

CONSUMER RESPONSE TO APPLES

Roger Harker

HortResearch, Private Bag 92169,
Auckland, New Zealand
rharker@hortresearch.co.nz

I. PRICE AND DEMAND

“Why do consumers buy apples?” and “How can we get them to buy more?” These are key questions facing the apple industry. The answers are far from simple and require us to consider eating quality, as well as the beliefs, attitudes and perceptions of consumers. This is the first of three articles that summarize the results from a review of the literature on consumer responses to apples. The Washington Apple Commission and Washington Tree Fruit Research Commission jointly funded the review.

Economists study the influence of price on consumer purchases of apples using supermarket sales data. As the price of apples increases, consumers tended to substitute their purchases of apples with purchases of other fruit such as oranges and grapefruit. These results remind us that we are competing not only against other apple producing regions/countries, but also against producers of all major fruit crops. However, for many consumers apples are habitually purchased items that respond very little to changes in price, but are relatively sensitive to income. More detailed examination of individual families indicates that the proportion of the household budget usually spent on fruit, and the price of apples on a particular shopping trip can explain the amount of apples purchased. To some extent cultivars compete with each other. As the price of one apple cultivar increases, some consumers tend to substitute it with another, less expensive cultivar. For example, Golden Delicious and Fuji tend to substitute for each other.

One study was able to characterize the relative importance of price compared to other factors (consumer perceptions and behavior, as well as eating quality) that influence consumers' choice of apples. Their results suggest these other factors are far more important than price. Demand (sales) for apples can be stimulated by decreasing the retail price or by increasing consumer choice (Table 1). A 1% decrease in price will only result in approximately 1% increase in sales. However, if we improve fruit quality and consumer attitudes towards apples by just 1%, then demand for apples could increase by 12% to 59% depending on cultivar.

The apple industry spends considerable sums of money trying to influence consumer perceptions of apples through promotion and advertising. However, when you ask United States consumers why they buy apples, about 70% reply that it is for the eating quality (flavor, taste, texture). This is an important finding as it suggests that consumer demand for apples can be stimulated through improvements in eating quality. Growers and packers, therefore, can have a direct influence on demand by growing, harvesting, and storing apples in ways that optimize eating quality. In Section II—Eating Quality, we will examine which characteristics of apples influence consumer perceptions of eating quality.

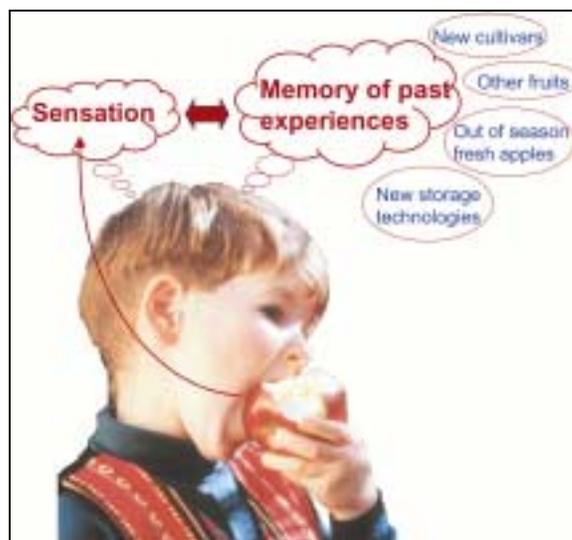
Table 1. Consumer demand for apples can be stimulated by a decrease in price or an increase in consumer preference.

Percentage Increase In Consumer Demand For Apples		
Variety	Due to a 1% decrease in price	Due to a 1% increase in preference
Red Delicious	1.13%	12.5%
Fuji	0.97%	26.2%
Gala	1.43%	59.5%
<i>Patterson and Richards (2000) USA</i>		

II. EATING QUALITY

So how do consumers judge apple quality? The per capita consumption of apples is relatively low, which means that for most consumers there is a gap between sequential eating experiences. Therefore, memory must play a part in their judgment of quality. Consumers can remember previous taste experiences, and compare the apple they are eating with this specific memory or 'engram' for apple taste. However, some memories are erroneous and may create unrealistic expectations. For example consumers tend to exaggerate both extremely good and extremely bad experiences—this is also relevant to tastes. Furthermore, people lose their taste sensitivity as they age, so they may never again experience the pleasure of the perfect apple they ate one day in 1950.

Over the past decade there have been some major changes in the marketplace that are likely to have resulted in an increasing expectation of the eating quality of apples (Figure 1). So even if the quality of our apples remains the same, outside influences are driving up consumer expectations of apple taste. Perhaps the most important question is – what happens when people have a bad eating experience? According to an Australian study, 58% change cultivar, 31% purchase fewer apples, 24% switch to other types of fruit, 17% stop buying for a while, 10% change to higher priced apples, 5% switch brands, and <1% change to lower priced apples.



