

Apple Preferences, Formulation and Testing: Red Delicious, McIntosh and Empire

George K. Criner, Alan S. Kezis,
Hsiang-tai Cheng, and Michael Nord

Introduction

The McIntosh is New England's traditional apple. It grows well in New England's less than ideal climate, has a distinctive tart flavor, makes excellent cider, and is a good cooking apple. Unfortunately, selected characteristics of the McIntosh in comparison to competing varieties may place it in a disadvantageous position. Consequently, the New England apple industry continually considers new apple varieties for production. One such variety is the Empire apple, which, due to its taste and other characteristics, is worthy of sensory research.

Objectives

The objectives of this paper are to review the results of a series of taste tests involving McIntosh, Red Delicious, and Empire apples. Several hypotheses regarding apple preferences will be discussed and tested. Implications for the New England apple industry and areas of future study are included.

New England Apples

The McIntosh is a two-toned, red and green apple with an oblate shape (round but flat at the very top and bottom). In addition to its distinctive sweet-tart flavor, the McIntosh is known for being tender and juicy, but not known for being a particularly crisp or firm apple. While its distinctive appearance and taste has historically been important for marketing the McIntosh, this variety also has the unfortunate characteristics of not storing as well, bruising more easily, and being more susceptible to stem punctures than many competing apples.

Red Delicious apples have an unique ovate shape tapering to a five-knobbed base. Their flesh is white and the Red Delicious are known for their sweetness and juiciness. As its name implies, Red Delicious apples are red in color, usually deep red. The Empire apple was introduced in 1966 and is a cross between the McIntosh and the Red Delicious. Due to this heritage, the Empire has characteristics from the McIntosh and the Red Delicious. It has a deep red skin, sometimes brushed with green and gold. It has firm white flesh which is mildly tart-sweet. The shape of the Empire is oblate, like the shape of the McIntosh.

In 1992, New England (MA, ME, CT, NH, RI, and VT) produced 320 million pounds of apples with a farm-gate value of \$53 million. While significant to the New England agricultural economy, New England is not a major U.S. apple producer with only 3 percent of total U.S. production. Although the exact varietal composition of New England's production is not known, a 1988 University of Maine survey of Maine's apple producers revealed that McIntosh accounted for 65 percent of the state's production, Red Delicious 13 percent, Cortland 9 percent, and all others 13 percent. Manalo and Lord (1990) found a very similar production split for New Hampshire with 65 percent McIntosh, 15 percent Cortland, and 10 percent Red Delicious. According to the Agricultural Departments of the Northern New England states (ME, VT, NH), the apple industry provide jobs for 1,150 full- and part-time resident workers (200 of which were packers), and over 1,300 seasonal pickers.

Over the last decade, the share of the New England apple market which is made up of New England apples has eroded. For the years 1984 and 1985 New England apples accounted for 36 percent of total Boston apple arrivals, while for the same two years Washington State accounted for 33 percent. However, in 1990 and 1991, New England's share had declined to under 15 percent while Washington's share had increased to over 60 percent. Figure 1 shows this dramatic change in the Boston market with apple arrival shares for Washington State, New

Associate Professor, Professor, Associate Professor, and former Graduate Research Assistant, respectively, Department of Resource Economics and Policy, University of Maine. This publication is Maine Agricultural and Forest Experiment Station Publication Number 1876.

England, and all other apple sources (USDA AMS and USDA). This competitive pressure from Washington State, primarily with Red Delicious apples, is likely to continue. In the September 1994 *Northeast McIntosh News*, it is reported that "Washington [apple producers] have served notice on Eastern retailers that they will 'do what it takes' to get their fruit in [Eastern] markets - even during the time when local retailers most like to feature local apples."

Another important factor relevant to New England apple marketing concerns Manalo's findings regarding preferences for the McIntosh and the age of consumers. In a 1989 mall survey, Manalo noted that older individuals preferred the McIntosh while "the under 20 and the 40-49 age groups tend to prefer Red Delicious" (p. 6). Based on his analysis Manalo states "assuming that a consumer's preference for apple varieties does not change as the consumer grows older, and holding all other factors constant, the number of people showing strong preferences for McIntosh would decline through time."

