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Consumers Prefer Low-priced and High-lycopene-content Fresh-market Tomatoes

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SUMMARY. Fresh and processed tomato (*Lycopersicon esculentum*) consumption has increased 40% in the United States over the last two decades. Through better breeding, fresh tomatoes now are marketed in different forms, sizes, colors, and flavors. However, little published information exists concerning consumer demand, preference, and demographic characteristics related to fresh tomato consumption. Taking advantage of a high percentage of Internet use in the U.S., two web-based surveys were released to approximately 6000 e-mail addresses reaching people in every region of the U.S. The surveys contained a total of 61 questions, including 50 digital images of five types of tomatoes (cherry, grape, cluster, plum, and regular slicing) with combinations of three additional factors (price, lycopene content, and production style) and demographic information. Among 389 respondents, 76% preferred and purchased slicing tomatoes in the 4 weeks prior to the survey. These were followed by grape/mini-pear (42%), plum (36%), cluster (27%), cherry (25%), and yellow slicing tomatoes (4.4%). Overall, production method (organic vs. conventional) had low relative importance in comparison to price and tomato type. However, younger participants (<age 38 years) placed more importance on production method. Participants between ages 39 and 57 years were the most price-sensitive, and female were less sensitive than males. Younger participants (<age 38 years) were less price-sensitive and placed more importance on the other attributes (production method, lycopene content, and tomato type).

Tomato is the world's most popular fruit vegetable. More than 10,000 tomato varieties are documented in the U.S. Department

of Agriculture (USDA) Plant Introduction Service [Genetic Resources Action International (GRAIN), 1997]. The U.S. is one of the world's leading

producers (11 million tons), ranking second only to China (Food and Agriculture Organization of the United Nations, 2003; USDA, 2004). California is the leading U.S. tomato producer (95% of U.S. processing tomatoes), followed by Florida. Florida is the leading fresh-market tomato producer (Lucier, 2003; Lucier et al., 2000; Williams, 2002); it produces nearly all of the fresh-market tomatoes grown in the U.S. from November to May. From 1997 to 1999 Florida produced 42% of all the domestic fresh-market tomatoes in the country (USDA, 2004).

Tomatoes are rich in vitamins A and C, and fiber; an average-size tomato (148 g) boasts only 35 calories and supplies 40% of the U.S. Recommended Daily Allowance (RDA) of vitamin C and 20% of vitamin A (USDA, 2004a, 2004b). Tomatoes and tomato products are good sources of lycopene; they provide more than 80% of the total lycopene intake in the U.S. (Giovannucci et al., 1995; Paetau et al., 1998; Shi and Le Maguer, 2000a, 2000b). Lycopene is a carotenoid pigment, the compound that makes tomatoes red. As the human body cannot produce carotenoids, they must be acquired from diet. Tomato lycopene has attracted attention due to mounting evidence of its beneficial effects on human health. New epidemiological research suggests that the consumption of tomato and tomato products rich in lycopene may have an inverse relationship with development of certain types of cancer (Agarwal and Rao, 2000; Boileau et al., 2003; Bowen, 2003; Erhardt et al., 2003; Giovannucci et al., 2002; Wu et al., 2004) and cardiovascular diseases (Arab and Steck, 2000; Sesso et al., 2003). The human body absorbs tomato lycopene more efficiently if it is in processed tomato products such as juice, sauce, paste, or ketchup (Paetau et al., 1998; Shi and Le Maguer, 2000a, 2000b). Furthermore, lycopene concentration in tomato fruit may depend on tomato variety, culture condition, maturity, and conditions during harvest handling (e.g., temperature, moisture, light,

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Units

To convert U.S. to SI, multiply by	U.S. unit	SI unit	To convert SI to U.S., multiply by
4.1868	calorie (nutritional)	kJ	0.2388
0.4536	lb	kg	2.2046
28.3495	oz	g	0.0353
0.9072	ton(s)	Mg	1.1023

and chemical treatments) (Dumas et al., 2003; Khachik et al., 2002).

