Consumer Preferences for Chestnuts, Eastern Black Walnuts, and Pecans

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ADDITIONAL INDEX WORDS. chinese chestnut, *Castanea mollissima*, *Juglans nigra*, *Carya illinoensis*, market survey, pull strategy, unsought product

SUMMARY. Edible chestnuts are an ancient tree crop undergoing a global renaissance. Scattered efforts are under way throughout the U.S. to develop domestic chestnut production based on chestnut cultivars from Europe or Asia. Concurrently, it is necessary to redevelop the domestic market by reintroducing the chestnut as a food crop to a new generation of U.S. consumers. A study was conducted to gauge the familiarity of participants with chinese chestnuts (*Castanea mollissima*), eastern black walnuts (*Juglans nigra*), and northern pecans (*Carya illinoensis*) to determine their interest in buying, consuming, and preparing these nuts and the key attributes that influence purchase decisions. The study also determined participants' interest in obtaining more information about the production, marketing, cooking, preparation, and nutritional information of nuts. Results of the study show that consumers were not familiar with chestnuts. Most had never tasted a chestnut, but did have interest in exploring them as a new food. Quality and nutrition–diet–health were consistently listed as the most important attributes influencing purchase and consumption decisions for chestnuts and black walnuts but for pecans, locally grown was the most important attribute.

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This work was funded through the University of Missouri Center for Agroforestry under cooperative agreement 58-6227-0-049 with the ARS. Any opinions, findings, conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture. Thanks are due to Dr. Bridget Behe, Michigan State University, and Dr. David Lehman, University of Missouri, for their review and insightful comments on an earlier version of this manuscript.

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In contrast to the U.S. public's ubiquitous familiarity with the lyric of the holiday song "chestnuts roasting on an open fire," chestnuts are an unfamiliar crop for producers (less than 1% of world production) and unknown food for U.S. consumers (Bodet, 2001). A century ago, prior to the eradication of the american chestnut (*Castanea dentata*) by the chestnut blight (*Cryphonectria parasitica*), chestnut was a more common part of the American diet (Vossen, 2000). Today, the U.S. consumer has a strong interest in both new and healthy foods. Chestnuts are experiencing a surge in popularity in many European countries, Australia, New Zealand and the U.S. (Kelley and Behe, 2002) and an increase in production in Asia, New Zealand, Australia, and the U.S. (Bodet, 2001). In response to this trend, efforts are in progress to revitalize chestnut production and consumption throughout the U.S.

Major research efforts are currently under way at the University of Missouri to develop improved varieties of northern pecan, eastern black walnut, and chinese chestnut, two native and one exotic nut species. However, compared to pecan and black walnut, two species that are well known in the scientific literature and regularly consumed by U.S. consumers, next to nothing is known about U.S. consumer preferences regarding chinese chestnut. The focus of this paper is to highlight current efforts and strategies to stimulate production and consumption in the midwestern U.S. chestnut market. Our specific objective was to conduct a consumer marketing study to gauge familiarity with chinese chestnut compared with pecan and eastern black walnut, to determine interest in buying, consuming, and preparing these nuts and understand key attributes that influence purchase decisions.

Bodet (2001) recently summarized existing chestnut literature, consumption, and production data. He suggested a two-track approach to increase domestic consumption of chestnuts: first, by targeting domestic ethnic Asian and European markets with longstanding cultural use of chestnut; second, by targeting consumers who have heard about chestnuts (typically via the song or holiday association) yet never tasted them. A study on chestnut culture in California predicted an increase in

domestic chestnut consumption, citing consumer research that indicates enthusiastic acceptance of chestnuts by the American consumer (Vossen, 2000). At present, U.S. consumers eat 0.1 lb (0.05 kg) of chestnut per capita while Europeans average 1 lb (0.5 kg) per capita. Koreans are the world's largest chestnut consumers at 4 lb (1.8 kg) per capita (Bodet, 2001). An increase in domestic consumption up to European levels will create the opportunity to increase domestic production to replace existing imports by providing a locally produced, fresh product and will help meet the increased demand.

