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Consumer Acceptance of the New Red-Fleshed Apple Variety

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ABSTRACT

The aim of this study was to investigate consumer preference for the novel red-fleshed apple genotypes. The information presented provides us with insight into consumer propensity to accept a new variety with radical visible innovative attributes and societal demand for a more sustainable production. The survey was carried out on the population of a province in central Italy, where there is consumer demand for organic and high-quality foods. The consumers' opinions contrasted greatly and can be divided into two groups. Over one quarter of the respondents declared that they did not like the innovative fruit. The cluster analysis and CHAID analyses were performed on the consumers' responses to determine sample groupings. Three clusters were identified among the consumers with positive opinions, enthusiastic, health-conscious, and unmotivated illustrating how the hierarchical level of preferences of the potential consumers of the red-fleshed apple fruit are triggered by various motivations. The surveys also pointed out that most consumers of the sampled population were not biased against research activities producing innovative food products. A large number of consumers, especially women, declared that they were willing to pay a higher price considering the increased nutritional value of red-fleshed apple fruits. By examining the broad context of this study, decision-making researchers and operators of the fruit industry will be able to make informed and realistic predictions concerning possible future scenarios and to determine the possible effects and desirability.

KEYWORDS

CHAID analyses; cluster analysis; customer behavior; functional food; red-fleshed apple

Introduction

Over the last few years, the EU policies for public health have been aimed at promoting the consumption of fruit and vegetables among the European population (Council Regulation No. 1234/2007 and No. 288/2009; Regulation No. 1308/2013 of the European Parliament). Many research projects have been funded to improve the nutritional value of fruits and vegetables and to investigate the perceptions and preferences of consumers in order to promote

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healthy eating habits (Bertschinger et al., 2009; Bonany et al., 2013, 2014). In addition to being rich in vitamins, minerals, and fiber, fruit and vegetables contain an array of many other essential nutrients (phytochemicals) that the human organism is unable to synthetize de novo, even if they are highly beneficial to human health and well-being. Phytochemical compounds include various classes of substances, in particular phenolic compounds, which are important for their antioxidant and antiradical properties (Vauzour, Rodriguez-Mateos, Corona, Oruna-Concha, & Spencer, 2010).

A series of epidemiological studies and meta-analyses have linked the long-term dietary intake of some classes of phytochemicals, such as phenols, to a reduced risk of cardiovascular and neurodegenerative diseases, diabetes, osteoporosis, and some types of cancers (Boyer, Latek, & Peterson, 2004; Wang et al., 2014). The global interest for phytochemicals has led the stakeholders of the agriculture and food sectors to develop a new category of products: functional foods that include fortified, enriched, or enhanced foods with improved health-promoting effects. The functional food market is expanding rapidly and represents one of the most promising and dynamically developing segments of the food industry (Sirò, Kapolna, Kapolna, & Lugasi, 2008). Apples are one of the most popular fruits in the EU and contain important classes of functional compounds such as flavonoids (anthocyanins, dihydrochalcones, flavonols, and flavanols) and phenolic acids (chlorogenic acid). Many studies have shown that the genetic variability within apple germplasm shows potential to improve the phytochemical content in fruit (Tsao, Yang, Xie, Sockovie, & Khanizadeh, 2005; Wojdylo, Oszmianski, & Laskowski, 2008). Developing new apple cultivars with enhanced health attributes could be an effective strategy for opening new segments in the hypercompetitive fruit market. Various breeding programs have focused on the development of red-fleshed apple cultivars, under the assumption that consumers associate the red coloration of the flesh with high antioxidant activity and health-promoting effects, which will generate a new market segment (Espley et al., 2013). Although a fair number of red-fleshed cultivars were released in the early 1940s, they have never been commercialized or put on the market. The Italian Red Passion (IRP) is a new line of apple genotypes, characterized by various peel colors, pink-red flesh, high phenol content, and a higher antioxidant potential than other commercial apples (Cirilli et al., 2015).

The successful positioning of new apple varieties requires a good knowledge of consumer preferences and perceptions to develop appropriate marketing strategies (Harker, Gunson, & Jaeger, 2003). In the apple market, it is generally the appearance and/or taste of the fruit that drive consumer preferences (Cliff, Sanford, Wismer, & Hampson, 2002; Pre-Aymard, Fallik, Weksler, & Lurie, 2005). Appearance includes the external fruit color, shape, and aesthetic appeal, as well as the color of the flesh, whereas taste includes flavor, texture, and mouth-

feel attributes (Harker, Amos, White, Petley, & Wohlers, 2008). Launching new products on the market poses several challenges; first, whether potential consumers will judge the characteristics of the new product positively. The colored flesh of new apple varieties might appear to be excessively radical innovations to European consumers, and although they originate from a traditional breeding program, they might be confused with OGM-derived products, which consumers are generally against, thus generating much debate for society in general (Martinelli, 2010). Placing a radical innovation on the market could create a discontinuity in consumer preferences (Aarikka-Stenroos & Lehtimäki, 2014; Schilling, 2005). Therefore, to estimate the market potential of radical innovation, a paradigmatic group of consumers should be carefully selected, which should also include those who prefer organic products, since they are becoming more and more popular in European countries (GMO Compass, 2009). The inhabitants of central Italy, where Tuscany and the Tuscia area are located, consume organic food and are becoming more and more exigent concerning food quality (Symphonyiri Group, 2015); therefore, there are many organic farms in the agricultural system of both areas (Mirto & Cosentino, 2014). For this reason, there are many negative reactions to certain innovations in agribusiness that result in poor product acceptance and market access.