Fresh and processed tomato consumption has increased significantly in the U.S. over the last two decades. Fresh tomato consumption increased by 40% between 1971 and 1999. However, little published literature is available about consumer demographics, preferences, or demand for fresh and processed tomatoes (Lucier et al., 2000). With great genetic diversity and variation in production styles (e.g., conventional, organic, hydroponic, field, and soilless media), tomatoes are marketed in different forms, sizes, colors, and flavors. These parameters and other factors such as price, country of origin, and availability may influence a consumer's purchase decision. Fresh-market tomato prices are higher and more variable than those of processing tomatoes due to larger production cost and greater market uncertainty (Lucier et al., 2000). On average, fresh tomato prices may range from \$0.99/lb to \$3.99/lb or higher depending on type, production method, and season. There is very little information available on how those aforementioned factors would affect a consumer's purchase decision.

Conjoint methodology is an often-used approach in the business literature to investigate products with complex attributes. It allows researchers to simultaneously investigate a number of product attributes and attribute variations and determine the relative importance of each attribute in the overall consumer's preference (Frank et al., 2001; Moskowitz et al., 2004). Conjoint analysis allows marketers or food scientists to deal with complex issues more deeply, and with less bias than focus groups or traditional direct question-and-answer surveys (Moskowitz et al., 2004). Conjoint analysis was successfully used for assessing consumer preference in many ornamental plants (Behe et al., 1999, 2003), food products (Moskowitz et al., 2004), bell peppers (*Capsicum annuum*) (Frank et al., 2001), and other fruits and vegetables (Pol and Ryan, 1996). Frank et al. (2001) utilized a face-to-face in-store survey on bell peppers and it was labor intensive as well as costly because pepper samples were provided for every combination.

Nearly 80% of U.S. adults have Internet access at home, work, or other locations, with about 63% considered

regular users (Mediamark Research, 2004). A web-based survey with high-quality images was developed to take advantage of a more geographically dispersed consumer sample with reduced cost. Further, the web-based survey also helped to decrease errors associated with hand coding and researchers' bias (Cobanglu et al., 2001).

An understanding of consumers' preferences for fresh-market tomatoes would be of interest to breeders, producers, wholesalers, and retailers. Health educators may also be able to utilize the information to promote more consumption of these products. Therefore, the objectives of this study were to 1) apply a conjoint methodology to assess relative importance of attributes affecting fresh tomato consumption; 2) determine how attributes (tomato type, production style, lycopene content, price) influence a consumer's willingness to purchase fresh-market tomatoes; and 3) determine how demographic characteristics affect purchase decision of fresh tomato.

Materials and methods

To assess the relative importance of factors affecting consumption and purchase of fresh tomatoes, researchers conducted two Internet surveys using conjoint design. Approval was obtained from the University of Florida Institutional Review Board for research involving human subjects prior to distribution of the website hosting the surveys in May 2003. The Internet survey was established on the University of Florida Institute of Food and Agricultural Sciences (IFAS), Family, Youth and Community Sciences Department webserver. The surveys were designed to be answered voluntarily by persons who were 18 years of age or older and currently living in the U.S. The surveys were released to 6000 e-mail addresses throughout the U.S.

Tomato types, prices, production methods, and lycopene contents were chosen as factors to describe the consumer preference of fresh tomatoes in both conjoint analyses. Because combinations of levels of each factor would have been too numerous for most participants to easily evaluate, the study was conducted in two surveys: tomato types and prices were common factors in both surveys. For each design and each factor, a measurable hierarchical set of levels was identified. By using a

partial factorial design, the numbers of photographs required, while maintaining factor orthogonality, were reduced from 30 to 25, and from 45 to 25, in the first and second conjoint design, respectively. This helped decrease potential participant fatigue.