Eating Quality (Texture, Taste and Flavor)

The texture, taste, and flavor of apples define eating quality. Texture relates to the mechanical properties of the apple flesh, mouthfeel, and juiciness. Words that are often used to describe different textures include: crisp, tough, soft (mechanical properties); mealy, floury, webby (mouthfeel properties); and initial and sustained juice release during chewing (juiciness). Taste properties that apply to apples include sweetness, acidity, and astringency. Flavor is closely associated with aroma, and is detected when a small gust of air carrying volatiles is pushed upwards out of the nose by the action of swallowing.

All consumers have preferences for different combinations of texture, taste, and flavor. Scientists have attempted to determine how consumers differ in their preferences for apples using a method called consumer preference mapping. Generally, consumers fall into two major

groups: those that like a sweet hard apple, and those that like a juicy acidic apple. Research in the UK has demonstrated that consumers express preferences for crispness and juiciness combined with moderate acidity and sugar content (cultivars such as Empire, Braeburn, Jonagold, Cox, Fiesta), there is a strong preference for hard 'fresh' tasting, highly acidic fruit such as Granny Smith, but cultivars with lower acidity and lower sugar content are less popular (Red Delicious, Golden Delicious, Gala). In a preference map one often finds a small group of consumers that tend to go against a predominant trend. For example about 20% of consumers over the age of 60 indicate they prefer softer rather than firmer apples.

Can We Use Our Knowledge of Consumers To Improve the Quality of Apples

Knowledge of consumer preferences for apples is of little use unless they can be interpreted in terms of instrumental measurements. This is necessary since fruit are inherently variable products (even apples growing beside each other on the tree can differ in quality) compared to processed foods and beverages. Thus multiple measurements are required to define quality of a line of fruit. Generally scientists have tried to use measurements of firmness (puncture force), soluble solids content (SSC), and titratable acidity (TA) to define quality. More recently industry has been attempting to use non-destructive measurements such as those based on acoustic properties of fruit and near infrared spectroscopy (NIR).

The measurements used to determine consumer acceptability are the same measurements used to assess harvest maturity and physiological condition of apples. This presents an immediate problem in that the same results can be interpreted differently. For example, an apple that measures 16 lb firmness could be interpreted as being an immature, unripe fruit that will be disliked by consumers, or conversely a ripe, crisp fruit that will be highly liked. Therefore, it is necessary to determine whether the fruit is ripe or unripe (mature or immature) before attempting to use any instrumental measurements as predictors of fruit acceptability to consumers. If the fruit is immature or unripe, consumers will probably dislike the product regardless of what instrumental measurements suggest. The starch pattern index (SPI) is one measurement that can discriminate between ripe and unripe (mature and immature) fruit, which is not ordinarily thought of as a predictor of taste texture or flavor. As long as the fruit are mature and ripe (i.e., contain no residual starch) the relationship between some instrumental measurements and consumer acceptability is relatively good.

Most published research focuses on the relationship between acceptability and firmness of apples. There is now consensus that firmness as measured by a penetrometer is a good predictor of consumer preferences. The number of consumers that reject apples rapidly declines as the firmness increases to about 13 lb. However, even at 13 lb most consumers consider the apple to be mediocre in quality and only slightly liked. It is not until the firmness reaches a value of about 15 lb that consumers responded positively, scoring texture as being "moderately liked" to "very much liked".

There has been less work on the relationship between SSC and TA and consumer responses to apples. However there is evidence that both are important predictors of consumer acceptability. It is well known that some consumers like sweet, high acid (tart) apples while others like sweet, low acid (sweet) apples. Sensory studies have shown a close relationship between TA and acid taste in apples. However, the relationship between TA and consumer acceptability is cultivar specific and there is insufficient information to make recommendations. SSC is a measure of sugar content of a liquid, and has been a good indicator of acceptability of juices and many

fruits, but not apple. Sensory research has shown that the relationship between sweetness and SSC is much poorer than the relationships between texture (e.g., ‘crispness’) and puncture force or ‘acid taste’ and TA. The reason for this may be associated with the presence/absence of particular flavor volatiles that enhance the perception of sweetness. However, SSC may still have an important role in predicting consumer acceptability because it indicates the overall condition of the fruit. A fruit that is high in SSC probably accumulated high levels of starch and other nutrients during the growth on the tree. Thus it may be a better fruit in terms of having a better physiological capacity to generate volatiles as well as having high levels of sugars and acids. Published recommendations on minimum SSC for apples are between 12% and 14%.

In summary, there is good evidence that consumer satisfaction can be improved by ensuring apples sold in the marketplace are moderate firmness and have a good soluble solids content. However, consumer choice of apples is often influenced by other factors such as attitudes to health. These factors will be considered in Section III—Beliefs, Attitudes and Perceptions.