Hypotheses

The three hypotheses examined in this study are:

1. There is a negative relation between McIntosh preferences and the age of consumers.
2. Due to its taste characteristics, the Empire will have a favorable blind taste preference rating compared to the McIntosh and the Red Delicious. However, the Empire will fare poorly in the visual relative to the blind taste test, relative to the Red Delicious, due to consumers' preferences for Red Delicious-like apples (red color and ovate shape).
3. Current apple preferences are shaped by a variety of factors including apple varieties consumed previously.

Procedures

College age individuals (30 and under) were utilized in three sensory tests; Empire versus Red Delicious, Empire versus McIntosh, and McIntosh versus Red Delicious. Because of the New England market penetration of Washington State Red Delicious, Washington State Red Delicious were selected for the taste tests while the McIntosh and the Empire were Northeast produced. The pair-wise testing of the apples was used instead of a three-way comparison based on the results of a pre-test where it was decided that comparing three apples on three attributes required too much time for untrained panelists in a cafeteria setting. A sense of being "over loaded" with choices was expressed by several of the panelists during the pre-test.

Before each test, subjects completed a survey regarding their socio-economic characteristics as well as their apple consumption practices. Following completion of the written information, subjects completed a "blind" taste test followed by a visual taste test. The first taste test is referred to as a "blind" test since apple variety was disguised by only providing subjects 8-10 apple chunks of approximately one-half inch. Only apple chunks red in color were used in order to conceal apple variety.

Subjects were asked to taste the samples and select the apple preferred based upon texture (mouthfeel), juiciness, flavor, and overall preference. After completing the taste test the subjects were presented with the same two whole varieties that they had tasted, and asked which apple, based on visual appeal, they would prefer to eat. The order of apple presentation (left side versus right side) was varied to eliminate order biases. This sequence, blind taste test followed by a visual test, was conducted three times, once for each pair of apples. The Chi-square goodness of fit test procedure was used to analyze the data.

Blind Taste Preference Results

Statistically significant differences were found in two of the three blind taste preference tests conducted (Table 1). The subjects significantly preferred the McIntosh to Red Delicious and the Empire to the McIntosh. It is worth noting that since the McIntosh was preferred to the Red Delicious, and the Empire was preferred to the McIntosh, the Empire was expected to be preferred over the Red Delicious. While the Empire was taste preferred over the Red Delicious (58% to 42%), the difference was not statistically significant. An explanation of this may be that apple taste preferences are not linear due to varying apple attributes being of critical importance in different apple comparisons. Perhaps in one comparison juiciness is the critical choice attribute while in another comparison flavor might be the most important attribute.

Visual Preference Results

In the tests for visual preference, McIntosh was significantly preferred to the Red Delicious, 78 percent to 22 percent (Table 2). No statistically significant differences were found with respect to visual preference between either the McIntosh and Empire or Empire and Red Delicious.

