The Future of Quality

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Abstract

Looking back twenty-one years when the Georgia Postharvest Team started its work that help lead to these conferences, much has changed. In the world of fruit and vegetable quality the most significant changes have been the introduction of fresh-cut products with many more pre-packaged items, the promise and lack of adoption of irradiation and GMOs in the marketplace, and a much more consumer-driven market. We predict that the next 10-20 years will see less total consumption of fresh fruits and vegetables with less emphasis on fresh and natural products, less emphasis on extended shelf life and low prices, fewer bulk items, and less interest in postharvest physiology and low-cost crop production. During the time there will be a similar emphasis on convenience of fruit and vegetable products and Purchase Quality. We also expect to see more emphasis on Quality of the products, particularly Consumption Quality and Value, with more local production and technological innovations to deliver fuller flavour, and research emphasising preharvest factors in postharvest quality as well as sustainable production to lessen undesirable impact to the environment.

If this series of conferences retains its triennial cycle, it will be interesting to review these predictions at the 2012 and 2021 conferences, possibly back here in Wageningen. We suspect that some of these predictions will be on target while others miss the mark completely. What is important is that we learn from the past, realise that extrapolating into the future solely from present circumstances is almost always inaccurate, and that flexibility to changing circumstances is a hallmark of success.

INTRODUCTION

There is great danger in attempting to predict the future, because typically the general assumptions made are in error. The marketplace rewards those who are able to anticipate consumer demands and exploit them. The marketplace also punishes those who are either too early or too late to anticipate these trends. This chapter seeks to learn from the past to anticipate future trends in the quality of fresh fruits and vegetables. Its true value will not necessarily to be right when judged ten years from now. Rather it will be to challenge the reader to think about the future and attempt to learn from the past.

MegaTrends 2000 listed ten trends that were to shape America and influence the rest of the world (Naisbitt and Aburdene, 1990). Of most interest here were the predictions of (1) "The Global Economic Boom of the 1990's", (6) "The Rise of the Pacific Rim", and (8) "The Age of Biology". The extended boom of the 1990's was a reasonably accurate prediction as was the rise of the Pacific Rim, although the authors failed to predict the collapse of Asian economies. They did anticipate opposition to genetically modified food products, but they were confident that the molecular biologists would triumph. Their prediction may come true, but, if it does, it will be later than anticipated. In a more recent volume focused on Asia, Naisbitt (1996) proclaims that "Asia will become the dominant region in the world: economically, politically and culturally." Of the eight megatrends described, four have direct relevance to fruits and vegetables: (3) "From Export-Led to Consumer-Driven", (4) "From Government-Controlled to Market-Driven", (5) "From Farms to Supercities" and (6) "From Labor-Intensive to High Technology". Again, no indication of a downturn in the Asian economy was noted, but the drive to adopt perspectives, techniques and technologies common to Europe and North America is becoming more evident. If Naisbitt is right, those of us in
the northwestern quadrisphere must continue to advance in these areas, particularly in becoming more consumer-driven and adopting high technology, just to keep up.

Strauss and Howe (1997) indicate in *The Fourth Turning* that the reason so many predictions about the future are in error is that most prophets extrapolate the future from the present and immediate past assuming a linear progression. In this book history is presented as a cyclical process based on the recurrence of a four-generation hierarchy. Their view of history describes a “turning” as one generation supplants another, and different values prevail. They predicted that a cataclysmic event would occur early in the 21st century that would lead to a world crisis (probably a major war fought to a decisive end) and a major shift in perspective and policy. The events of September 11, 2001, certainly fit their catalysing event in this scenario with major attitudinal change in the United States and a more sceptical Europe looking on. A major war involving many nations would certainly disrupt global trade in fresh fruits and vegetables and require major changes in the way they are marketed and distributed.

In *The Future of Life*, Wilson (2002) suggests that we need to look at a horizon of 50 – 100 years into the future. He argues that we are letting short-term economic interests direct public policy with long-term consequences to the environment. Current economic analyses of building and production activities frequently do not take environmental costs into consideration. Current generations are depleting the natural resources that future generations will need to survive. He takes an optimistic view that governments will recognise their responsibilities in maintaining biodiversity and steer a middle course between unconscious development and environmental extremism. His suggested solution is still rather radical for the American mind but should be received with much more sympathy in Europe. Among his predictions is a huge increase in demand for imported food for China accompanied by a decrease in grain consumption with a requisite increase in fruit and vegetable consumption.