First, it was essential to make a careful assessment of consumer acceptances by investigating the population of an area inhabited mainly by consumers of traditional and organic products who could confuse the radical innovation, the red-fleshed apple of Italian Red Passion varieties, with a genetically modified product that could lead to the ban of the innovation. In fact, consumers are aware that fruit biologists indicate the possibility of obtaining fruit with enhanced nutrient composition and food quality among the benefits obtained from using GMO technology, which can increase the accumulation of polyphenols (Phillips, 2008), such as flavonoids, which in turn could determine the red coloration of flesh. Another aim of the survey was to gain insight into consumers' level of interest and purchase decisions regarding the new red-fleshed apples, by focusing on pre-purchase factors such as attributes and price and identifying the sociodemographic characteristics of consumers associated with the level of interest.

Methodology

Study area and sampling procedure

The Italian Red Passion (IRP) apple group developed by DAFNE, one of the departments of the University of Tuscia (Viterbo, Italy), includes lines deriving from the open pollination of an Italian autochthonous red-fleshed apple. The survey was carried out in January 2014 at the *Centro Commerciale Tuscia* shopping center located in Viterbo (Italy). Viterbo and the

surrounding area is a typical Italian province, with urban-intermediate-rural areas (ISTAT, 2013) and a population density of inhabitants 86.6/km^2. The consumers were recruited by means of the quota sampling method, which stratifies them by age, class, and gender, from the total residential population in the province of Viterbo. The sampling share was calculated on 500 interviews. Fifteen uncompleted questionnaires were discarded; therefore, the final sample was composed of 485 participants corresponding to 97% of the total. The interview was run over a 7-day period including weekends at various shopping hours to avoid bias of the consumers' opinions and to guarantee the homogeneity of data-gathering conditions. Participation in the survey was voluntary.

Questionnaire and variables

During the selection of Italian Red Passion genotypes, a trained sensory panel was used to test the predominant sensory attributes of apple fruits, with the aim of evaluating consumer acceptance by guaranteeing high-quality fruit attributes. The panel members were strongly influenced by the appearance of the red flesh, and some of them suspected that the apple fruits could have come from GMO plants; therefore, the panel members were blindfolded before participating in the sensory test of fruits. In a previous survey carried out in 2012, the participants were asked to voice their opinion on innovative foods. This exploratory analysis was conducted on a sample composed of 508 consumers, with the aim of understanding whether there was consensus concerning their interest toward a new food product or whether their interest was divided into two segments of contrasting opinions. The results obtained from this survey indicated that 73.4% declared to be highly interested in the innovative apple product, while the remaining 26.6% declared their dislike (Figure 1, Supplemental Material).

The questionnaire filled in by the consumers selected for the 2014 survey included 13 questions (Table 1) concerning three main topics: (1) consumer habits regarding apple fruit; (2) the level of interest for tasting and purchasing red-fleshed apples, based on the extrinsic quality of the fruit and health-promoting effects; (3) consumer profile, delineated by the sociodemographic characteristics of consumers (i.e., gender, age and profession). Various types of scales were used for measuring the answers to the closed-response questionnaire. The consumption habits of the respondents regarding apples and purchase propensity were collected by means of a dichotomy yes/no question. To avoid a central tendency bias of the responses, a 6-point Likert scale (Bernués, Ripoll, & Panea, 2012; Likert, 1932; Matell & Jacoby, 1971), ranging from *not important at all* (scoring value 1) to *very important* (scoring value 6), was used to collect information concerning the respondents' interest in tasting the red-fleshed IRP apple and motivational factors. The questionnaire included multiple-choice questions on the consumers' impressions after observing the red-

Table 1. Questionnaire used in the survey. The consumers expressed their opinion with yes/no answers, and by judging the consumption of the apple fruit, the importance of extrinsic apple attributes and purchasing habits.

Do you frequently consume apple fruit? [1]	Yes or No response
Are you already familiar with red-flesh apples or IRP apples?[1]	Yes or No response
Are you interested in tasting this new red-flesh apple variety?[2] (assign a score from 1 *not interested* to 6 *very interested*)	6-point Likert scale from *not important at all* (1) to *very important* (6)
How the following motivations influenced your interest/not interest to taste red-flesh apple?	
If interested (assigning a score from 4 to 6)	
• Curiosity[2] (assign a value from 1 to 6)	6-point Likert scale from *not important at all* (1) to *very important* (6)
• Nutritional properties[2] (assign a value from 1 to 6)	6-point Likert scale from *not important at all* (1) to *very important* (6)
• Appearance[2] (assign a value from 1 to 6)	6-point Likert scale from *not important at all* (1) to *very important* (6)
If not interested (assign a score from 1 to 3)	
• Mistrust in novel food products[2]	6-point Likert scale from *not important at all* (1) to *very important*' (6)
• Mistrust in OGM-free origin of red-flesh apple[2]	6-point Likert scale from *not important at all* (1) to *very important* (6)
What is your opinion on this novel food? (Choose until three answers)	Multiple-choice questions
Appealing flesh color	
Unusual flesh color	
Not very intense flesh color	
Appealing shape	
Unusual shape	
Too small size	
Other	
Given the higher nutritional value compared to other commercial cultivar, would you would willing to purchase red-flesh apple?[1]	**Yes or No response**
If yes, would you pay a premium price?[3]	Multiple-choice questions
No, the same average price of apples currently on the market	
Yes, 25% more than the average apples price	
Yes, 50% more than the average apples price	
Yes, 75% more than the average apples price of apples	
Yes, 100% more than the average apples price	
If not, why wouldn't you buy red-flesh apple?[3]	
I am not interested	Multiple-choice questions
Red-flesh apples are not better than other varieties	
I do not believe to what affirmed by researcher about its higher nutraceutical properties	
Other	