A detailed study by the University of Nebraska Food Processing Center identified marketing opportunities for chestnuts. The study assessed the interest of upscale restaurant chefs in value-added chestnut products but also looked at the ingredient and retail markets (Wahl, 2002). Results indicated that product freshness and quality were very or extremely important. This creates a market niche for locally produced chestnuts delivering a fresh, high-quality product. The study also indicated that growers in midwestern U.S. have an excellent market opportunity with value-added chestnut products, including shelled and frozen vacuum-packed chestnut kernels (Wahl, 2002).

Another recent study on chestnut marketing, developed by the Midwest Nut Producers Council and Michigan State University, identified market opportunities in upscale restaurants in Michigan for both peeled and unpeeled chestnuts (Smith et al., 2002). The chefs participating in the study preferred peeled chestnuts and used them in a variety of dishes (Kelley and Behe, 2002).

Because chestnuts are so unfamiliar to consumers, they can be considered an unsought product that consumers are unaware of and haven't necessarily thought of buying (Nickels and Wood, 1997). Nickels and Wood (1997) suggested using point of purchase displays and demonstrations to bring unsought products to the attention of customers.

One approach used in marketing unsought products was presented in a study by Kelley et al. (2002). Looking at markets for edible flowers, the study sought to identify different market segments, determine needs for each type of consumer, and identify char-

acteristics that influence purchase and the potential for purchase. A similar strategy has merit in efforts to market chestnuts.

The University of Missouri Center for Agroforestry (UMCA) initiated field trials in 1996 at the Horticulture and Agroforestry Research Center (HARC) to identify the best chestnut cultivars for nut production in the lower midwestern part of the U.S. (mainly chinese chestnuts) and developed a guide to help those interested in growing chinese chestnuts in Missouri (Hunt et al. 2001). Now that production field research is well under way, it is essential to explore market demand.

Our overall objective is to develop a comprehensive marketing program to stimulate both production and consumption of chestnuts in Missouri. The program focuses on generating demand by increasing consumer awareness about chestnuts by using a pull strategy. At the same time, by providing information and support to actual and future producers, we intend to generate enough local production to meet the created demand.

The first step in the implementation of the pull strategy was the creation of the Missouri Chestnut Roast, a festival organized to expose the general public to chestnuts (plus pecans and black walnuts) by offering information and samples of fresh, roasted, and prepared nuts. Local producers were on hand to sell their nuts. The Missouri Chestnut Roast was held on 4 Oct. 2003, at the University of Missouri's Horticulture and Agroforestry Research Center (HARC) in the Missouri "River Hills" adjacent to New Franklin, Mo. (population 1145). HARC is a 660-acre (267.1 ha) research farm located 26 miles (41.8 km) from Columbia, Mo. (population 85,000), the largest city in the surrounding area.

Our specific objective was to conduct a marketing study during the Missouri Chestnut Roast to gauge the familiarity of participants with chestnuts, eastern black walnuts, and pecans to determine their interest in buying, consuming, and preparing these nuts and the key attributes that influence purchase decisions. The study also determined participants' interest in obtaining more information about the production, marketing, cooking, preparation, and nutritional information of these nut species.

Materials and methods

Data were collected based on a survey questionnaire administered during the 2003 Missouri Chestnut Roast, the first time this one-day event had taken place. The survey was designed to provide start-up information for a comprehensive marketing program that plans to stimulate consumption of chestnuts by implementing a pull strategy. This strategy encourages consumers to seek out the products, indirectly persuading other channel partners to carry and support the product (Nickels and Wood, 1997). To establish a benchmark associated with consumer knowledge about chestnuts, the survey compared consumer knowledge of chestnuts with pecans and eastern black walnuts. For each nut species, the questions asked covered the following topics: frequency of consumption, familiarity with cooking/preparing, interest in buying and consuming, attributes that influence purchase decisions, and interest in obtaining more information. The survey comprised closed-end questions that used a five-point Likert scale, plus two yes/no questions that tested the participants' general knowledge about chestnuts.