Figure 1. Boston Market Apple Arrivals

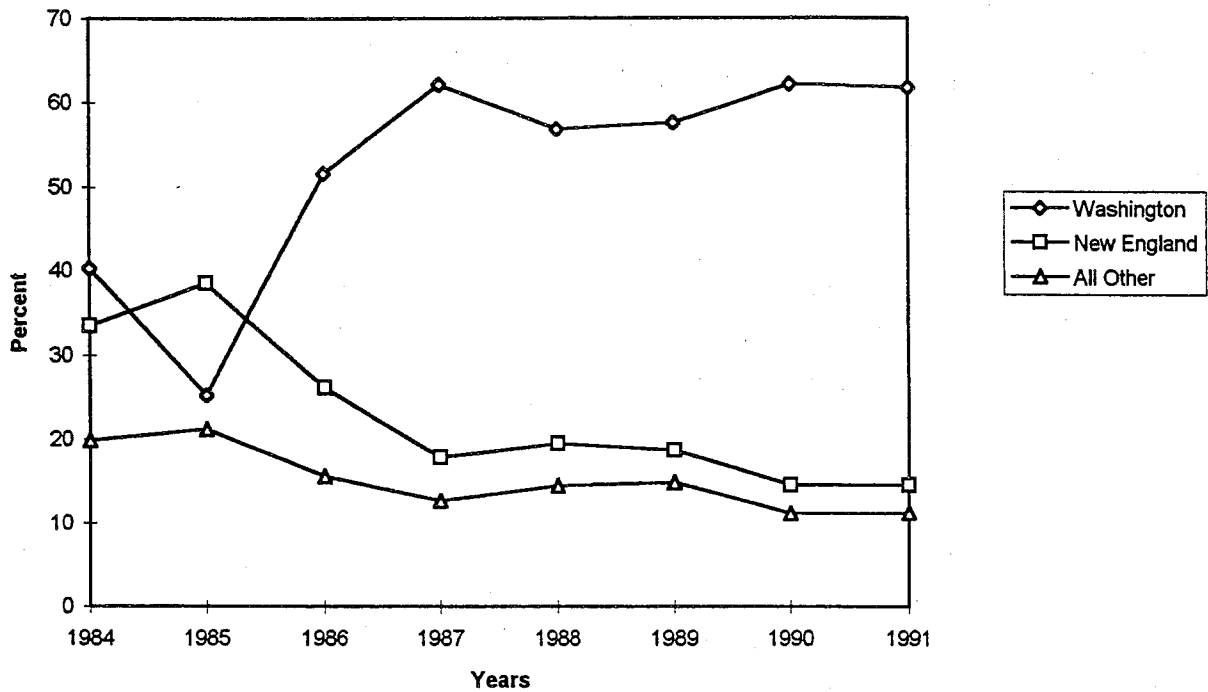


Table 1
Blind Taste Test Varietal Preferences

Test	Percent Preferring Red Delicious	Percent Preferring McIntosh	Percent Preferring Empire	Statistical Significance
One: n=67	33	67		99%
Two: n=74		16	84	99%
Three: n=59	42		58	--

** Statistical significance below 90% denoted by --.

Table 2
Visual Varietal Preferences

Test	Percent Preferring Red Delicious	Percent Preferring McIntosh	Percent Preferring Empire	Statistical Significance
One: n=67	22	78		99%
Two: n=74		58	42	--
Three: n=59	44		56	--

** Statistical significance below 90% denoted by --.

Analysis of Socio-Economic Factors

The socio-economic factors examined included age, sex, education of parents, income of parents, apples served by parents, and apples normally preferred. Of these factors, only parent income and parent education resulted in no significant preference differences in all variety comparisons. The relations found statistically significant are found in Table 3.

Significant differences existed in both blind and visual apple varietal preferences for subjects within the selected age groups. In the blind preference test, 51 percent of subjects 22 years or younger preferred the Red Delicious to the Empire, while the older group preferred the Empire over the Red Delicious 78 percent to 22 percent. In the McIntosh versus Red Delicious blind preference test, both age groups preferred the McIntosh. The younger group preferred the McIntosh over the Red Delicious 60 percent to 40 percent, while the older group preferred the McIntosh 81 percent to 19 percent. With respect to visual preference, 60 percent of the younger group preferred the McIntosh to the Empire while for the older group the ratio was reversed. For the visual Red Delicious versus McIntosh test, 82 percent of the older group preferred the McIntosh, while for the younger group only 53 percent preferred the McIntosh.

Regarding gender, significantly more males preferred the Empire to the McIntosh in the blind preference test with 88 percent of the males preferring the Empire as compared to 68 percent of the females. The only other significant difference occurred in the visual comparison between the Red Delicious and McIntosh. Eighty-two percent of the females preferred the McIntosh as compared to 46 percent of the males.

In order to investigate the impact on current apple preferences of apple varieties subjects were served at home as well as their current apple preferences, apple varieties were segmented into commonly observed varietal groupings. The McIntosh grouping includes McIntosh and any other varieties excluding the Red Delicious. The Red Delicious grouping includes Red Delicious and any other varieties excluding the McIntosh. Red Delicious and McIntosh grouping includes the two varieties with any combination of other varieties. The Other grouping includes any varieties excluding the McIntosh and Red Delicious. The Empire was treated as an Other variety since it was rarely mentioned as having been served or as being currently preferred.