(*1) Yes or No response (*2) 6-point Likert scale from *not important at all* (1) to *very important* (6) (*3) Multiple-choice questions.

fleshed apple fruit, their propensity to pay a premium price, and the percentage of price overcharge. Last, the consumers' sociodemographic characteristics, such as age, place of residence, gender, and profession, were also collected.

Considering the relevance of the nutritional properties of the fruits of the IRP genotypes, information was provided by means of a poster (Figure 2, Supplemental Material) with various photographs of one representative red-fleshed IRP apple and information on its high antioxidant capacity and

health benefits. The symbol of "no OGM" (GMO-free products) was also included in the poster. Red-fleshed apple fruits and sections of them were shown while the questionnaires were being handed out.

Data analysis

The two distinct radical opinions observed in the sample population in the 2012 survey were also found in the 2014 survey; we therefore decided to divide the sample into two segments: favorable and unfavorable (Figure 3, Supplemental Material).

The data concerning the consumers' opinions were represented by means of frequencies, and a weighted average was performed for each of the attributes analyzed.

The correlation indexes among the variables were calculated to assess the subsequent use of the cluster analysis. The results showed a low correlation value among the variables (Tables 1 and 2 Supplemental Material), which led us to consider the possibility of applying the cluster analysis without using the factorial analysis.

The cluster analysis enables us to identify groups of consumers according to preference and define variables (Keen, Wetzels, De Ruyter, & Feinberg, 2004), measure of distance, relatedness, or similarities between importance ratings or utility measures (Aldenderfer & Blashfield, 1984). The effectiveness of the cluster analysis has been widely demonstrated in the literature (Johnson, 1967; Kern & Culley, 2015; Park & Baik, 2006), particularly for understanding food consumption behavior (Müller & Hamm, 2014; Sahmer, Vigneau, & Qannari, 2006; Visschers, Hartmann, Leins-Hess, Dohle, & Siegrist, 2013; Walthouwer, Oenema, Soetens, Lechner, & De Vries, 2014).

A two-stage clustering approach was used as suggested by Punj and Stewart (1983). First, a hierarchical cluster was used to determine the number of clusters; subsequently, a nonhierarchical cluster was used to fine-tune the results, as iterative or nonhierarchical clustering methods are better than hierarchal clustering methods. A preliminary identification of clusters was obtained by means of Ward's linkage method (1963), which minimizes the total within-cluster variance, and was refined with the K-means procedure (Keen et al., 2004; Moore & Semenik, 1988). The Caliński and Harabasz index (1974) was used to determine the number of clusters on the dendrogram; subsequently, a K-means procedure Euclidian distance was adopted to fine-tune the results. One-way ANOVA was used to evaluate the statistical significance of the identified clusters, considering the scores as the dependent variable and the cluster membership as the independent variable (Annunziata & Vecchio, 2011; Bernués et al., 2012). Finally, the latent class cluster (LCC) analysis was used to validate the cluster number obtained with the two-stage clustering approach suggested by Punj and Stewart (1983). The

advantage of LCC is that it uses a statistical model in which the choice of the cluster criterion is less arbitrary (Vermunt & Magidson, 2002; see Table 3 and Table 4, Supplemental Material).

The cluster analysis (CA) was used to determine the intensity of the reasons that made the consumers appreciate the values of innovation and wellbeing of the IRP apple. The results obtained from the CA were statistically validated with the analysis of variances (ANOVAs), which were used for continuous outcomes to test for differences based on sociodemographic characteristics. The consumers' mood and the pomological properties of apple fruit were analyzed together to identify a hierarchal classification of the consumers' opinions. The resulting classes of favorable consumers depended on the Likert values that they assigned to each of the three attributes: curiosity, nutritional, and visual. The visual attributes of the apple are based on the pomological characteristics that are generally considered when evaluating the pleasantness of an apple, such as the color of the skin and pulp. The unfavorable consumers to IRP apples, who assigned Likert values less than or equal to 3, included those who distrust novel foods and/or reject GMO-derived products.

The sociodemographic characteristics linked to consumer propensity to purchase red-fleshed apples were evaluated by means of a decision-tree methodology based on the chi-squared automatic interaction detection (CHAID) algorithm (Gámbaro, Ellis, & Prieto, 2013; van Diepen & Franses, 2006). The CHAID technique generated a classification tree, on which the relationships between the predictor variables (i.e., professional, gender, age) are visible as well as those that have significant statistic values (p value) in the chi square test. The CHAID algorithm is an easy model to understand and interpret and has proven to be useful for understanding consumer preferences and purchase intentions in the food market (Bozkir & Sezer, 2011). SPSS v. 22.0 software was used for carrying out the descriptive statistic, cluster analysis, and CHAID.