For this study a convenience sample was used. The questionnaire was distributed to festival participants. Out of 900 attendees, there were 232 questionnaires collected and analyzed.

Using SPSS (SPSS Inc., Chicago), descriptive analysis, correlations, and multiple linear regression were performed to analyze the data. Descriptive statistics were used to provide a general understanding of basic relationships among variables. In addition, Pearson correlation coefficients were calculated to identify the strength of the relationships between the interest in buying and consuming nuts and variables that included quality, price, locally grown, ease of preparation, taste, and nutrition–diet–health. The numbered categories in the Likert scale were considered on a continuum ranging from not at all (1) to very interested (5) and from not at all (1) to very strongly (5). The use of continuous data provided by the Likert scale offered more flexibility in using statistical tools for analysis (Ravid, 2000). Multiple linear regression analysis was performed to identify significant relationships among

dependent variables: interest in buying raw nuts from farmers' markets and grocery stores; interest in buying prepared/semi-prepared products that contain nuts in grocery stores; and interest in consuming prepared food that contains nuts in a restaurant; and the independent variables: price, quality, taste, locally grown, ease of preparation, and nutrition–diet–health.

Results and discussion

DEMOGRAPHIC CHARACTERISTIC OF SURVEY RESPONDENTS. Respondents were 60% female and 40% male. The largest segment, 47%, was represented by people over 55 years old (24% between 56–65 years and 23% over 65 years), followed by people between 46 and 55 years (23%), 36 to 45 years (13%), 26 to 35 years (8%), and 9% under 25 years. The majority of participants were well educated (college 52%, or masters/PhD 12%). The remaining 32% had a high school (25%) or technical school education. Four percent of participants were full-time farmers and 9% part-time farmers. The other participants had a variety of professions, such as retired (24%), professor/teacher (9%), and student (7%). Compared with the demographic characteristics of the state of Missouri, the following population segments were overrepresented: people over 55 years (47% for our sample vs. 23% for Missouri population), female (60% vs.

51.4%), and higher education—more than high school (67% vs. 32%).

DESCRIPTIVE ANALYSIS: LEVEL OF FAMILIARITY WITH CHESTNUTS, PECANS, AND EASTERN BLACK WALNUTS. In terms of frequency of consumption, chestnut is by far the least familiar (67% had never tried a chestnut before the festival) and no participants consumed chestnuts on a monthly or weekly basis. The majority of respondents (90%) consume pecans at least 2–6 times a year, 50% consume pecans on a monthly or weekly basis, and only 1.4% never tried pecans before this festival. The familiarity and consumption of black walnuts falls in between pecans and chestnuts. Fifty-eight percent of participants consume black walnuts at least 2–6 times a year, 23% on a monthly or weekly basis, and 15% had never tried eastern black walnut (Fig. 1).

Familiarity with cooking/preparing chestnuts, pecans, and black walnuts was relatively low among participants at the festival. This points toward the population's general trend of consuming prepared foods and not creating meals from scratch. Only 5% of participants were familiar with preparing chestnuts, while 74% had no knowledge regarding cooking/preparing chestnuts. The result is not surprising, considering that most of the respondents hadn't eaten a chestnut before this event. Regarding the other nuts, 59% of participants were familiar

Fig. 1. Frequency of consumption for chestnuts, pecans, and black walnuts, based on consumers' answers to questions asked in a survey conducted during the Missouri Chestnut Roast, 4 Oct. 2003.

and very familiar with preparing pecans and 45% with preparing black walnuts (Fig. 2).

LEVEL OF INTEREST IN BUYING AND CONSUMING CHESTNUTS, PECANS, AND BLACK WALNUTS. The greatest interest in buying or consuming either raw nuts from grocery stores or farmers' markets, in semi-prepared form or prepared in restaurants, was expressed for pecans. Among these preferences, the highest was for consuming pecans in restaurants (65%), followed closely by buying raw pecans from farmers' markets (61%) and buying semi-prepared products in grocery stores (59%) (Table 1).