**RETROSPECTIVE**

In 1982 a Postharvest Team was established at the University of Georgia Experiment Station in Experiment, Georgia, USA. Its mission was to apply a systems approach to understanding the quality of fruits and vegetables during postharvest handling. It featured a mobile laboratory that could go on sight to the field and trace changes in quality to the processing plant (Prussia and Tollner, 1984). It quickly shifted from frozen southern peas (Prussia and Shewfelt, 1985) to fresh-market items such as snap beans (Shewfelt et al., 1986) tomatoes (Campbell et al., 1986; Shewfelt et al., 1987), peaches (Jordan et al., 1987a; Thai and Shewfelt, 1990), and lettuce (Muttiah et al., 1988). Along the way the team identified the interfaces (1) between the field and the packinghouse and (2) between the retail outlet and the consumer as the two most critical, unexplored areas of postharvest research. While little was achieved at the first interface (Brennan and Shewfelt, 1989; Beverly et al., 1993), many studies focused at the second (Shewfelt et al., 1989; Malundo et al., 1995, 1997, 2001a,b). The major contributions of the Team effort were to (1) introduce a systems approach to an understanding of postharvest handling of fruits and vegetables (Prussia et al., 1986; Prussia and Hubbert, 1991), (2) champion a consumer orientation to fruit and vegetable quality rather than the prevailing product orientation (Shewfelt 1987, 1990) and provide an economic component to postharvest research (Jordan et al. 1985, 1986, 1987 a,b, 1988). The Team’s effort culminated in a book that summarised its findings and perspective (Shewfelt and Prussia, 1993).

Later a concerted effort on fruit and vegetable quality was initiated in Europe with a strong emphasis on modeling (Singh and Oliveira, 1994). One of the leaders in this effort was at Wageningen. Key contributions of this research included development of mathematical and conceptual models of consumer preference (Steenkamp, 1987; Linnemann et al., 1998), keeping quality (van Doorn and Tijskens, 1991; Tijskens and Polderdijk, 1996; Tijskens et al., 1997; Schouten et al., 1997), chilling injury (Tijskens et al., 1994), and colour changes (Tijskens and Evelo, 1994).
In the 1990's, as part of a peace dividend at the end of the Cold War, a research institute was established at Grossbeeren, Germany. Among many project initiatives, it pursued both interfaces deemed critical by the Georgia Team. It has provided leadership in identifying and studying preharvest factors that affect postharvest quality for lettuce (Linke et al., 1996), tomato (Auerswald, 1996; Peters et al., 1998; Veit-Kohler, 1999) and radish (Schreiner et al., 2002). In addition it has provided new insight on the sensory quality of tomatoes (Krumbein and Auerswald, 1998; Auerswald et al., 1999).

Interaction between the Georgia Postharvest Team and the Institute at Grossbeeren led to an international conference in Potsdam, Germany, in 1997. The conference focused on a more integrative approach to quality and value changes in fruits and vegetables in the postharvest distribution chain and provided a set of terms to help standardise communications (Shewfelt and Bruckner, 2000). This conference was followed three years later in Griffin, Georgia, USA, with a broader perspective on fruit and vegetable value and quality (Florkowski et al., 2000). Another three years elapsed before the current conference in Wageningen, The Netherlands, with its emphasis on quality in chains.


Since the Postharvest Team was established, many changes have occurred in our world. We have seen the end of the Cold War, the dissolution of the Soviet Union and conflicts in the Persian Gulf, Bosnia-Herzigovnia, Kosovo and many parts of Africa. The Internet, mobile phones, fresh-cut fruits and vegetables, and Wal-Mart have all appeared and taken root in our societies.

Seven issues that were critical to the fresh produce business in 1982 were:

1. Purchase and use of computers in a fresh produce operation to keep track of orders, distribution, accounting, invoicing and market trends,
2. Adoption of irradiation for insect control, potato sprouting and shelf-life extension,
3. Eradication of the Medfly,
4. Prevention of postharvest food losses,
5. Use of shrink-wrap to extend shelf-life of fresh fruits,
6. Promotion of agricultural crops to consumers, and
7. Increasing exports of fresh fruits and vegetables.