Consumers were first presented with the overall goals of the study on the main survey webpage. If they agreed to participate prior to entering the survey page, they also agreed that they were at least 18 years of age or older. Two independent surveys were established next. In the first survey, researchers asked consumers to answer four questions related to tomato consumption and their tomato purchases over the 4-week period preceding the survey (Figs. 1 and 2). Questions were also included to assess their preferences for price, taste and flavor, availability, origin of production, and production style (organic vs. conventional). After consumers answered those questions, they could proceed to evaluate photographs in the conjoint design (Fig. 3). The terms "regular slicing" and "slicer" in each of the figures referred to standard round fresh tomatoes, per USDA definition (USDA, 1991). Each photograph included a combination of five tomato types (cherry, grape, cluster, plum, and regular slicing), three price points (\$0.99/lb, \$1.99/lb, and \$3.99/lb), and two production methods (organic or conventional). A total of 30 questions, including 25 photographs, was used in the first survey. At the end of the first survey, the consumers were asked to provide some demographic information such as gender, the year in which they were born, zip code, and number of people in the household.

In the second survey the researchers provided some information about lycopene, then asked consumers about their general attitude related to nutrition and health and their willingness to invest in health and well-being through food (Fig. 4). Next they were shown 25 photographs that were combinations of the same factors, including five types of tomatoes (cherry, grape, cluster, plum, and regular slicing); three price points (\$0.99/lb, \$1.99/lb, and \$3.99/lb), and three levels of lycopene (low, moderate, and high) (Figs. 1, 2, and 4). All photographs were high resolution, making the choices very real to the consumers, as if the products were in front of them.

1. In the last four weeks, have you bought any of these products? (please check all that apply)

- ☐ Regular slicing tomato
☐ Yellow slicing tomato
☐ Roma tomato (Plum tomato)
☐ Cherry tomato
☐ Cluster tomato
☐ Grape and mini pear type tomato

CLICK ON THE PICTURES FOR VIEWING A LARGER SIZE!!!

2. How many _____ did you purchase over the last month?

- Regular slicer tomato number of lb.
 Yellow slicer tomato number of lb.
 Roma tomato (Plum) number of lb.
 Cherry tomato number of lb.
 Cluster tomato number of lb.
 Grape, or mini-pear type number of lb.

3. Did you use the _____ for (please check all that apply)

used raw (snacks or salads)

- ☐ Regular Slicer Tomatoes
☐ Roma Tomato (Plum)
☐ Yellow Slicer Tomato
☐ Cherry Tomato
☐ Cluster Tomato
☐ Grape Tomato

cooked in a prepared meal

- ☐ Regular Slicer Tomatoes
☐ Roma Tomato (Plum)
☐ Yellow Slicer Tomato
☐ Cherry Tomato
☐ Cluster Tomato
☐ Grape Tomato

4. Please rate the importance of each factor below when you think about buying tomatoes.

(5 = Most Important and 1 = Least Important)

- Price
 Taste and flavors
 Availability
 Origin of the production
 Type of production (organic Vs conventional production)

Fig. 1. First question in the tomato purchase behavior survey conducted in 2003 via the University of Florida Institute of Food and Agricultural Sciences website. Participants 18 years of age or older were shown high-quality pictures as a means to communicate the exact types of tomatoes to which the survey referred. The term "slicing" refers to standard round fresh tomatoes per USDA definition (1991).

Researchers asked participants to rate their willingness to buy each of the combinations shown in the photograph on a five-point Likert scale (1 = not willing to buy, 3 = may or may not buy, 5 = like very much to buy). Conjoint analysis defines the overall consumer preference for a particular product (combination of factors: tomato types, prices, lycopene contents, and production styles) as the sum of the part-worths (also called utilities) for each factor level. Conjoint and other statistical analyses were accomplished by using SPSS (version 10.0; SPSS, Inc., Chicago).

Results and discussion

DEMOGRAPHIC OF PARTICIPANTS.

During the 1-month survey period, the first page of the website was accessed more than 2000 times (approximately a 33% response rate). Researchers received 692 and 293 responses for the first (production) and second (lycopene) surveys, respectively. The total usable number of forms (completed) for each survey was 389 and 168, respectively. Incomplete and repeated responses were discarded.

Participants in the first survey (n = 389) were 62% male and 38% female. They ranged in age from 21 to 75 years old with a mean age of 47 years. More than half (57%) of the participants earned advanced degrees; 12% were only high school graduates; and 31% had either attended or graduated from college or technical school.