Results

Sample characterization

More than one half of the participants (58.8%) lived in the city of Viterbo, with a total number of residents equal to 63,707, while the remaining respondents (41.2%) lived in the same province or the neighboring provinces, spread across the Tuscia area and Tuscany. These are particularly rural provinces with numerous small towns and villages composed of fewer than 10,000 residents. The sociodemographic characteristics of the consumers (Table 2) proved to be representative regarding the gender and age groups of the population of the province of Viterbo and Italy.

Table 2. Frequency and percentage of respondents as subdivided among gender and age classes of the sampled population. These values are compared to those observed in the population residing in the province of Viterbo and the national Italian population. The total Italian population is 60,782,668 (Istat, 2013), while the population under 14 years of age (8,448,133) was excluded from the table since it was considered irrelevant for the survey. Similarly, this segment of the population (40,367) was not included in the population of the province of Viterbo.

	Sample		Viterbo		Italy	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
M	242	49.90	136,350	48.4	25,139,683	48.0
W	243	50.10	145,478	51.6	27,194,852	52.0
Total	**485**	**100.00**	**281,828**	**100.0**	**52,334,535**	**100.0**
15–19	26	5.40	13,804	4.9	2,862,527	5.5
20–29	60	12.40	33,524	11.9	6,417,828	12.3
30–39	77	15.90	44,502	15.8	8,115,064	15.5
40–49	78	16.10	51,626	18.3	9,857,747	18.8
50–59	82	16.90	46,036	16.3	8,435,388	16.1
≥ 60	162	33.40	92,336	32.8	16,645,981	31.8
Total	**485**	**100.00**	**281,828**	**100.0**	**52,334,535**	100.0

Source. (Istat, 2013).

The largest professional categories, among the 12 main categories of this area, were pensioners (21.5%), students (14.5%), housewives (14.5%), and clerical workers (11.0%).

Sixty percent of the consumers declared that they eat apples on a regular basis, yet 95.0% declared that they were not familiar with red-fleshed apples or Italian Red Passion apple lines. As already observed in the 2012 survey concerning the willingness of consumers to taste the red apple pulp, 73.4% expressed a strong degree of interest in the innovative apple product (Figure 1 Supplemental Material). These data showed that the participants in our study had two opposing viewpoints.

Consumer orientation

Despite the fact that the percentage of unfavorable consumers increased to 36.1% (Table 3, Figure 1 Supplemental Material), the data obtained from the 2014 survey confirmed the results obtained in 2012. We therefore decided to carry out the analysis by considering the group of favorable interviewees, composed of most of the consumers (64.0%), separately from the group of unfavorable consumers who were not interested in tasting the red-fleshed apple (Table 3).

The degree of interest in tasting the new red-fleshed apple expressed by the favorable consumers was evaluated by means of the Likert scale (Table 4). The members of this group declared that curiosity (45.5% on the total) was the main motivation (weighted mean 5.02) that influenced their decision.

Nutraceutical properties (36.1% on the total) and visual appearances (36.7% on the total) also played important roles in the decision-making process, with each scoring a weighted mean value of 4.81 and 4.41,

Table 3. Degree of interest to taste IRP red-flesh apple expressed from the consumers.

Are you interested in tasting this red-flesh apple variety?	Frequency	Percentage
1 = *not important at all*	91	18.8
2	48	9.9
3	36	7.4
4	103	21.2
5	90	18.6
6 = *very important*	117	24.1
Total	485	100.0

Table 4. Frequency, percentage, and weighted average of attributes that motivated the favorable consumers.

	Curiosity		Nutraceutical properties		Visual appearance	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1 = *not at all*	1	0.3	5	1.6	20	6.4
2	7	2.3	12	3.9	27	8.7
3	17	5.4	26	8.4	39	12.6
4	69	22.3	63	20.3	59	19.0
5	74	23.9	92	29.7	52	16.8
6 = *very much*	142	45.8	112	36.1	113	36.5
Total	310	100.0	310	100.0	310	100.0
Weighted average	**5.02**		**4.81**		4.41	

respectively (Table 4). All the data indicate that curiosity and the nutritional properties that are important for promoting health are the main motivations among the consumers, scoring 92% and 86.1%, respectively, whereas visual appearance scored only 72.3%. In general, the results indicated a positive reaction of the respondents toward a potentially beneficial innovation.

The consumers who were unwilling to taste the red-fleshed apple declared that it was not because they mistrusted new foods or the GMO putative origin of red-fleshed apples—in fact, these motivations scored mean values of 3.34 and 3.22, respectively (Table 5). However, 49.1% of consumers were skeptical of every new food product, and 45.7% of consumers assigned a score from 4 to 6 because they suspected that the new apple fruit could be a GMO product (Table 5). Among these consumers, 18.3% of them (Likert values 4–6) were extremely wary of the IRP apple as a new product, whereas 14.9% of consumers (Likert 4–6) did not like it because they assumed it to be a GMO apple fruit.