In the intervening years many changes have occurred. Distributors of fresh fruits and vegetables have become much more sensitive to consumer wants and needs leading to a consumer-driven marketplace. Fresh-cut items have gained popularity with cut vegetables exceeding initial expectations in sales while cut fruits have not reached early projections. Genetically modified organisms have appeared on the scene with vigorous opposition in Europe and other parts of the globe and indifference in America. GMOs have been more successful as ingredients in formulated products such as soy and corn than in whole fruits and vegetables such as the tomato. Formulated foods and combination meals are replacing whole, recognisable foods. With advances in transportation and distribution schemes, more exotic items are available and availability extends for longer periods of the year.

A search of the scientific literature via Science Citation Index reveals interesting trends in publications. The number of publications in postharvest research steadily increased in the decade of the 1980's, but has declined since the early 1990's (Figure 1). The percentage of those articles that had a quality component has remained relatively constant at about 20%. A similar trend was observed in studies with a consumer component (Figure 2). The peak in interest also came in the early 1990's with a decline in published articles on consumers in the latter part of the decade. Studies of consumer attitudes represented greater than 10% of consumer articles between 1986 and 1993, but declined rapidly after 1994. The numbers of articles looking at consumer acceptability or acceptance have remained reasonably constant over the 20-year period.

Seven issues that are considered critical to the fresh produce business today are:

1. Centralisation of purchasing of perishables by different supermarket chains,
2. Prevention of accidental contamination with food-borne pathogens,
3. Biosecurity of crops throughout the distribution chain,
4. Antioxidant properties and other health benefits of fresh items,
5. Growing problems with obesity,
6. Market research to determine consumers wants and needs, and
7. Increasing dominance of one supermarket company world-wide.

QUALITY TODAY

If we are in a truly in a consumer-driven market, then it is important to learn what the consumer wants with respect to quality (Shewfelt, 1999). In a series of electronic chats Henderson (2002) found that quality was very important to fresh fruit and vegetable consumers in the U.S. Flavour and texture are the main factors leading to consumer dissatisfaction of fresh fruit. Appearance of vegetables, in addition to flavour and texture problems, is a major source of dissatisfaction of fresh vegetables. Distributors should provide fresh fruit that has been harvested at a more advanced state of maturity and a wider variety of cultivars with varying sensory properties to meet consumer needs. He also concluded that better means of communicating proper handling techniques is needed as many conscientious consumers are making poor decisions in home produce storage. It will be imperative for suppliers of fresh produce to global markets to develop consumer-friendly specifications for their products and develop a wider range of choices for a single item analogous to those available to apple consumers (Shewfelt, 2000). Also, the market must become more sensitive to the needs of the home purchasing agent (Shewfelt et al., 2000).

Retail outlets are featuring a wide range of produce items from the traditional bulk merchandising to packaged whole items to fresh-cut products. Many of the fresh-cut items are packaged with accessories such as salads with croutons, broccoli and cauliflower with cheese packets and apples with caramel sauce. Each item is carefully packaged within a larger package for minimal preparation upon opening. Trends towards fresher, more natural and more convenient are apparent. Wholesale warehouses are trans-shipment points that have more storage conditions available for different commodity types with short turnover times from receipt to delivery.

Sales of fresh items are increasing at the expense of traditionally processed products. Minimal processing of items is still flourishing for fresh-cut vegetables while fresh-cut fruits are still not reaching earlier projections of production due to flat sales. Transportation is becoming more efficient with some partitioning of storage conditions in loads to meet the requirements of certain commodities.

Mechanical harvesting of fresh produce is becoming more sophisticated for items that can withstand the mechanical damage it can inflict, but many crops are still hand-harvested with the help of mechanical aids for workers. Crop production still seeks better yields with as the primary interest in quality the selection of suitable cultivars. The ability of a cultivar to withstand shipping and storage as well as appearance factors are still more important than flavour.

In 1982 the fresh produce industry was not all that interested in how the consumer defines quality. In 2002 consumers define quality differently for different fruits and vegetables, but they have clear expectations for flavour, texture and appearance for each item, and they are demanding better performance from distributors (Henderson, 2002).