The preference values for chestnuts and black walnuts, although much lower than for pecans, were similar. The highest preference for consuming chestnuts (46%) and black walnuts (45%) was in restaurants, followed by buying prepared and semi-prepared products and buying them in a raw form from farmers' markets (Table 1).

ATTRIBUTES THAT INFLUENCE THE PURCHASE DECISION WHEN BUYING CHESTNUTS, PECANS, AND BLACK WALNUTS. For our population sample, taste, quality, and nutrition-diet-health were the attributes that significantly influence purchase decisions when buying chestnuts, pecans, and black walnuts. Taste and quality were listed as the most important attributes, while price had the lowest value influencing purchase decisions (Table 2). Over the past 5 years, numerous studies have reported health benefits from regular consumption of these nuts (Albert et al., 2002; Feldman, 2002; Hebert et al., 1998; Lino et al., 2000; Rainey and Nyquist, 1997). It is likely that the general public has been influenced by these and other recent reports in the media (Harvard School of Public Health, 2002; Roan, 2003).

LEVEL OF INTEREST IN OBTAINING MORE INFORMATION ABOUT CHESTNUTS, PECANS, AND BLACK WALNUTS. The pattern of interest is the same for all three kinds of nuts. Respondents were more interested in obtaining nutritional information and recipes and less interested in obtaining technical information about how to produce and market nuts (Table 3).

PARTICIPANTS' MINIMAL KNOWLEDGE ABOUT CHESTNUTS. To test the participants' knowledge about chestnuts, two basic facts (i.e., need for refrigeration and fat content) were

Fig. 2. Familiarity of participants in the Missouri Chestnut Roast, 4 Oct. 2003, with cooking/preparing chestnuts, pecans, and black walnuts.

Table 1. Proportion of respondents participating in the Missouri Chestnut Roast, 4 Oct. 2003, who indicated that they were interested and very interested in buying and consuming chestnuts, pecans, and black walnuts.

Statements presented to survey respondents	Chestnuts	Pecans	Black walnuts
	----- (%) -----		
Interested in buying raw nuts from farmers' markets or grocery stores	26	61	32
Interested in buying semi-prepared products that contain nuts in farmers' markets or grocery stores	36	59	38
Interested in consuming prepared food that contains nuts in restaurants	46	65	45

Table 2. Attributes that strongly and very strongly influence the purchase decision when buying chestnuts, pecans, and black walnuts, based on answers to questions asked in the survey conducted during the Missouri Chestnut Roast, 4 Oct. 2003.

Attributes that influence the purchase decision	Chestnuts	Pecans	Black walnuts
	----- (%) -----		
Nutrition-diet-health	55	62	53
Ease of preparation	48	60	48
Locally grown	45	54	44
Taste	72	79	69
Quality	69	77	66
Price	26	46	36

presented as yes-no questions. Most of the participants didn't know that, compared to pecan or walnut, fresh chestnuts must always be refrigerated due to high moisture content (72% of participants) or that chestnuts are very low in fat (63% of participants), two important attributes unique to chestnuts. Both of these facts create a

marked distinction between chestnuts as compared to pecan, walnut, or most other nuts (Kelley and Behe, 2002; Künsch et al., 1999; UMCA, 2004a, 2004b, and 2004c; USDA, 2004a and 2004b).

CORRELATION ANALYSIS. Preliminary bivariate correlations were calculated (Table 4). We analyzed the

Table 3. Proportion of respondents participating in the Missouri Chestnut Roast, 4 Oct. 2003, indicating that they were interested and very interested in obtaining more information about chestnuts, pecans, and black walnuts.

Statements presented to survey respondents	Chestnuts	Pecans	Black walnuts
	----- (%) -----		
How interested are you in obtaining more information about production of chestnuts, pecans, and black walnuts?	39	32	28
How interested are you in obtaining more information about marketing of chestnuts, pecans, and black walnuts?	26	28	25
How interested are you in obtaining more information about cooking and preparation of chestnuts, pecans, and black walnuts?	56	56	47
How interested are you in obtaining more information about nutritional information of chestnuts, pecans, and black walnuts?	55	55	47

correlations among the interest in buying each type of nut in farmers' markets, grocery stores, and restaurants, and the following attributes: price, quality, taste, locally grown, ease of preparation, and nutrition-diet-health.