The apple varieties which subjects were served in their parent's homes only significantly affected preferences between the Red Delicious and McIntosh. Dramatically more subjects that had been served the

McIntosh in their parent's homes preferred the McIntosh to the Red Delicious in both the blind and visual preference tests. Seventy-nine percent of the subjects that were served the McIntosh and 69 percent of those that were served McIntosh and Red Delicious preferred the McIntosh in the blind preference test. Similar results were found in the visual preference test. Seventy-five percent of the subjects that were served the McIntosh and 61 percent of those served the McIntosh and Red Delicious preferred the McIntosh.

Subjects' current apple varietal preferences affected both their blind and visual preferences. Significant differences were observed in all blind and visual tests including Red Delicious apples. Individuals with a stated preference for Red Delicious or McIntosh choose it significantly more often in comparison with the other varieties. In addition, individuals with a stated preference, including the McIntosh, seemed to choose the Empire significantly more often in comparison with the Red Delicious.

The Age-McIntosh Hypothesis

The data and analysis of this study supports the age-McIntosh hypothesis that there is an age-preference relation for the McIntosh apple. Specifically, the goodness-of-fit tests show that the younger subjects prefer the McIntosh less than the older group. For the visual Red Delicious versus McIntosh test, 82 percent of the older group preferred the McIntosh, while only 53 percent of the younger group preferred the McIntosh. Although this is the second time this age-McIntosh phenomena has been noted, the authors would like to see additional replications. Another important issue is whether a subject's apple preferences change as the subject ages. Perhaps younger subjects prefer Red Delicious but will prefer the McIntosh more as they age. It should be noted that even though the McIntosh was preferred less by the younger group, both age groups preferred the McIntosh over the Red Delicious in both the blind taste and visual tests. It is important to know whether this is a static preference situation or whether this is a trend; in five years will the younger group prefer the Red Delicious to the McIntosh in absolute terms?

Empire Preferences

Based on the analysis it cannot be said that the Empire was clearly preferred over the McIntosh and the Red Delicious. The Empire was significantly preferred over the McIntosh with the blind taste test, but with no difference for the visual test. The Empire was taste preferred over the Red Delicious 56 percent to

Table 3
Summary for Apple Preferences and Socioeconomic Characteristics

Test	Variety	Socioeconomic Characteristic	Results	Significance
Blind Taste n=71	Empire vs. Red Delicious	Age: 22 or less vs over 22	Red Delicious preferred 51:49 by younger group, Empire preferred 78:22 by older group	97%
Blind Taste n=78	McIntosh vs. Red Delicious	Age: 22 or less vs over 22	McIntosh preferred to Red Delicious: 60:40 by younger group, 81:19 by older group	92%
Visual n=88	Empire vs. McIntosh	Age: 22 or less vs over 22	McIntosh preferred to Empire 60:40 by younger group, Empire preferred 60:40 by older group	91%
Visual n=80	McIntosh vs. Red Delicious	Age: 22 or less vs over 22	McIntosh preferred to Red Delicious 53:47 by younger group, 82:18 by older group	98%
Blind Taste n=86	Empire vs. McIntosh	Male vs Female	Empire preferred to McIntosh 88:12 by males, 68:32 by females	98%
Visual n=80	McIntosh vs. Red Delicious	Male vs Female	Red Delicious preferred 54:46 by males, McIntosh preferred 82:18 by females	99%
Blind n=68*	McIntosh vs. Red Delicious	Apples Parents Normally Served	If respondent's parents normally served McIntosh, McIntosh preferred 79:21; if served Red Delicious, Red Delicious preferred 57:43; if normally Red Delicious and McIntosh, McIntosh preferred 69:31; if Other served, Red Delicious preferred 75:25.	92%
Visual n=70*	McIntosh vs. Red Delicious	Apples Parents Normally Served	If respondent's parents normally served McIntosh, McIntosh preferred 75:25; if served Red Delicious, Red Delicious preferred 86:14; if served Red Delicious and McIntosh, McIntosh preferred 61:39; if served Other, Red Delicious preferred 75:25	99%

Table 3 (continued)