THE FUTURE OF QUALITY

This chapter will show a bias to an American perspective on the future of quality as that is where the experience of the authors has been gained. Some consideration will be given to the European point of view from a vantage point across the Atlantic Ocean. With a more global economy, however, there appears to be a homogenisation of attitudes toward fruits and vegetables in U.S. and Europe. The perspective for the remainder of the chapter is that some trends are linear while others are cyclical. While it is typical to think of the present as a crossroads, it is not a useful analogy as many factors influence a path
that tends to set a course between two extremes. We see seven future trends beginning to develop that will affect the future of fruit and vegetable quality. We suspect that these trends will become evident over the next ten years. We have adopted a perspective that certain things will be de-emphasised while others will receive more emphasis. We do not see complete reversals of what is occurring today.

LESS total consumption of fruits and vegetables and MORE emphasis on Quality

There has been an unprecedented growth of fruit and vegetable consumption in recent years, but we don’t expect this trend to continue. The American generation that is completing young adulthood and entering positions of leadership, popularly known as Generation X, is notoriously known for low vegetable consumption. Despite the Five-a-Day campaign in the U.S. and similar campaigns in Europe, we predict that more consumers will prefer dietary supplements to meet their phytochemical needs with less interest in whole foods. Vegetables will still be ingredients in mixed meals like pasta dishes, but they will become less available in meals as separate side dishes or in simple salads. Nutrition will cease to be a major reason for consuming fresh fruits and vegetables. While the loss of consumption will come in volume on the mass market, fruits and vegetables will become more of a high-value specialty item where Quality is valued and where fruit and vegetable consumers are better able to judge Quality. Along with improved Quality, consumers will demand safe product that is free of contaminants whether accidental (food-borne illness) or deliberate (bioterrorism). Safety will still be associated with reduced levels or total absence of pesticides, absence of contaminants will be much more important. Distributors who can provide consistently high-quality produce with a guarantee of safety will predominate over those who produce for the mass market.

LESS emphasis on fresh & natural the SAME emphasis on convenience and MORE emphasis on Local Production

Fresh and natural have become hallmarks of high-quality product that they are used and abused in in-store merchandising and in advertising campaigns. While still ideal concepts, the abuse of the terms is rendering them almost meaningless to the consumer. As fruit and vegetable consumers become more sophisticated and more Quality-oriented, they will be less likely to be swayed by appeals to nebulous claims of freshness or naturalness. Despite the Slow-Foods movement (Sicotte, 2002; Miele and Murdoch, 2002), consumers will still expect convenience in their products such that food preparation will not interfere with their busy lives. With the threat of interrupted supplies in a growing uncertain global market due to the increased threat of regional conflicts, there will be greater incentive to produce more food locally to reduce dependence on imported crops. By taking advantage of shorter, but very efficient, distribution patterns, Quality will become associated with product grown closer to the point of consumption.

LESS emphasis on shelf life, the SAME emphasis on purchase quality but MORE emphasis on Consumption Quality

A driving force of shelf-life extension has dictated American distribution in recent decades, while the European consumer has been more sophisticated in this area. As we turn from a product-driven market to a consumer-driven market, a long shelf life will be considered a negative attribute for a product (Shewfelt, 2000). Purchase quality (those attributes related to aiding in the buying decision such as colour and firmness-to-the-touch) will still be important, but this signal will be superseded by a demand for better Consumption Quality (those attributes leading to satisfaction during eating such as flavour and mouthfeel) (Shewfelt, 1993). As American consumers of fresh fruits and vegetables approach the sophistication of their European counterparts, terms like fresh and natural and other heuristics like Purchase Quality attributes will be superseded by a true appreciation of flavour.
LESS concern about price and MORE emphasis on Value

As fruits and vegetables become more of a specialty item and less aimed at the mass market, sophisticated consumers will be willing to pay more for higher Quality. Value is defined as the price the market assigns to a product based on its quality and other factors (Florkowski, 2000). Once again consistency of Quality will be critical as consumers will not be forgiving to distributors of items that do not meet their Quality expectations. In addition, consumers will be demanding more information on best storage practices within the home and will be looking for more options than are available in a home refrigerator. While some research has been conducted in this area (Hall, 1979; Evans, 1992; Ismail and Wilhite, 1992; Maney, 1992; Baez-Saundo et al., 1994; Shewfelt et al., 2000), much more work needs to be done to maintain Value in the home. Once again, maintaining high Consumption Quality for a short time is more important than extending shelf life of acceptable Purchase Quality for a long time.