The higher nutritional properties of the IRP apple varieties compared to commercial apples motivated 73% of consumers to purchase red-fleshed apples, and 35% of them would be willing to pay a higher price than other apple varieties. In fact, 76% of the favorable consumers were willing to pay up to 25% more than the normal price (Table 6). It is important to note that the percentage of consumers who declared they would buy the new apple fruit was 9% higher

Table 5. Frequency, percentage, and weighted average of attributes that motivated the unfavorable consumers.

	Novel food		GMO origin	
	Frequency	Percentage	Frequency	Percentage
1 = *not at all*	41	23.4	48	27.4
2	15	8.6	20	11.4
3	33	18.9	27	15.4
4	39	22.3	31	17.7
5	23	13.1	22	12.6
6 = *very much*	24	13.7	27	15.5
Total	175	100.0	175	100.0
Weighted average	**3.34**		3.22	

than consumers who declared that they were willing to taste the new apple fruit (64%). Among the unfavorable consumers who were not interested in purchasing the IRP apple, 54% of them did not believe the red-fleshed apple to have higher nutritional qualities than other varieties, whereas 28% of them were simply not interested (Table 6). A small percentage of consumers (11%) declared that they did not believe the researchers' claims concerning the high-quality properties; furthermore, they suspected that the red-fleshed apple was not a natural fruit.

The color of apple pulp was the factor that attracted the attention of consumers (Table 7). The red color of the pulp proved to be appealing and unusual for 29.1% and 26.8% of the total responses. The shape of the apple also proved to very attractive, since it scored 24.7% of total responses (Table 7), whereas the consumers gave less importance to the size of the fruit.

Consumer profile

The consumers' responses to the question "Are you interested to taste this new red-flesh apple variety?" ranged from *not interested* to *very interested*, which scored from 1 to 6, respectively, on the Likert scale used for evaluating

Table 6. Consumers' opinion on the possibility of purchasing red-flesh apples.

Considering the highest nutritional value of IRP-apple, would you be willing to buy it?	Frequency	Percentage
Yes	355	73.2
No	130	26.8
Total	485	100.0
If yes, what do you think is the right price for selling it?	Frequency	Percentage
The same price of other fruit varieties	232	65.4
Higher price than other fruit varieties	123	34.6
Total	355	100.0
How much higher could the price be?	Frequency	Percentage
25%	94	76.4
50%	17	13.8
75%	7	5.7
100%	5	4.1
Total	123	100.0

Table 7. Consumers' opinions concerning the apple fruit characteristics. Each consumer was able to choose three attributes among the fruit characteristics indicated and/or voice his or her own opinion.

What is your opinion after observing this novel apple varieties?	Frequency	Percentage
Appealing flesh color	207	29.1
Unusual flesh color	191	26.8
Not very intense flesh color	33	4.6
Appealing shape	176	24.7
Too small size	95	13.3
Other	10	1.4
Total	712	100.0

the degree of interest. The consumer sample was divided into two groups: the favorable group (1) composed of those willing to taste the red-fleshed apple who assigned a score between 4 and 6; and the unfavorable group (2) composed of those unwilling to taste the red-fleshed apple who assigned a score between 1 and 3.

By splitting the group, the characteristics of the various consumer segments of both the favorable and unfavorable groups to taste the red-fleshed apple were determined by means of the cluster analysis based on the motivations that influenced their choice. A further nonhierarchical cluster analysis confirmed the segments identified. The cluster analysis identified three cluster segments for the consumers who were interested in tasting the red-fleshed apple: enthusiastic, health-conscious, and unmotivated (Table 8). The identification of the three cluster segments was validated by LCC (Table 3, Supplement Material).

The enthusiastic consumers who represent the main segment of the cluster, accounting for 56.6% of total variability, assigned the same importance to curiosity, nutritional properties, and visual appearance, which scored similar highest mean values of 5.53, 5.14, and 5.48, respectively. This segment was composed mainly of women over 60 years of age and of the professional categories of pensioners, housewives, and shop assistants (Table 9).

The health-conscious consumers considered the nutraceutical properties (5.21-scored value) as being the main reason driving their interest, whereas

Table 8. Number of identified attributes, profiles, and intensity values of correlation as observed in the cluster analysis of favorable consumers. The number of clusters were identified by Caliński and Harabasz index, and the visualization of dendrogram of cluster analysis.

	Importance score (%)				ANOVA	
Attribute	Excited (n = 175)	Health-conscious (n = 67)	Unmotivated (n = 67)	Mean value	F	P-value
Curiosity	5.53	4.81	3.91	5.02	8.95	< .001
Nutraceutical properties	5.14	5.21	3.54	4.81	5.60	< .001
Visual appearance	5.49	2.15	3.87	4.41	3.63	< .003

Table 9. Sociodemographic characteristics and purchase intention of the favorable consumers of the three clusters.