Fig. 2. Questions 2–4 in the tomato purchase behavior survey conducted in 2003 via the University of Florida Institute of Food and Agricultural Sciences website. Participants 18 years of age or older were asked these questions before they proceeded to the next part of the survey. The term "slicer" refers to standard round fresh tomatoes per USDA definition (1991); 1 lb = 0.4536 kg.

1 = not willing to buy 5 = very much willing to buy .

1	2	3	4	5
	☐	☐	☐	☐	☐
cherry	conventional		\$ 0.99 /lb
1	2	3	4	5
	☐	☐	☐	☐	☐
cluster	organic		\$ 1.99 /lb
1	2	3	4	5
	☐	☐	☐	☐	☐
cluster	conventional		\$ 3.99 /lb
1	2	3	4	5
	☐	☐	☐	☐	☐
cluster	conventional		\$ 0.99 /lb
1	2	3	4	5
	☐	☐	☐	☐	☐
grape	conventional		\$ 0.99 /lb		

Fig. 3. Webpage used in the conjoint survey conducted in 2003 via the University of Florida Institute of Food and Agricultural Sciences website. The figure shows the first five out of 25 combinations of the conjoint design with five types of tomatoes (cherry, cluster, grape, plum, regular slicing), two production styles (organic or conventional), and three price points (\$0.99/lb, \$1.99/lb, \$3.99/lb). Although not shown in this figure, plum and regular slicing tomatoes are part of the conjoint design. Each of the combinations has a radio button for participants 18 years of age or older to select; \$1.00/lb = \$2.2046/kg.

Many participants had an annual household income in the category of >\$60,001 (49%); followed by \$30,001 to \$45,000 (20%); and \$45,001 to \$60,000 (17%). Many participants (45%) had one person other than themselves living in the home, and 20% had two additional persons in the home. Most participants (75.8%) purchased regular red slicing tomatoes in the 4 weeks prior to taking the survey (Table 1). Yellow slicing tomatoes were the least frequently purchased. More tomatoes were consumed raw rather than cooked.

Participants in the second survey (n = 168) were 67% male and 33% female. Participants ranged in age from 22 to 70 years old with a mean age of 45 years. Many participants earned advanced degrees (54%); 9.6% were only high school graduates; and 36.1% had either attended or graduated from college or technical school. Nearly half of the participants had an annual household income in the category of >\$60,001 (49%); followed by \$30,001 to \$45,000 (22%); and \$45,001 to \$60,000 (16%). Many participants (53%) had only one person in the household, and some (23%) had one other person in addition to themselves living at home.

The income level reported by survey participants was consistent with the results of Lucier et al. (2000), who stated that fresh tomato usage and consumption increased as income

1) Have you heard about the health benefit of lycopene and other phytonutrients in tomatoes and tomato products?

2) Nutrition and diet affect one's general health and well being.

3) If you know that certain foods are good for your health, would you be willing to consume more and pay more money of those foods?

4) Answer the following questions based on the pictures to the left.

1 = not willing to buy 5 = very much willing to buy .

1	2	3	4	5
	☐	☐	☐	☐	☐
cherry	moderate lycopene		\$ 0.99 /lb
1	2	3	4	5
	☐	☐	☐	☐	☐
cluster	low lycopene		\$ 1.99 /lb		

Fig. 4. Webpage used in the consumer survey conducted in 2003 via the University of Florida Institute of Food and Agricultural Sciences website. Questions were asked of participants 18 years of age or older about their general attitude related to nutrition and health and their willingness to invest in health and well-being through food. Shown are two out of 25 possible combinations of conjoint designs with factors including five tomato types (cherry, cluster, grape, plum, regular slicing tomato), three lycopene levels (low, medium, high), and three price points (\$0.99/lb, \$1.99/lb, \$3.99/lb); \$1.00/lb = \$2.2046/kg.

increased. Consumers in the high-income group consumed 44% of all fresh tomatoes while consumers from lower-income group consumers consumed only about 16% of fresh tomatoes (Lucier et al., 2000). Lucier's results were similar to this study, where a majority of participants in both our surveys were in the highest income bracket (39% of the U.S population).