Test	Variety	Socioeconomic		Results	Significance
		Characteristic	Characteristic		
Blind Taste n = 64*	Empire vs. Red Delicious	Apples	Normally Preferred	If respondent normally preferred McIntosh, Empire preferred 71:29; if normally preferred Red Delicious, Red Delicious preferred 76:24; if normally preferred Red Delicious and McIntosh, Empire preferred 67:33, if normally served Other, Empire preferred 65:35	98%
	McIntosh vs. Red Delicious	Apples	Normally Preferred	If respondent normally preferred McIntosh, McIntosh preferred 72:28; if normally preferred Red Delicious, Red Delicious preferred 62:38; if normally preferred Red Delicious and McIntosh, McIntosh preferred 54:46, if normally served Other, McIntosh preferred 81:19	
Visual n = 69*	Empire vs. Red Delicious	Apples	Normally Preferred	If respondent normally preferred McIntosh, Empire preferred 57:43; if normally preferred Red Delicious, Red Delicious preferred 82:18; if normally preferred Red Delicious and McIntosh, Empire preferred 63:37, if normally served Other, Red Delicious preferred 67:33	96%
	McIntosh vs. Red Delicious	Apples	Normally Preferred	If respondent normally preferred McIntosh, McIntosh preferred 69:31; if normally preferred Red Delicious, Red Delicious preferred 86:14; if normally preferred Red Delicious and McIntosh, McIntosh preferred 71:29, if normally served Other, McIntosh preferred 71:29	

Tests were conducted with Chi-square goodness-of-fit methodology. Details found in Criner, Kezis, Cheng, and Nord (1994).
 *Indicates Chi-square warning where 25% or more of the cells have 5 or fewer observations.

44 percent, but this difference was not statistically significant. The hypothesis that the Empire is preferred less on the visual tests is shown most clearly in Table 4 on the analyses which involve "apples which subjects normally serve." If subjects normally served apples other than McIntosh and Red Delicious, respondents preferred the Empire on taste, over the Red Delicious, 65 percent to 35 percent. However, in the same situation, subjects preferred the Red Delicious visually 67 percent to 33 percent. Thus, there does appear to be sight recognition problem for the Empire apple when compared to the Red Delicious.

Apple Preference Formation Hypothesis

Figure 2 represents an hypothesized link between apples normally consumed in the home, apples normally served, and current preference results. Regarding the McIntosh and Red Delicious, subjects that consumed Red Delicious in the home tended to state that Red Delicious was their preferred variety (with the same also being true for the McIntosh). For McIntosh and Red Delicious, if subjects stated they normally preferred the Red Delicious or the McIntosh, subjects tended to both blind and visually preferred that apple. This shows that consumers do have an ability to recognize apple varieties (both blind and visual), and that preferences are shaped by past consumption practices.

Table 4 presents the results of the test comparing apples normally served by subjects' parents and apples normally preferred by subjects. As expected, subjects which were served one of the tested varieties were more likely to have a current stated preference for that variety. Of note is the stated preference of subjects which were served varieties other than the McIntosh or Red Delicious. Sixty-eight percent of them currently prefer the Red Delicious as compared to only 21 percent having a stated preference for the McIntosh.

Implications and Further Study

Given the preference development path put forth in Figure 2, the development of a market for a new variety may require a sustained promotional effort in order to obtain a sufficiently large recognition by consumers. This is especially important when the apple considered for introduction appears similar to competing varieties, such as the McIntosh and the Empire. An important consideration for the New England apple industry is whether the resources are available to introduce and promote a new variety to the point of mainstream market acceptance.