III. BELIEFS, ATTITUDES AND PERCEPTIONS

Importance of Familiarity on Consumer Choice of Apples

As an industry we know that some regions within the domestic market and particular countries within the export market seem to require a very specific mix of cultivars. It seems that ethnic differences in tastes need to be understood. However, the scientific data shows that generally peoples of all ethnicities have similar taste sensitivities, and that their choice and preference for foods is influenced by their existing diet and familiarity with various types of food. In some cases, choice of food is influenced by cultural considerations. For example, Polynesian consumers’ opinion of an apple slice product was not influenced as positively as New Zealanders’ by advertisements that the product was for use when ‘on the move’. This was possibly related to Polynesian attitudes towards eating in public.

A study of consumers on the western and eastern seaboard of Canada indicated that people had different preferences for apples when the decision was based on appearance. Consumers on both the East and West coasts selected those cultivars with an appearance that they were most familiar with. However, when slices of the apples were tasted, the consumers from both coasts expressed similar preferences based on texture and flavor. A USA study has shown that consumers tend to retain a preference for those apple cultivars that they were served as children (Table 2). These studies indicate that consumer preferences for apples are as much based on familiarity with the fruit, as they are with ethnic and/or regional differences in taste sensitivity/preference.

Table 2. Parent’s choice of apples to serve in the home influences their children’s preferences (as determined at University).

Cultivar Served By Parents	Children’s Preferred Cultivar			
	McIntosh	Red Delicious	McIntosh & Red Delicious	Other
McIntosh	61%	5%	10%	24%
Red Delicious	0%	70%	9%	21%
McIntosh & Red Delicious	32%	18%	23%	27%
Other	21%	68%	11%	0%

Criner et al. (1995)

Attributes That Influence Consumer Choice of Apples

Perhaps the best place to start is by comparing apples with other snack foods such as potato chips, chocolate bars and cakes. Consumers that pick an apple when presented with a choice between chocolate and fruit tend to have a high awareness of health issues, while those that choose chocolate tend to focus on its sweetness and use food as a reward according to a recent study. A more detailed examination of consumer perceptions shows some key advantages and disadvantages of apples as shown in Table 3.

Table 3. Consumer perceptions of apples as a snack food.

Advantages	Disadvantages
<ul style="list-style-type: none"> • Healthy • Refreshing • No Mess/Convenient 	<ul style="list-style-type: none"> • Not Filling • Not To Share • Not Strongly Seen as a Treat
Jack et al. (1997) UK	

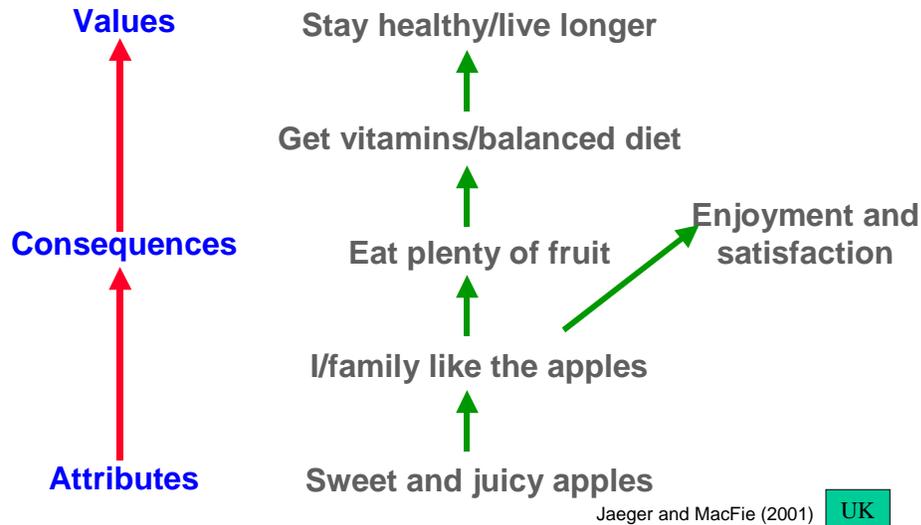
Importance of Health

The impact of health on consumers' choice of apples is well demonstrated in a study that involved detailed interviews with a group of 40 women in England. The consumers were presented with a choice of several different cultivars of apple and asked to select one. Once they had made a choice they were questioned about their reason as indicated in the following example:

- | | |
|--|---|
| Q – Why did you choose a red apple? | A – Because it is sweet. |
| Q – Why does it need to be sweet? | A – Because my children will eat it. |
| Q – Why should your children eat apples? | A – Because they should eat lots of fruit and vegetables. |
| Q – Why do they need fruit and vegetables? | A – Because they will be healthy. |
| Q – Why do they need to be healthy? | A – So that they will live a long life. |

Using this approach consumer scientists have been able to trace a pathway from attributes of apples such as color and sweetness, to consequences such as eating more fruit, and on to values such as living a long and healthy life (Figure 2). Some consumers can only respond as far back as consequences associated with factors such as enjoyment and satisfaction. However, more than 85% of consumers in the English study responded in terms of health and/or long life.