TOMATO TYPES PREFERRED. Participants bought an average of 3.2 lb of regular slicing tomatoes in the month prior to the study. Plum and cluster tomatoes were the next highest, averaging 2.7 lb, followed by cherry tomatoes at 2.0 lb, grape/mini-pear-type tomatoes at 1.8 lb, and yellow slicing tomatoes at 1.7 lb. Overall, slicing tomatoes were the tomato type preferred by all age groups in both first (Table 2) and second surveys (Table 3). This may be due to that fact that the regular slicing tomato is the most common tomato type, found in almost every grocery store, whereas other types (yellow slicing tomato, cherry, plum, and cluster) may not be as common. When we examined preferences by age group, the next most-preferred tomato types varied. Overall, the least favored was the plum tomato. This varied by age group, with two of the three age groups placing it last among their preferences.

Using any type of tomato in raw applications (75%) was favored over cooking (Table 1). From a separate question, taste was the most important factor when purchasing tomatoes (mean = 4.1, $n = 389$) on a five-point Likert scale (5 = most important and 1 = least important). Taste was followed by price (mean = 3.3, $n = 389$), availability (mean = 2.7), origin of production (mean = 2.6), and production style (organic or conventional) (mean = 2.1).

DOES PRODUCTION METHOD MATTER? The conjoint model accounted for 99% of the variance in consumer preference (most of the variation in consumer preferences). Price was the most important attribute (accounting for 77% of the variance in consumer preferences); with tomato type the second most important feature (19%), followed by production style (4%). Consumers logically preferred the lowest price point (\$0.99/lb). Overall production style had low relative importance in comparison to price and tomato type but differences in age

Table 1. Summary of an Internet survey on tomato purchase behavior conducted in 2003 via the University of Florida Institute of Food and Agricultural Sciences website. Participants were consumers 18 years of age or older. Shown here is the purchase behavior in the 4 weeks (28 d) prior to completing this survey, indicating how participants used the fresh tomato during that time period. These survey results correspond to the survey questions in Figs. 1 and 2.

Tomato type	Purchased (%) ^z	Used raw (%) ^z	Used cooked(%) ^z
Regular slicing tomato	75.8	69.9	26.0
Yellow slicing tomato	4.4	4.4	0.5
Roma tomato (plum tomato)	35.7	27.8	14.9
Cherry tomato	24.7	23.7	2.1
Cluster tomato	26.7	25.4	5.1
Grape/mini-pear-type tomato	42.4	41.6	4.4

^zPercentages were calculated from the total number of respondents ($n = 389$).

Table 2. Summary of an Internet survey on consumer preference of tomatoes conducted in 2003 via the University of Florida Institute of Food and Agricultural Sciences website. Participants were consumers 18 years of age or older. Data shown here are the overall consumer preferences as related to production styles for tomato type by age group for participants of the survey. Numbers in the tables are the results of conjoint analysis showing the part-worths (utilities) of different factors used in the design. The higher the utility value, the more important is its factor.

Tomato type	Age group of participants			
	Overall ^z $n = 389$	Younger than 38 years ^y $n = 64$	39–57 years ^x $n = 222$	Older than 58 years ^w $n = 102$
----- Utility values (part-worths) -----				
Slicing	0.2696	0.3533	0.218	0.2963
Plum	-0.2245	-0.2584	-0.1775	-0.3194
Cherry	-0.1756	-0.1996	-0.1946	-0.0912
Grape	0.0516	-0.0624	0.1216	-0.0037
Cluster	0.0789	0.1671	0.0324	0.1181

^zAverage importance of tomato type was 19.1%, Pearson's $R = 0.986$.

^yAverage importance of tomato type was 23.2%, Pearson's $R = 0.981$.

^xAverage importance of tomato type was 16.2%, Pearson's $R = 0.986$.

^wAverage importance of tomato type was 22.7%, Pearson's $R = 0.979$.