	Curiosity (n = 175; 56.63)		Health-conscious (n = 67; 21.68%)		Unmotivated (n = 67; 21.68%)		
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	p value
Gender							
Male	85	48.6	34	51.5	39	58.2	<.408
Female	90	51.4	32	48.5	28	41.8	
	175	100.0	66	100.0	67	100.0	
Age Group							
15–19	8	4.6	3	4.5	3	4.5	< .251
20–29	14	8.0	8	12.1	9	13.4	
30–39	27	15.4	15	22.7	14	20.9	
40–49	31	17.7	11	16.7	5	7.5	
50–59	30	17.1	7	10.6	20	29.9	
≥60	65	37.1	22	33.3	16	23.9	
	175	1	66	100.0	67	100.0	
Professional category							
craftsman	4	2.3	0	0.0	3	4.5	< .047
housewife	35	20.0	4	6.1	10	14.9	
salesgirl	7	4.0	1	1.5	1	1.5	
unemployed	12	6.9	4	6.1	4	6.0	
military	6	3.4	2	3.0	2	3.0	
employee	13	7.4	13	19.7	8	11.9	
entrepreneur	9	5.1	7	10.6	6	9.0	
teacher	15	8.6	1	1.5	8	11.9	
worker	11	6.3	3	4.5	5	7.5	
retired	35	20.0	15	22.7	11	16.4	
student	18	10.3	11	16.7	7	10.4	
other	10	5.7	5	7.6	2	3.0	
	175	100.0	66	100.0	67	100.0	
Residence							
Viterbo	105	60.0	35	53.0	28	41.8	< .038
province	70	40.0	31	47.0	39	58.2	
	175	100.0	66	100.0	67	100.0	

visual appearance was quite irrelevant (Table 8). This segment was composed mainly of women, with the most representative age classes ranging from 20 to 49 years and the over 60s. The main professional categories were clerical workers, students, entrepreneurs, and pensioners (Table 9).

The segment of the unmotivated cluster was composed of consumers who were not attracted by any of the three motivations, as shown by the similar low values scored (Table 8). This segment was composed mainly of consumers belonging to the 50–59 age group, as well as men who were teachers, employees, and workers (Table 8).

The cluster analysis of the consumers who were not interested in tasting the red-fleshed apple identified two segments (Table 10): the indifferent (42.20%) and the traditionalists (57.80%). The identification of the two cluster segments was validated by LCC (Table 4, Supplement Material). The indifferent segment included consumers who were not influenced by

Table 10. Number of identified attributes, profiles and intensity values of correlation as observed in the cluster analysis of unfavorable consumers. The number of clusters were identified by Caliński and Harabasz index, and the visualization of dendrogram of cluster analysis.

	Importance score (%)			ANOVA	
Attribute	Indifferent (n = 73)	Traditionalist (n = 100)	Mean profile	F	p value
Mistrust in novel food product	1.41	4.55	3.23	2.96	<.014
Mistrust in non-GMO free	2.59	3.89	3.34	1.72	<.131

any of the motivations suggested in the questionnaire (Table 1) and was composed mainly of men belonging to the under 39 age group (56.2%) and the professional category of students and unemployed (Table 11). The traditionalist segment, which included those consumers who were fairly skeptical of new food products, showed the highest scored value (4.55), and they suspected that the red-fleshed apple was a GMO product (Table 10). This segment was composed mainly of the older members of the population, that is, age classes over 40 and pensioners (Table 11).

Sociodemographic characteristics of consumers

The results obtained with the CHAID analysis identified the sociodemographic characteristics of consumers who were willing to purchase red-fleshed apples (Figure 1). This propensity, which represents the target variable, proved to be based mainly on information concerning the profession of the respondents. In fact, the most important predictor proved to be the profession, followed by the gender predictor, while no significant values were observed for age and origin. The profession predictor enabled us to divide the sample into three (nonterminal) parent nodes (Figure 1). Node 1 includes the professional categories of workers, housewives, clerical staff, teachers, and others, and the interest declared by these professional categories differed statistically from all the other categories and proved to be strongly inclined toward purchasing. Seventy-seven percent of the consumers of this node were inclined to buy red-fleshed apples. It is interesting to note the effect of the gender predictor, which divides this parent node into child nodes 4 and 5. Moreover, although it was not statistically significant (p value > 0.05), according to the age predictor, child node 4 was divided into terminal nodes 8 and 9 (Figure 1). On one hand, the members of nodes 4 and 5 were characterized by the women's interest in purchasing (81.4%) and, on the other hand, by a slight reduction of men's interest (69.3%).

Parent node 2 (Figure 1), which includes students, artisans, pensioners, the unemployed, and shop assistants, differs from all the other categories since the members interested in purchasing red-fleshed apples decreased to 66.9%.

Table 11. Sociodemographic characteristics and purchase intention of the unfavorable consumers of the two clusters.

	Indifferent (n = 73; 42.20%)		Traditionalist (n = 100; 57.80%)		
	Frequency	Percentage	Frequency	Percentage	p value
Gender					
Male	33	45.2	48	48.0	<0.717
Female	40	54.8	52	52.0	
	73	100.0	100	100.0	
Age group					
15–19	10	13.7	2	2.0	<0.000
20–29	21	28.8	8	8.0	
30–39	11	15.1	10	10.0	
40–49	10	13.7	20	20.0	
50–59	6	8.2	18	18.0	
≥60	15	20.5	42	42.0	
	73	100.0	100.0	100.0	
Professional category					
craftsman	0	0	8	8.0	<0.007
housewife	5	6.8	15	15.0	
salesgirl	1	1.4	4	4.0	
unemployed	8	11	7	7.0	
military	0	0	3	3.0	
employee	7	9.6	11	11.0	
entrepreneur	2	2.7	2	2.0	
teacher	3	4.1	2	2.0	
worker	4	5.5	7	7.0	
retired	13	17.8	30	30.0	
student	25	34.2	9	9.0	
other	5	6.8	2	2.0	
	73	100.0	100	100.0	
Residence					
Viterbo	48	65.8	69	69.0	<0.654
province	25	34.2	31	31.0	
	73	100.0	100	100.0	

The gender predictor proved to be highly influential for this node, too, and was responsible for the segmentation of this node into two additional terminal nodes 6 and 7. A significant reduction in women's intention to purchase was observed in node 6, whereas no changes were observed concerning men's opinions in node 7.