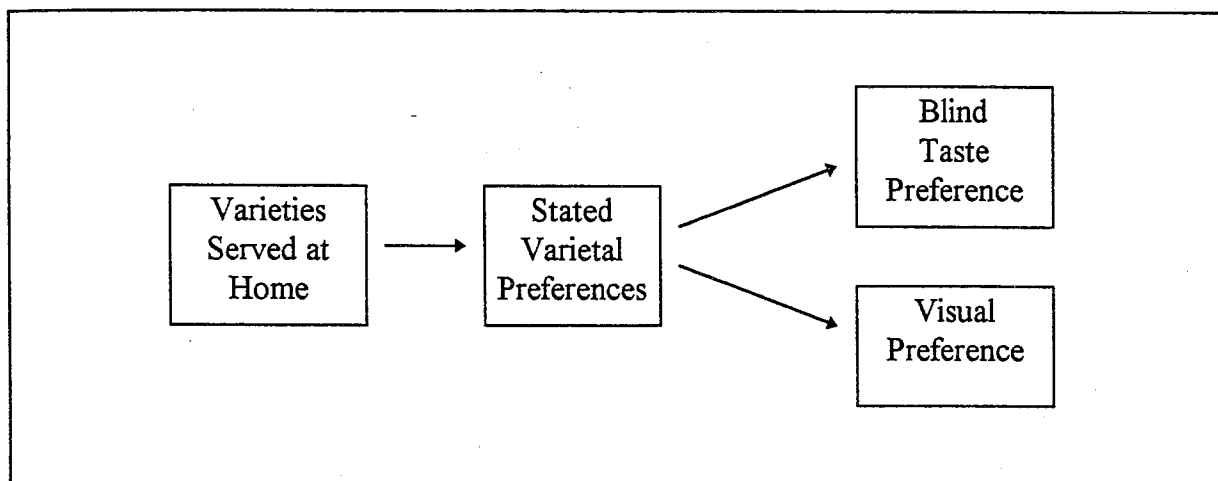
In general, more sensory tests are needed. Apple attributes can vary by variety, growing season, region, etc. Further, it is not known to what extent apple preferences are static and to what extent apple preference can be manipulated or trained by promotional efforts and new variety development.

Table 4. Percentage of Subjects Who Normally Prefer Selected Apple Varieties Who Were Served Selected Apple Varieties by Their Parents

Varieties	Varieties Served at Parents' Home			
	McIntosh	Red Delicious	McIntosh and Red Delicious	Other
Normally Prefer:				
McIntosh	61	0	32	21
Red Delicious	5	70	18	68
McIntosh & Red Delicious	10	9	23	11
Other	24	21	27	0

$\chi^2 = 87.887$ d.f. = 9 Significance: 99%

Figure 2. Apple Preference Flow Diagram.



References

- Criner, G. K., A. S. Kezis, and H. T. Cheng. "Young Adult Apple Varietal Preference: Socio-economic Factors." Northern New England Product Development and Marketing Center Staff Paper F.I. 007. University of Maine, Sept. 1994.
- Feick, L. F. and U. C. Toensmeyer. "Delaware Household Consumption of Fresh Apples." Agricultural Experiment Station Bulletin 421. Newark, DE: University of Delaware, 1977.
- Manalo, A. B. "Preferences of Apple Consumers in the New Hampshire Seacoast." Agricultural Experiment Station Research Report No. 120. University of New Hampshire, July 1989.
- Manalo, A. B. and W. G. Lord. "Production and Marketing Options for New Hampshire Apple Growers." Agricultural Experiment Station Research Report No. 122. University of New Hampshire, April 1990.
- Manalo, A. B. "Assessing the Importance of Apple Attributes: An Agricultural Application of Conjoint Analysis." *Northeast Journal of Agricultural and Resources Economics*. Oct. 1990: 118-24.
- McCracken, V. A., B. Maier, T. Boylston, T. Worley. "Development of a Scheme to Evaluate Consumer Apple Variety Preferences." *Journal of Food Distribution Research*. 25.1 (1994): 56-63.
- Nord, Michael T. Marketing the New England Apple Using Preference Evaluations for McIntosh, Red Delicious, and Empire. Unpublished Masters Thesis. Department of Resource Economics, University of Maine, Orono. 1994.
- Northeast McIntosh News*. Northeast McIntosh Growers Association. Sept. 1994.
- O'Rourke, A. D. *The World Apple Market*. Binghamton, NY: Haworth. 1994.
- Trotter, C.E. and T. A. Brewer. "Consumer Reactions to Fresh Apples Marketing in Allentown-Bethlehem, PA, 1974-75." Agricultural Experiment Station Bulletin 816. Pennsylvania State University, University Park, PA, 1977.
- United States Department of Agriculture. Agricultural Marketing Service. Fruit and Vegetable Division. Market News Branch. *Fresh Fruit and Vegetable Arrivals in Eastern Cities*. Washington: GPO, 1980-1993.
- United States Department of Agriculture. National Agricultural Statistics Service. Agricultural Statistics. Washington: GPO, 1993.