Presiding over the symposium was P. E. Nelson, Purdue University, Lafayette, Indiana.

IMPACT OF CHANGING QUALITY REQUIREMENTS, by Amihud Kramer, University of Maryland, College Park.

CHEMICAL AND PHYSICAL BASIS OF TEXTURE IN HORTICULTURAL PRODUCTS, by Johan E. Hoff, Purdue University, Lafayette, Indiana.

THE INFLUENCE OF MULTIPLE QUALITY REQUIREMENTS ON THE PLANT BREEDER, by M. Allen Stevens, University of California, Davis.

NATURALLY OCCURRING TOXICANTS OF HORTICULTURAL SIGNIFICANCE, by Irvin E. Liener, University of Minnesota, St. Paul.

MICRO-CONTAMINATION OF HORTICULTURAL PRODUCTS, by Wilbur A. Gould, The Ohio State University, Columbus.

# IMPACT OF CHANGING QUALITY REQUIREMENTS[1]

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It is most appropriate to begin this Symposium with a definition of quality. This definition, slightly modified from one developed by a recent task force, is: *Quality is the composite of attributes that differentiate among units of a product and have significance in determining the degree of acceptability of the unit by the buyer.* Accordingly it is the buyer who dictates quality specifications. These may change in accordance with his requirements, or those of his buyer, the consumer (3). Sometimes, a quality attribute becomes less important and another, more important. It may then be necessary to introduce new standards, that is, methods of measuring the new attribute of concern. The changes may also be only of degree, so that the standard in use may be retained, but only the grade levels changed. For example, a buyer of fresh sweet corn who had been using it to manufacture cream style corn and needed a medium maturity level raw material in order to obtain the desired consistency of the end product may decide to change to the manufacture of whole kernel corn where he needs a decidedly less mature raw product. The standard, that is, the method by which maturity is tested may remain the same, but the grade changes from a more mature, starchier corn, to one that is less mature.

Let us consider another situation where the buyer decides to manufacture frozen sweet corn instead of canned sweet corn. In the canned product, the buyer could add sugar to the liquor in the can to maintain the sweetness level. In the manufacture of frozen sweet corn, where no liquor is added, he has no opportunity to sweeten the corn. Then the sweetness or sugar content of the raw material becomes important, and he does need to have a new standard by which to measure the sweetness of the raw material which he is purchasing.

Even if the buyer should continue with the manufacture of the same end product, consumer preference and other competitive pressures or new or revised government regulations may dictate changes in quality requirements. Many cases may be cited where practically the entire production of an item met top grade requirements. In order to gain some competitive advantage, therefore, grade limits were tightened in order to give the buyer an opportunity to select among several lots all of which score within the same grade.

The upgrading of quality requirements may result from the development of new superior cultivars, such as a new highsugar sweet corn. Where previously a sugar content of 4% was the best attainable, it is now possible to obtain sweet corn with a sugar content of 7 or even 8% (5).

Tightening of mandatory regulations has caused steady changes in quality levels. For example, mold count limits of some tomato products have decreased gradually from 40 to 20% positive counts during the first half of this century. More recently, with the growth of consumerism, changes in quality requirements are increasingly common. To cite just one example, DDT tolerances have decreased in just a few years from 7 ppm to zero.

### Ingredients for further processing

The standard fresh or processed fruits and vegetables are maintaining with difficulty a very slow annual production growth, and often are declining on a per capita consumption basis. Their use as components, however, in further processed foods is increasing at a very satisfactory rate (1). Such use is not new, as attested by the use of certain fruits for manufacture of ice cream and other milk and bakery products. Quality specifications vary for every one of these literally thousands of new products in which fruits or vegetables may be used as ingredients. The same raw materials used in different ways will require different sets of specifications. Certainly no one manufacturing tomato relish will be satisfied with tomatoes that

[1]Miscellaneous Publication No. 820, Contribution No. 4619 of the Maryland Agricultural Experiment Station, Department of Horticulture (Food Science Program).

would be perfectly satisfactory for pizza pies. Blueberries to be used in a baking of muffins will have entirely different specifications from those to be used in ice cream, or pie. Peas frozen in bulk, thawed, and refrozen as part of a TV dinner will differ in their raw product specifications from other peas also frozen in bulk, but then mixed with other ingredients into a canned vegetable soup.

For further processing, the raw ingredient may be peeled and/or sliced or diced, or lose its structural identity completely in the form of a slurry or juice. In such instances the usual sensory attributes of appearance, texture, and flavor may play a secondary role, while yield value and functional properties may be of major importance (4). It is of little importance to the manufacturer of whole canned tomatoes whether the tomatoes include as little as 4% solids or as much as 8% solids. If, however, the same tomatoes are to be used in catsup or paste, total solids would be of major importance. Appearance characteristics, such as size, wholeness, firmness, and flavor, would be of major importance to the whole tomato processor. For the manufacturer of catsup on the other hand, these are of negligible importance since he comminutes[2] the product. It matters little to such a buyer whether the tomatoes are large or small, whole or cracked, or even in pieces (provided they are not contaminated), whether they are soft or firm, or whether they are particularly flavorful, since in the manufacturing process, these attributes are controlled either by the process itself, or by the addition of other ingredients. Yield, on the other hand, in terms of total solids, becomes extremely important. Color would be important for both purposes.