Parent node 3 (Figure 1) proved to be a terminal node and included military personnel and entrepreneur categories, which showed a significant increase in their intention to purchase, irrespective of age and gender. Military personnel and entrepreneurs seem to be the most interested in purchasing the product, regardless of age and gender.

For the other professional groups, gender played an important role with the women who were more inclined to purchase red-fleshed apples. An important factor to consider is the amount of disposable income characterizing the various professions (Figure 1). For this reason, it is essential to distinguish the categories of entrepreneurs, military, employees, teachers, and

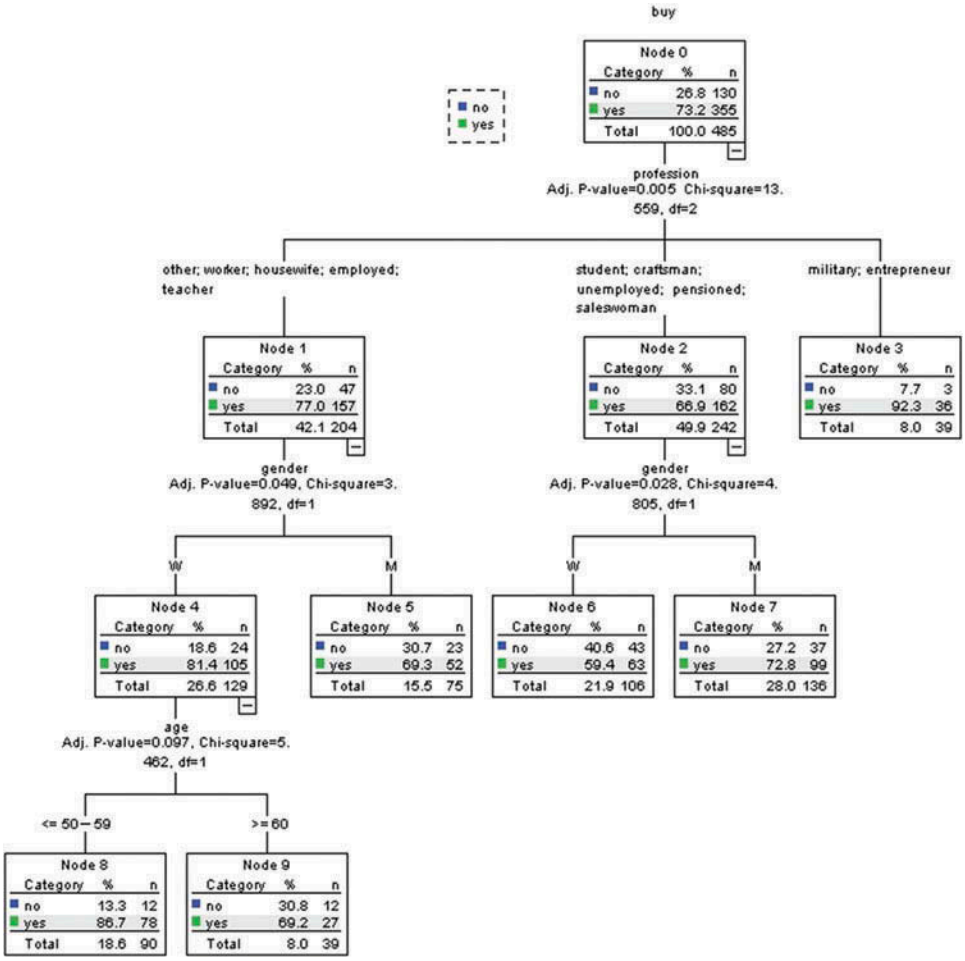

Figure 1. Tree of propensity to purchase red-fleshed apple fruit according to type of consumers, as determined by chi-squared automatic interaction detection (CHAID) algorithm based on adjusted significance testing (Bonferroni).

workers who have sufficient regular income to purchase, from the unemployed, students, and pensioners who have low, irregular, or no incomes.

Discussion

Today there is growing interest in the beneficial properties of food products. The phenolic components of fresh and processed vegetable products could help to safeguard people from human diseases (Latruffe, Menzel, Delmas, Buchet, & Lançon, 2014; Wang et al., 2014). Therefore, gaining insight on consumers' preferences for new types of apple fruit, as well as any other fruits, may prove to be useful for researchers and decision-makers, especially when placing new cultivars on the market. The information obtained will

help researchers to understand the main fruit attributes, which should be developed through improvement programs of new varieties. Recently, breeding programs are focusing more and more on nutritional values and health-promoting effects rather than production issues (Espley et al., 2013), as suggested by EC regulations. Italian Red Passion (IRP) apples lines are an innovative product; characterized by a red-colored flesh, they are rich in phenols and have numerous nutritional properties (Cirilli et al., 2015).

