °F) when harvested, and rapid removal of field heat is critical to retard deterioration. Maximum quality is retained by precooling corn to 0 °C (32 °F) within 1 h of harvest and holding it at 0 °C (32 °F) during marketing. In practice, cooling to this extent is rarely achieved. However, cooling is the first step in a good temperature-management program. Sweet corn has a high respiration rate, which results in a high rate of heat generation. Supersweet varieties have respiration rates equal to that of traditional sweet corn varieties and lose sugar as rapidly (Evensen and Boyer 1986, Olsen et al. 1991), so cooling is still critical with these newer varieties. Sweet corn should not be handled in bulk unless copiously iced because it tends to heat throughout the pile.

Vacuum-cooling can adequately precool sweet corn, but the corn must be first wetted (and top-iced after cooling) to minimize water loss from husks and kernels (Showalter 1957, Stewart and Barger 1960). Crated sweet corn can be vacuum-cooled from about 30 °C (86 °F) to 5 °C (41 °F) in 30 min. Hydrocooling by spraying, showering, or immersion in water at 0 to 3 °C (32 to 38 °F) is effective, though it takes longer than vacuum-cooling if the sweet corn is packed. Bulk sweet corn takes about 60 min to cool from 30 to 5 °C (86 to 41 °F) in a well-managed hydrocooler, while crated sweet corn takes about 80 min (Talbot et al. 1991)—and few if any operators leave it in that long. Periodic monitoring of sweet corn temperature is needed to ensure proper cooling to at least 10 °C (50 °F). Hydrocooling nomographs for bulk and crated sweet corn are available (Stewart and Couey 1963).

After hydrocooling, top-icing is desirable during transport or holding to continue cooling, remove the heat of respiration, and keep the husks fresh. When precooling facilities are not available, sweet corn can be cooled with package ice and top ice. Injection of an ice-water slurry (slush ice) into cartons was as effective as hydrocooling and better than vacuum-cooling in maintaining quality (Talbot et al. 1991), probably due to residual ice in the cartons, since the cooling rate was slower than for the other methods.

Optimum Storage Conditions

Traditional sweet corn varieties are seldom stored for more than a few days because of the resulting serious deterioration and loss of tenderness and sweetness. The loss of sugar is about 4 times as rapid at 10 °C (50 °F) than at 0 °C (32 °F). At 30 °C (86 °F), 60% of the sugar in *su1* sweet corn can be converted to starch in a single day, while only 6% is converted at 0 °C (32 °F). While *sh2* varieties lose sugar at the same rate as *su1* varieties, their higher initial sugar levels keep it sweet-tasting longer. For *sh2* varieties, water loss and pericarp toughening supplant loss of sweetness in limiting postharvest life (Brecht et al. 1990). The former is minimized by prompt cooling, trimming flag leaves and long shanks, and maintaining high RH, usually by icing. Denting of kernels is promoted by water loss from husk leaves (Showalter 1967). A loss of 2% moisture may result in objectionable kernel denting. Pericarp toughening can also be minimized by prompt cooling and by maintaining sweet corn at 0 °C (32 °F). Under optimum storage conditions, the potential postharvest life of *sh2* sweet corn is >2 weeks.

Controlled Atmosphere (CA) Considerations

Increased attention for CA and MAP was spurred by an interest in marine transport to export sweet corn from the United States to Europe and the Far East, which can involve transit times of >2 weeks. Injurious atmospheres at 2 °C (35 °F) contain <2% O_2 or >15% CO_2 (Spalding et al. 1978), resulting in fermentation, off flavors, and odors. Reduced O_2 and elevated CO_2 reduce respiration and slow sucrose loss; elevated CO_2 also reduces decay and maintains green husk color (Spalding et al. 1978, Schouten 1993, Aharoni et al. 1996).

Retail Outlet Display Considerations

Sweet corn should be displayed in refrigerated cases or with ice.

Chilling Sensitivity

Sweet corn is not chilling sensitive. It should be stored as cold as possible without freezing.

Ethylene Production and Sensitivity

Sweet corn produces only trace ethylene, and exogenous ethylene is not a problem, though high ethylene amounts can lead to husk yellowing given sufficient exposure time.

Respiration Rates

Temperature	mg CO_2 kg^{-1} h^{-1}
0 °C	30 to 51
5 °C	43 to 83
10 °C	90 to 120
15 °C	142 to 175
20 °C	210 to 311
25 °C	282 to 435

Data from Tewfik and Scott (1954), Scholz et al. (1963), and Robinson et al. (1975).

To get mL CO_2 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 per ton per day or by 61 to get kcal $tonne^{-1}$ day^{-1}.

Physiological Disorders

There are no significant disorders.

Postharvest Pathology

Decay is not usually a serious problem, but when present it typically occurs on the husk and silks. Trimming ears can promote decay development on the cut kernels and other damaged tissues mainly caused by *Alternaria alternata* (Fr.) Keissler, *Fusarium moniliforme* Sheldon, and

Mucor hiemalis Wehmer (Aharoni et al. 1996). Thus, proper sanitation and temperature management are important to minimize decay in trimmed sweet corn.

Quarantine Issues

There are no known quarantine issues.

Suitability as Fresh-Cut Product

Fresh-cut sweet corn kernels are extremely perishable. Their respiration rate is very high, several times that of intact ears. Thus, temperature control is extremely critical if the kernels are to have acceptable shelf-life. Problems during handling can include off flavors, microbial survival and growth, and discoloration if the temperature is not maintained near 0 °C (32 °F). Especially troublesome is browning when the kernels are cooked. This browning is greater in kernels from more mature ears and is correlated with temperature, storage duration, and extent of physical damage.

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