**Functional properties**

With the rapid increase in prepared, formulated convenience foods, functional properties of raw fruits and vegetables or their components, are becoming increasingly important. Functional properties describe how the ingredient behaves when it is mixed with other ingredients and processed in a certain manner to achieve an end product (6). An often important functional property is solubility. For example, a processor may look for fruits or vegetables, which will produce a completely nutritious and tasteful whole breakfast drink when blended with other ingredients. He would require, therefore, raw materials that when comminuted and added to other ingredients, will not precipitate out, and if not entirely in a true solution, at least will be uniformly dispersed throughout the product. The raw material should probably have an iso-electric point that is not the same as the pH of the blended material.

Another important functional property is that of coagulation or precipitation as a result of heat processing or freezing. Certain starchy vegetables used in the manufacture of puddings, sauces or pie fills, may or may not be acceptable depending on this property of their starches.

Water binding properties of raw fruits or vegetables or their components, including the pectin content, and its degree of methylation and esterification, as well as the quantity and nature of the starches would contribute to the degree of thickening, or gelling of the end product.

Other functional properties that may determine the suitability of raw materials for specific purposes would be their whipping and emulsifying properties, both from the standpoint of quantity and stability.

It should be noted that such functional requirements may or may not be met by the part of the plant that is commonly used as food. However, other parts of the plant also may be useful for such special purposes, thereby enabling a more complete utilization of the raw plant material. An obvious example is the use of citrus and apple wastes for manufacture of pectin. A more recent development is the utilization of waste plant materials, particularly tomato wastes, for use as high protein foods.

**The institutional market**

The institutional market is for food prepared for immediate consumption by a group larger than one family and includes schools, hospitals, military installations, and other institutions, as well as restaurants. This market for centuries was fairly stable, and was relatively small part of the total market for raw foods. In the last few decades, however, it has grown immensely so that now it constitutes about half of the total market for raw foods or ingredients. While the institutional market requirements may not vary appreciably from those of the household consumer, the quality attributes desired may vary substantially not only between those of the retail buyer and the institutional buyer, but also among different types of institutions. In general, the institutional buyer should, and in many instances does, pay more attention to product yield and nutritive value, and less attention to its appearance. As a larger buyer, he may test more thoroughly the quality attributes of interest to him. With no changes in grades and standards, the institutional buyer should and frequently does take advantage of lots of raw material that are of a poorer grade only because of superficial appearance. For example, the institutional buyer of potatoes has the opportunity of buying jumbo-sized potatoes which will provide him with a better yield, and pay less for them than the retail buyer who insists on US 1 Grade potato. Another attribute which is of considerable importance to the institutional buyer is that of uniformity. Imagine what might happen if in a mental or correctional institution each patient or inmate in the dining room was served for dessert with one banana varying considerably in size from portion to portion.

**Synthetic foods**

The tremendous increase in the variety and total volume of the so-called synthetic foods must of necessity cause increasing competition with natural fresh fruits and vegetables and their products (2). Of course these foods are not actually synthesized from raw inorganic materials, but usually are fabricated from refined ingredients that were produced initially by photosynthesis, or the ingredients entering these synthetic foods may be fermentation products produced by microorganisms using both organic and inorganic substrates. In any event, such products are already on the market, many of them very successful imitations of the real natural products. Because of the method of manufacture of these products, their sensory quality, as well as their nutritive value can be controlled precisely. Raw materials for manufacture of such commodities may be far less expensive than the natural raw ingredients. For example, they may include the waste, or by-products of natural processed foods. It is entirely possible to produce an imitation synthetic product that is certainly more uniform, and perhaps of higher sensory quality than the natural product. Although it is still difficult to imagine the manufacture of a snythetic pear with the quality of a real pear, synthetic cherries produced from pectin, calcium, and synthetic coloring and flavoring are being produced and utilized successfully in manufacture of such products as fruitcake and ice cream. The challenge in this instance is to produce better quality, more nutritious raw fruits at competitive prices.

**Natural or organic foods**

Any discussion on foods at this time cannot ignore the existence of the organic, or natural, food movement which has already exceeded the one billion dollar sales level. It is not necessary at this meeting to point to the inherent fallacies and excesses perpetrated by the suppliers of such products on an ill-informed, misguided public. This movement, however, cannot be ignored, and the producer of raw fruits and vegetables as well as the grower of any food commodity is faced with the choice of producing an inferior quality product and selling it at a high price, thereby taking advantage of the ignorance of the consumer, or lending his support in educating the consumer to the real situation.

From a practical standpoint, the major problem of the supplier of such organic foods is that he is caught right in the middle of two conflicting sets of quality requirements. On the one hand, to produce organically grown products, he cannot possibly meet not only permissive but also mandatory requirements of quality (e.g. insect fragments, mold counts). If he attempts to meet such rigid mandatory requirements (e.g. zero tolerance for insect fragments) his gross yields will be minimal, and labor costs of cleaning up such poor quality raw material without the use of any chemicals must raise the price of the eventually inferior product very substantially.

[2]Comminute, to break up or shatter into small pieces.

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