Two important messages evolve from this research. Firstly, health is a principal factor influencing consumers' choice of fruit; although it is rarely more than a subconscious influence at the time that people pick up an apple in the supermarket – we all know that fruit are healthy so we don't think about health as we make our choice of apples. Secondly, consumers see taste and texture as the key that unlocks the door to the health benefits associated with apple consumption. No matter how healthy an apple is consumers are reluctant to repurchase fruit unless it tastes good.

Figure 2. Consumer motivation (means-end chain study).

The Importance of Country of Origin

It is inevitable that industries struggling through a period of intense competition will consider the impact that a “Buy USA grown” campaign might have on sales. There is no information on the influence that country of origin information has on US consumers of apples. However, a number of international studies have considered this issue for apples and other fruits. In interviews with UK women, a quarter of participants at some point mentioned that they were motivated to buy British apples. This motivation was unlinked to the chain of motives shown in Figure 2, and needs to be compared to the 85% of participants that mentioned they were motivated by health concerns. German consumers expectations of taste of German-grown tomatoes improved when a country of origin label was used.

The Future

As the apple industry looks into the future and beyond the present difficulties, it must look for sources of information that are going to help Washington apples to remain America's preferred apples. Consumers' beliefs, attitudes, and perceptions of apples not only affect the profitability of the industry, but also affect the health of America. There is great synergy between the apple industry and the public health sector in the need to increase consumption of apples, and this may lead to new opportunities in the future. Washington apples have the advantage of being perceived as setting the standard for quality. Retailers seem happy to accept apples that meet the Washington extra fancy grade. The industry should not allow this perception to erode by allowing competitors to exceed the benchmark for quality in the marketplace. Inevitably the apple industry will need to consider the bottom line – “what are the economic benefits we will achieve through improving eating quality?” and “How much will it cost to improve quality?” Studies by economists suggest that improvement in quality will stimulate consumer demand for apples. The cost of achieving this will depend on whether the industry ends up having to throw away fruit that don't make the grade, or whether it can modify production, harvest, and storage protocols to ensure the quality of all fruit is substantially improved.

A question that might be asked is: what are the implications for research? The review confirms the emphasis on research on fruit quality currently taken by the industry. However, there is a need to streamline sources of market intelligence into a system that can more rapidly direct consumer information to those who make research decisions (both scientists and industry representatives). In many cases, information is not available for specific cultivars. In my opinion the industry needs stronger and more focused research targets. For example, one such a target might be to provide a range of products, technologies, as well as orchard and postharvest protocols that will ensure 90% of the apples exported from Washington are firmer than 15 lb by 2005. The economic viability of such a target requires all growers to have access to the tools and approaches to ensure the majority of their production meets the criteria for higher firmness. Furthermore, implementation of this hypothetical firmness criterion should not substantially increase the cost of production. As many readers of this article will recognize, such a target would represent a real challenge for both research and for industry implementation.

Recommended Reading

- Criner, GK; Kezis, AS; Cheng, H; Nord, M. 1995: Apple preferences, formulation and testing: Red Delicious, McIntosh and Empire. *Journal of Food Distribution Research* **26**: 64-71.
- Jack, FR; O'Neill, JO; Piacentini, MG; Schroder, MJA. 1997: Perception of fruit as a snack: a comparison with manufactured snack foods. *Food Quality and Preference* **8**: 175-182.
- Jaeger, SR; MacFie, HJH. 2001: The effect of advertising format and means-end information on consumer expectations for apples. *Food Quality and Preference* **12**: 189-205.
- Patterson, PM; Richards, TJ. 2000: Newspaper advertisement characteristics and consumer preferences for apples: a MIMIC model approach. *Agribusiness* **16**: 159-177.

How Do U.S. Consumers Respond to Issues Discussed in This Article?

- U.S. consumers agree that a bad apple is mealy or mushy.
- Top reasons for eating apples include:
 - Like the eating experience (64%)
 - Health/nutrition (51%)
 - Fun to eat (16%)
 - Easiest and most convenient to eat (15%).
- Only 6% of consumers gave 'best value' as one of a top three reasons for eating apples.
- 9% of consumers indicate they are eating fewer apples than two years ago. Their reasons for this include:
 - 'So many other fruits to choose from' (39%)
 - 'Poor quality' (30%)
 - 'Prefer the taste of other fruits' (31%).

(Source: Washington Apple Commission)