WHAT IS QUALITY AND HOW CAN WE MEASURE IT?

Judith A. Abbott* USDA-ARS, Horticultural Crops Quality Laboratory, Bldg. 002, Beltsville, MD 20705, USA

The term quality connotes a degree of excellence of a product or its suitability for a particular use. Quality is not a single, well-defined attribute but is a human construct comprising many properties or characteristics. In fact, the component attributes of quality vary with context. Fresh fruits and vegetables are highly perishable. Thermal, chemical, or irradiation treatments used for insect or pathogen disinfestation can disrupt metabolic processes. Known responses include abnormal ripening, increased susceptibility to pathogens, disrupted water relations, cellular debonding or breakdown, altered production of volatile compounds, and degradation of vitamins. These responses result in changes in quality attributes: appearance, texture, flavor, aroma, and nutritive value. Quality attributes obviously can be assessed by sensory perception. However, objective measurement of quality attributes reduces variations in judgment among individuals and provides a "common language" among researchers, industry, and consumers. Objective measurements also have improved legal standing in questions of export regulations and damage liability.

Appearance may entail color, color distribution, or translucence. Color can be assessed with color meters that relate to human observers or by spectral measurement of light transmittance or diffuse reflectance. Either approach can use spot measurement or imaging. Imaging may be useful for quantifying uneven ripening and lesions. Chlorophyll fluorescence has great potential for measuring injury to chloroplasts.

Texture is the human perception of mechanical properties, so objective textural measurements use combinations of force, distance, and time to try to predict what people perceive. Many empirical and engineering methods have been developed for measurement of different texture attributes and of different commodities. They include the familiar puncture tests like the Magness-Taylor fruit firmness test, the Kramer shear-compression test, compression tests, bending tests, and numerous others. The most common for fresh produce is the Magness-Taylor-type puncture test, but puncture may not adequately reflect the textural attributes that determine "quality" or the changes that result from quarantine treatments.

Aroma is the human perception of certain volatiles. "Flavor" usually encompasses both taste and aroma and (in fruits and vegetables) results mainly from soluble sugars, acids, and volatile compounds. Sugars are readily measured by refractive index or by chromatographic separation of individual sugars, and nondestructive near-infrared methods are being developed. However, sugars alone do not always predict sensory sweetness scores. Acidity is measured by pH and titration. Volatiles are far more complex. Currently, most volatile research is done with gas chromatography and may not be practical for routine commercial screening of produce quality. However, an alternative method, electrochemical sniffers, is being developed. These sniffers are based on polymers whose electrical conductivity is altered by specific classes of volatiles. They are less specific than chromatographic separation but they are fast and the changes seem to relate to quality changes.

Nutritive values of fruits and vegetables are not as obvious as the previously mentioned tributes; however, they are critical to human health. It is estimated that produce contributes 90% of vitamin C (ascorbic acid), 50% of vitamin A, 35% of vitamin B_6, 20% of thiamin, and 20% of niacin. Nutritive values can be be significantly diminished through thermal abuse and potentially by other alternative disinfestation treatments. These compounds are generally analyzed by GC or HPLC.