Table 3. Summary of the results of an Internet survey for consumers (age 18 years or older) conducted in 2003 via the University of Florida Institute of Food and Agricultural Sciences website. The overall preferences of tomatoes were derived from scores given by participants who took part in the conjoint survey (Fig 3.) with combination of five tomato types, three price points, and two production methods. Numbers in the table are the conjoint analysis results showing the part-worths (utilities) of different factors used in the design. The higher the utility value, the more important is its factor.

Tomato type	Age group of participants			
	Overall ^z $n = 168$	Younger than 38 years ^y $n = 31$	39–57 years ^x $n = 45$	Older than 58 years ^w $n = 21$
----- Utility values (part-worths) -----				
Slicing	0.1995	0.2142	0.2089	0.3029
Plum	-0.1243	-0.3277	-0.1644	0.0267
Cherry	-0.1219	-0.0890	-0.1600	0.0076
Grape	0.0555	0.0594	0.1200	-0.2210
Cluster	-0.0088	0.1432	-0.0044	-0.1162

^zAverage importance of tomato type was 10.2%, Pearson's $R = 0.985$.

^yAverage importance of tomato type was 17.4%, Pearson's $R = 0.960$.

^xAverage importance of tomato type was 11.3%, Pearson's $R = 0.986$.

^wAverage importance of tomato type was 14.3%, Pearson's $R = 0.983$.

Table 4. Rating of relative importance (%) in price, production style, and tomato type as related to participant age group in the survey for consumers (age 18 years or older) conducted in 2003 via the University of Florida Institute of Food and Agricultural Sciences' website. The scores were derived from the conjoint survey design (Fig 3.) with combination of five tomato types, three price points, and two production methods. The higher the relative importance score, the more important is its factor.

Participant age (years)	Relative importance score (%)			
	Participants (no.)	Price	Production	Tomato type
Younger than 38 ^z	102	70.05	6.72	23.23
39 to 57 ^y	222	81.13	2.66	16.22
Older than 58 ^x	64	74.18	3.13	22.69

^zPearson's R = 0.981.

^yPearson's R = 0.986.

^xPearson's R = 0.979.

Table 5. Rating of relative importance in price, production style, and tomato type as related to participant's gender in the survey for consumers (age 18 years or older) conducted in 2003 via the University of Florida Institute of Food and Agricultural Sciences' website. The scores were derived from the conjoint survey design (Fig 3.) with combination of five tomato types, three price points, and two production methods. The higher the relative importance score, the more important is its factor.

Participant gender	Relative importance score (%)			
	Participants (no.)	Price	Production style	Tomato type
Male ^z	242	75	3	22
Female ^y	147	75	8	17

^zPearson's R = 0.984.

^yPearson's R = 0.984.

Table 6. Rating of the relative importance of price, lycopene content, and tomato type based on age group of participants in the survey for consumers (age 18 years or older) conducted in 2003 via the University of Florida Institute of Food and Agricultural Sciences' website. In this survey the researchers provided information on lycopene to consumers, and then asked them about their general attitude related to nutrition and health and their willingness to invest in health and well being through food. The participants were asked to score 25 photographs that were combinations of the five types of tomatoes, three price points, and three levels of lycopene (Fig 4). The more important the factor, the higher is its percentage.

Participant age (years)	Relative importance score (%)			
	Participants (no.)	Price	Lycopene content	Tomato type
Younger than 38 ^z	31	52.84	29.78	17.37
39 to 57 ^y	45	70.73	17.94	11.33
Older than 58 ^x	21	52.41	33.29	14.3

^zPearson's R = 0.960.

^yPearson's R = 0.986.

^xPearson's R = 0.983.

groups were seen (Table 4). Participants in the youngest age group (<age 38 years) placed the most importance on production style, followed by the oldest age groups, and finally the intermediate age group.

Gender differences in preferences were also seen in production preferences. Like the overall scores, price was the most important, followed by to-

mato type and production style (Table 5). Males placed greater importance on tomato type, whereas females placed greater importance on production style. The differences in price were not as great as seen in the lycopene survey, but female participants appeared to be less price-sensitive than males.