LESS attention to bulk products but MORE emphasis on Technological Solutions

Despite the environmental toll of increased food packaging, consumers will become more wary of bulk merchandise associating it with mass-marketed, less-convenient, lower-priced, lower-Quality product and will expect pre-packaged product with specially handled, more-convenient, higher-priced, higher-Quality product. Technology will be more accepted on both sides of the ocean. Irradiation and genetic modification will probably never receive widespread acceptance, at least in Europe, which may doom these technologies world-wide, but similar campaigns against future technologies are less likely to be effective. Future leaders of Generation X in America and the voters are more likely to evaluate issues on their merits and less likely to evaluate them on emotional appeals of either the left or the right (Strauss and Howe, 1997). We suspect that similar patterns will develop in Europe, particularly if rejection of these technologies will lead to decreased availability of desired products. With increased sophistication of consumers who can recognise true fruit and vegetable flavour and increased sophistication of food processing techniques, any technique that can deliver improved Consumption Quality with Convenience will be accepted. These new solutions may be as simple as improving techniques for fresh-cut product to those that employ novel thermal or non-thermal processes to produce currently unimagined products. To be accepted these technological solutions will need to focus on maximising flavour even at the expense of extended shelf-life, requiring a paradigm shift for most food scientists and postharvest physiologists.

LESS emphasis on postharvest physiology but MORE emphasis on Preharvest Factors

Much of our current distribution system for fresh fruits and vegetables is attributable to advances in research in postharvest physiology, pathology and technology. As critical as we occasionally are about the current distribution of fresh fruits and vegetables, the availability of a wide range of items year round at reasonable prices of acceptable quality should not be underestimated. As important as Quality in Chains is today, it will gradually lose importance in fruit and vegetable research relative to gaining a better appreciation of the preharvest factors that affect postharvest Quality. We now have a good idea of what needs to be done within the postharvest system to maintain Quality of products from harvest to consumption. Implementation of these factors is the main need at present. Biological variation from batch to batch and location to location has been clearly documented (Tijskens et al., 2003). Growers and distributors who can exploit these differences to meet market demands for increased Consumption Quality will be rewarded, while those who are unable to exploit them will be punished (Shewfelt, 2000). Integrating Quality factors across the critical harvest step is the next major frontier of fruit and vegetable research. This task must extend past judicious selection of cultivars to effects of fertilisation, salinity and other soil conditions, irrigation, temperature-stress conditions, and any other factors that could affect postharvest performance. While articles
have addressed these factors (Beverly et al., 1993; Johnson and Ridout, 2000) and some
research has been conducted (Auerswald, et al., 1996; 1999; Veit-Kohler et al., 1999;
Schreiner et al., 2000; 2002) we still have little true knowledge of the mechanisms of
these interrelationships.

LESS emphasis on low-cost production and MORE emphasis on Sustainable
Production
While we believe that the 50-100 year outlook (as Wilson, 2002 recommends) is
unrealistic for democracies to seriously consider, governments will begin to insist on
better accounting of longer-term (5-10 or even 10-20 year) costs to the environment.
While crop-production costs will be important for grower survival, more restrictions on
production for greater sustainability of crops will be implemented. Regulations are more
likely to take the form of tax incentives than strict controls. Economic realities will also
exert a strong influence on the type of crops grown and the methods used to produce the
crops. Inputs such as agricultural chemicals, water and energy will become more
expensive thus spurring innovation of reducing these inputs while still maintaining crop
yields and improving Consumption Quality. Additional costs are likely to be passed to the
consumer in higher prices. Europe is far ahead of America on this score now, but both
continents will need to come to terms with new realities soon.

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Figure 1. Publications with a keyword of 'postharvest' and the keywords 'postharvest' plus 'quality'
Figure 2. Publications with a keyword 'consumer', 'consumer attitudes', and 'consumer acceptability' or 'consumer acceptance'