In this study, despite the fact that 95% of the participants were not aware of the existence of apple genotypes with red flesh, only a small percentage thought that they were of GMO origin. Moreover, although the red color of the apple flesh might represent a radical innovation for consumers, they seemed to be favorable toward the product and demonstrated being highly inclined to purchase this type of apple. Few consumers, less than 20%, did not consider the red color of flesh, per se, as the main factor driving their purchase decisions; in fact, consumers considered this attribute as a property, which makes the product unusual and exciting to taste and purchase. Moreover, the high nutritional and health-promoting attributes proved to be the main drivers of consumer preferences. These results are explained by the current level of knowledge of consumers on quality criteria, such as the content of phytonutrients; consequently, high-quality and health-promoting foods are expected (Ares, Giménez, & Gámbaro, 2009; Bech-Larsen & Grunert, 2003; Enneking, Neumann, & Henneberg, 2007). Moreover, it is becoming more and more important to provide consumers with information on the nutritional value of each product, which, together with the sensory characteristics, leads them to purchase the fruits (Endrizzi et al., 2014). There are an increasing number of consumers who are interested in the organoleptic qualities of fruit, as well as information on their health attributes. The best-informed members of the general public are those belonging to age classes over 18–20, which is confirmed by the results obtained from this survey. In fact, the members of the health-conscious cluster belong to the over 20 age classes, in contrast to what was observed in the under 20 population (Stevenson et al., 2007). Several studies have compared the behavior of consumers of various age groups, and it was observed that consumers over 20 proved to be more knowledgeable and sensitive to food quality and the antioxidant properties of the apple (Ares et al., 2009; Herath et al., 2008, Endrizzi et al., 2015; Harker et al., 2008; Lalor, Madden, McKenzie, & Wall, 2011). Endrizzi and collaborators (2015) attributed young people's behavior to their lack of attention and knowledge concerning antioxidant food properties, which is generally associated with the lack of interest in nutritional information. In fact, the indifferent segment contained a large percentage of young people as determined by the cluster analysis. The set of these results indicates that adults and the elderly have a more positive approach toward functional foods and are more receptive to health claims,

making them more likely to purchase food with high health values. Some studies have found that informing consumers of the properties of a food may increase their level of satisfaction and trigger their curiosity to taste new food products (Ares, Gimènez, & Gàmbaro, 2008; Bech-Larsen & Grunert, 2003; Žeželj, Miloševic´, Stojanivic´, & Ognjanov, 2012).

Women, who are more driven by curiosity, proved to be more health-conscious than men and are therefore more likely to taste this new apple fruit. This result confirms those observed by Szakály, Szente, Kövér, Polereczki, and Szigeti (2012), who suggested that women are strongly motivated to taste new food products and are willing to buy previously demonstrated new foods. Therefore, gender is important for promoting new functional foods.

Despite the various nutritional properties of the apple, elderly consumers have proven to be wary of the new product. This group can be considered to be traditionalist, and the male component was the discriminatory gender. These data confirm the findings of Szakály et al. (2012), who found that men seldom purchase new types of food and tend to prefer traditional products and recipes. Therefore, the appearance of the red-fleshed attribute was the most relevant to this cluster, although the entire profile of the product experience proved to be attractive for the consumers, which led them to purchase it.

Moreover, Stead, McDermott, MacKintosh, and Adamson (2011) suggested that social and symbolic meanings associated with healthy eating, as opposed to processes and values, are of crucial importance for the younger members of the population, since self-image and fitting in is a reflection of the peer group. Therefore, the diet of the young is based on a low consumption of fruits and vegetables and high calcium and fat content; this type of eating behavior is often influenced by social and environmental factors. The authors stated that it is emotionally and socially risky to be interested in healthy eating, and it is reasonable to say that reduced sensibility and inclination toward the health properties of food make the young less inclined toward the red apple fruit, which is rich in nutritional properties.

The innovative characteristics of IRP red-fleshed apples allow for the opening of new segments in the apple market, even if marketing strategies, regarding both the red color of the flesh and higher nutritional values, must be developed for the successful introduction of this product on the market in order to penetrate specific consumer groups. This product could make healthy eating easier and more available, thus satisfying people's emotional needs for food quality requirements that are becoming more and more widespread. In fact, information on functional and nutritional properties also influences consumer acceptance or willingness to purchase (Gadioli et al., 2013). However, Endrizzi et al. (2014) demonstrated that nutritional

information influenced apple acceptance only for some consumer groups, depending on their attitude toward healthy food.

Conclusion

Our study shows that consumers in central Italy seem to prefer the red flesh color in apples. The preference of consumers for red flesh is due to the nutraceutical properties and visual appearance of the apple, which in turn lead to curiosity. Changing consumer demand is one of the main factors behind an apple-improvement program for producing new apple varieties to be commercialized in future years. Consumers have also declared themselves to have confidence in researchers who carry out research activities with the aim of producing food with high nutritional values and health-promoting effects. Therefore, new improvement programs should consider the innovative qualitative traits, and since these programs may take several years to organize, farmers today should try to foresee the attributes consumers will expect in the future. Therefore, by analyzing this broad context, the operators will be able to make informed and realistic predictions regarding feasible future scenarios and analyze the possible impacts and desirability of these predictions.

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