Sweet Corn Quality -- What is it?

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"Sweet corn was our family's weakness. We were prepared to resist atheistic communism, immoral Hollywood, hard liquor, gambling and dancing, smoking, fornication, but if Satan had come around with sweet corn we at least would have listened to what he had to sell."
– Garrison Keillor in Leaving Home

Presentation Summary

Numerous production and consumption statistics reinforce the notion that sweet corn is a strong "temptation" for growers, processors and consumers. Sweet corn is a leader among vegetable commodities in per capita consumption and its production for fresh or processing markets is a major industry in many states. For example, the approximately 16000 acres of fresh market sweet corn planted annually in Ohio has an estimated total value near nineteen million dollars. Over the years, industry and research partnerships have played important roles in the successful production and sale of sweet corn. Sweet corn growers, processors, and others successfully apply the knowledge gained through research which identifies the components of quality and provides clues on how to achieve it. The combined efforts of biochemists, breeders and geneticists, food scientists, horticulturists, members of the industry, and others have helped bring us to the point where we understand issues related to sweet corn quality perhaps better than we do that for most other vegetable commodities. Criteria that consumers use to gauge the quality of sweet corn are well documented. The primary genetic, production, and post-harvest influences on sweet corn eating quality are also known. The principal determinants of sweet corn eating quality, as defined by consumers through research, and fundamental genetic and production-related forces that shape them are outlined in this summary.

Descriptions of Sweet Corn Eating Quality. The combined efforts of researchers in a number of disciplines over many decades has helped clarify which physical and chemical characteristics of sweet corn consumers value and to what extent. In general, the eating quality of a helping of fresh or processed whole-kernel sweet corn is determined by its unique combination of flavor, texture, and aroma. Which, if any, of these factors is most important? Results from tests involving analyses made by consumers trained to identify and rate specific sensory properties give us an answer. Typically, consumers weight flavor more heavily than they do texture in their evaluation of sweet corn. Aroma impacts consumer ratings of quality but generally less so than taste and texture. Interestingly, achieving the desired level of a pleasant "sweet corn"-like aroma can be more important to the quality of processed whole-kernel than fresh market sweet corn.

The story of sweet corn eating quality does not stop with identifying that flavor, texture, and aroma (generally, in that order) typically comprise consumer perceptions of quality. Specific components within

each of these factors add or detract from each factor in particular and eating quality in general. For example, sweetness makes up most of what typical consumers describe as flavor – sweetness itself depending largely on kernel sucrose content. Texture is determined primarily by pericarp tenderness, levels of water-soluble polysaccharides (phytoglycogen), and kernel moisture content. Several factors that comprise flavor and texture, such as the levels of sucrose, starch, and kernel moisture, are related so that high levels of one may be associated with lower levels of another. For example, kernel moisture levels tend to decline as starch levels increase. Aroma tends to be associated with the presence of sulfur-containing compounds, including dimethyl sulfide, that are detected by the consumer only when the product is heated.

Genetic and Production influences on Sweet Corn Eating Quality. Thomas Jefferson's "Garden Book" of 1810 is said to contain the first written record of sweet corn, as distinguished by endosperm mutants, in English-speaking North America. This early reference foretold the fact that genetic manipulation of the endosperm's composition would have an enormous impact on the growing and selling of sweet corn. The endosperm is the primary storage tissue of the seed. Its physical and chemical makeup effects not only the crop's eating quality but also the kernel's ability to function as a seed. The types of sugars made by the plant and stored in the endosperm and the rate at which they are converted to other compounds, especially starch, continue to be manipulated through genetics and breeding. So also are the factors that control kernel texture and, to a lesser extent, aroma. Breeding efforts are consistent with the fact that flavor and texture drive consumer appeal of fresh and whole-kernel processed corn and that consumers generally prefer corn that is sweet and tender with a creamy texture, low starch content, and pleasant "sweet corn"-like aroma. Over the years, varieties with different types and levels of sugars at harvest maturity, rate of sugar conversion to starch and moisture loss after maturity, and pericarp characteristics (e.g., tenderness, color) have been available. Compared to normal corn, standard sugary or "su" varieties accumulate more sugars and water-soluble polysaccharides (phytoglycogen) and less starch. However, su-type varieties rapidly convert sugars to starch after harvest maturity, leaving narrow harvest and market windows. As a result, su-type varieties are rarely grown in the U.S. Instead, sugary enhanced (se)- and shrunken2 (sh_2)-type varieties dominate since they are more sweet and tender and have longer harvest and market windows than su-type varieties. Se-type varieties tend to bear the creamy texture provided by relatively high levels of phytoglycogen which are lacking in most sh_2-type varieties. As a group, se- and sh_2-type varieties have overlapping ranges of total endosperm sugar level at harvest maturity although the varieties with the absolutely highest sugar levels tend to be of the sh_2 type. Rates of kernel sugar conversion to starch and dry-down also may be similar among se- and sh_2-type varieties as a group but, as in kernel sugar levels, varieties with the slowest sugar-to-starch conversion and kernel dry-down rates tend to be of the sh_2-type.

A variety's genetic makeup strongly but not completely determines its potential eating quality. Although not as clearly defined as various genetic influences, environmental factors and management are also known to influence crop quality. For example, high temperature stress during pollination and kernel development can reduce the number and eating quality of kernels, partly through undesirable effects on texture. Likewise, low and high moisture stress are thought to reduce crop quality. Excessive nitrogen fertilization can also reduce the number and quality of sweet corn kernels.

Other Consumer Quality-related Traits. A crop's flavor, texture, and aroma (eating quality) are the last traits to be evaluated by the consumer. Other traits related to the appearance of ears sold in the fresh market are recognized as influencing the attractiveness of the crop to the consumer and, therefore, the likelihood that they may buy it. These traits include: husk and flag leaf color and length, tip fill, and row configuration. The genetic control of these traits is poorly understood. Variety, environment, and management appear to have comparable levels of control over these traits. Anecdotal evidence suggests that nitrogen fertilization and moisture stress may influence husk and flag leaf color and tip fill: High nitrogen availability is associated with dark green husks and flag leaves but excessive nitrogen fertilization and moisture stress (low, high) are associated with poor tip fill.

Summary. Fresh and processed sweet corn remains an extremely popular food item. Through the combined efforts of members of the industry and scientists in many disciplines, it has been possible to identify the physical and chemical traits of sweet corn kernels that affect their palatability to the consumer. Most consumers appear to prefer sweet corn that is sweet and tender with a creamy texture, low starch content, and pleasant "sweet corn"- like aroma. Other traits related to the appearance of whole ears seem to influence the likelihood that consumers will buy them for fresh consumption. In general, consumers appear to prefer dark green husks and flag leaves and well-filled ears with straight rows. Although the most desirable plant, ear and other traits may differ between fresh and processing markets, traits related to eating quality appear to be similar, regardless of market type. And, just as important, these traits continue to be incorporated into new varieties. Along with favorable environments and proper management, the use of improved varieties helps to ensure greater crop marketability and grower profit potential.

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