Chapter 15
Breeding Tomato for Quality and Processing Attributes

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15.1 Introduction

Once considered inedible, the tomato has become one of the most popular and extensively consumed vegetable crops, with an annual world production approaching 61 million MT (FAO Production Year Book 1986). In the U.S.A. alone the extent of consumption is such that as a fresh commodity and as processed product tomato represents a major vegetable source of essential nutrients (Rick 1978). In addition, to raw tomatoes which are eaten directly as a raw vegetable or added to other food items such as salads, sandwiches and other forms of fast food, a variety of processed products such as paste, whole peeled tomatoes, diced products, and various forms of juices and soups are increasingly gaining acceptance. The tomato products juice, catsup, sauce, soup and paste have become an integral part of the diet. The improvement of the tomato through breeding for nutritional quality and processing attributes is being vigorously pursued worldwide.

15.2 Fruit Quality

Total dry matter generally comprises 4% to 7.5% of the fresh weight of the commercial tomato fruit. The soluble and insoluble solids account for approximately 75% and 25%, respectively, of this total dry matter. The major components of the soluble solids are the reducing sugars, glucose and fructose, which comprise approximately 50% of the total solids and 65% of the soluble solids. Sucrose is present in very small quantities, generally less than 0.1% of the fresh weight. The remaining soluble solids are composed of organic acids, lipids, minerals, pigments, volatiles, etc. The insoluble solids include protein, cellulose, pectic substances and hemicellulose (Davies and Hobson 1981).

Fruit quality in regard to flavor is an important consideration in tomato improvement programs. Since perception of flavor is a result of sensory and visual stimuli, which is highly subjective, evaluation by taste panel to quantify the importance of individual quality attributes should precede improvement efforts to define the relative importance of each (Tigchelaar 1986).

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Monographs on Theoretical and Applied Genetics 14
Genetic Improvement of Tomato (ed. by Prof. Kalloo)
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In processing tomato breeding, the improvement of raw product quality has long been of prime concern. However, it is essential that a processing cultivar have equal or better yielding ability and, more recently, suitability for once-over machine harvest. Organic acids and sugars become critical constituents of flavor and other quality determinants in tomato fruits. Acidity influences the storability of processed tomatoes and tomato products by inhibiting the spore germination of thermophilic organisms. If a fruit sample has a pH above 4.5 and below 0.35 g citric acid/100 g of fresh weight, it is commercially undesirable as it would require increased processing time and temperature to avoid spoilage. Soluble and total solids are related to yield of concentrated tomato products and yield of certain processed products are determined by sugar content of fruit (Hewitt and Garvey 1987). The major component of total solids are sugars, which also influence flavor. A primary determinant of tomato flavor is the ratio of sugars to acids. High-soluble solids have been shown to be highly correlated with tomato-like flavor (Lambeth et al. 1964; Stevens et al. 1977). Stevens et al. (1977) found that fructose and citric acid are more important to sweetness and sourness than glucose and malic acid, respectively. They also observed that pH was a better objective measure of tart taste than titratable acidity.

Insoluble solids, the second important component of total solids, are made up of proteins, pectins, cellulose and polysaccharides. Insoluble solids determine the viscosity, and polygalacturonides are the major component of insoluble fractions that determine viscosity. Quality of tomato juice, catsup, sauce, soup and paste are influenced by viscosity of the product. Processed product consistency and the amount of raw product required to achieve a desired consistency is influenced by the viscosity potential of the raw fruit (raw product). For tomato products that are sold on the basis of solid contents, the higher the solids of the raw product, the greater the value of crop yield. For example, an increase in solids of 1%, as from 5% to 6%, represents a 20% increase in yield for products whose processed product yield is directly influenced by solids constituent.

Nutritional Value

Although the percentage composition of vitamin A and vitamin C are not high in tomato, by virtue of the amount of fruit consumed, the tomato ranks high as a natural source