DOES LYCOPENE CONTENT MATTER? Most participants (79%) had heard

about the health benefits of lycopene and other phytonutrients found in tomatoes and tomato products either through the survey or past experience. The majority of participants agreed or strongly agreed with the statement that nutrition and diet affect one's general health and well being (93%). If they knew that certain foods were good for their health, most (86%) would be willing to consume more and pay more money for those foods.

The conjoint model accounted for 99% of the variance in consumer ratings (most of the variation in consumer's preferences). Price was the most important attribute (accounting for 64% of the variance in consumer preferences); followed by lycopene content (26%) and tomato type (10%). Consumers logically preferred the lowest price point (\$0.99/lb) and the highest lycopene content. Slicing tomatoes were the most preferred tomato type overall and by age group (Table 3). Increasing lycopene content was perceived as a health benefit. Older participants preferred the greatest lycopene content (Table 6). Nutritional concerns and health issues appeared to increase with age. Participants <age of 38 years also placed high importance on lycopene content. The price trend found in the lycopene survey held true in the production survey, in that the intermediate age group was the most price-sensitive (Table 6). As in the production (first) survey, the younger participants (<age 38 years) were the least price-sensitive and placed more importance on the other attributes, while the older participants (>age 58 years) showed slightly higher price sensitivity.

Gender differences in preferences were also seen. Consistent with the overall scores, price held the most relative importance, followed by lycopene content and tomato type (Table 7). The relative importance for each component in comparison is affected by gender. Females were less price-sensitive than males. The importance that females placed on the type of tomato to purchase and whether it had high lycopene content correlated higher than in males.

In similar studies with tabletop Christmas trees and orchids (Orchidaceae), researchers discovered that the importance of price decreased as participant age increased until age 60 years, when price again became a

Table 7. Rating of the relative importance (%) of price, lycopene content, and tomato type based on gender of participants in the survey for consumers (age 18 years or older) conducted in 2003 via the University of Florida Institute of Food and Agricultural Sciences' website. In this survey the researchers provided information on lycopene to consumers, and then asked them about their general attitude related to nutrition and health and their willingness to invest in health and well being through food. The participants were asked to score 25 photographs that were combinations of the five types of tomatoes, three price points, and three levels of lycopene (Fig. 4). The more important the factor, the higher is its percentage.

Participant gender	Relative importance score (%)			
	Participants (no.)	Price	Lycopene content	Tomato type
Male ^z	113	65.32	24.83	9.85
Female ^y	55	57.92	26.99	15.09

^zPearson's R = 0.984.

^yPearson's R = 0.985.

more important component (Behe et al., 2005). Following the American generations age distribution (Mitchell, 2002), researchers divided participants into three age groups: a) people younger than 38 years (millennial and generation X), b) people 39 to 57 years (baby boomers), and c) participants >58 years or older (World War II and swing generations). What was observed in both the Christmas tree and orchid surveys was opposite of what we observed in the lycopene survey. Price sensitivity was lowest in people <38 years and >58 years but was significantly greater for baby boomer-era participants (39 to 57 years) (Table 6). This type of information can be used by retailers in adjusting their prices for the promotion of fresh tomatoes. For example, if a retail store is located near a community where most people are younger than 38 years or older than 58 years, slightly higher prices may not affect the quantity sold.

Conclusion

The Internet survey using high-resolution photographs allowed researchers to show participants products in a consistent and realistic manner. Based on these research results, price consistently emerged as the most important factor, followed by tomato type, lycopene content, and production style. Despite availability of many types of tomatoes, slicing tomatoes were the most preferred and the most frequently purchased and had the greatest amount (weight) purchased in the 4 weeks prior to the survey. Although the least favored tomato was the plum tomato, it was the third most frequently purchased. Overall, production style had

low importance in comparison to price and tomato type but differences in age groups were seen. The youngest group (age <38 years) placed the most importance on organic production. Most fresh-market tomatoes were used in food raw, without cooking. Tomatoes remain an important functional food in the American diet. Preference differences seen here can be utilized by marketers as they target specific age segments to increase their purchases of fresh tomatoes.

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