The results indicated statistical significance for all correlations; i.e., there are relationships between the interest in buying/consuming nuts and each of the mentioned attributes. For people interested in buying nuts from farmers' markets, the most important attribute that influences their purchase decision is quality for chestnuts ($r = 0.438$, $P < 0.01$) and black walnuts ($r = 0.490$, $P < 0.01$) and locally grown for pecans ($r = 0.355$, $P < 0.01$). The interest in buying nuts in a semi-prepared form from farmers' markets or grocery stores is strongly associated with nutrition-diet-health for chestnuts ($r = 0.470$, $P < 0.01$) and pecans ($r = 0.323$, $P < 0.01$) and quality for black walnuts ($r = 0.605$, $P < 0.01$).

The preference for consuming nuts in restaurants is associated most strongly with quality for chestnuts ($r = 0.435$, $P < 0.01$) and black walnuts ($r = 0.649$, $P < 0.01$) and with nutrition-diet-health for pecans ($r = 0.421$, $P < 0.01$).

MULTIPLE LINEAR REGRESSION ANALYSIS. To explore the relationships from the correlation analysis in more detail, a multiple linear regression was performed to identify how much the mentioned attributes influence the purchase or consumption decision for nuts and which are statistically significant. Using SPSS, an F-test was used to test the statistical significance of the whole model and a *t*-test to check if the regression coefficients were statistically different from zero while controlling for the effects of the other independent variables.

The multiple linear regression analysis indicated that the six independent variables together (i.e., quality, price, taste, locally grown, ease of prep-

aration, and nutrition-diet-health) accounted for approximately 20% of the variance in the interest in buying chestnuts from farmers' markets, 27% of the variance in the interest in buying chestnuts in a semi-prepared form in grocery stores, and 20% of the variance in the interest in consuming prepared chestnuts in restaurants (Table 5). Of the six independent variables, only quality was statistically significant for buying raw chestnuts from farmers' markets and grocery stores and consuming chestnuts in restaurants. Quality and nutrition-diet-health were both significant for buying prepared/semi-prepared products that contain chestnuts in farmers' markets and grocery stores (Table 6).

For pecans, the independent variables together accounted for approximately 16% of the variance in the interest in buying pecans from farmers' markets, 11% of the variance in the interest in buying pecans in a semi-prepared form in grocery stores, and 20% of the variance in the interest in consuming prepared pecans in restaurants (Table 5). Locally grown and ease of preparation were both significant for the interest in buying raw pecans, locally grown was significant for the interest in buying pecans in semi-prepared form, locally grown and nutrition-diet-health for consuming pecans in restaurant (Table 6).

The best prediction was obtained for black walnuts. The independent variables together explain approximately 23% of the variance in the interest in buying black walnuts from farmers' markets, 39% of the variance in the interest in buying black walnuts in a semi-prepared form in grocery stores, and 45% of the variance in the interest

Table 4. Summary of bivariate correlation analysis among the interest in buying each type of nut in farmers' markets, grocery stores, and restaurants, and the following attributes: price, quality, taste, locally grown, ease of preparation, and nutrition-diet-health.

Variables	Pearson correlation ^{z, y}					
	Price	Quality	Taste	Locally grown	Ease of preparation	Nutrition-diet-health
Buy raw chestnuts from farmers' markets	0.285	0.438	0.379	0.241	0.183	0.283
Buy semi-prepared chestnuts	0.373	0.463	0.415	0.397	0.425	0.470
Consume chestnuts in restaurant	0.301	0.435	0.404	0.352	0.334	0.402
Buy raw pecans from farmers' markets	0.089	0.349	0.313	0.355	0.105	0.265
Buy semi-prepared pecans	0.064	0.279	0.268	0.315	0.243	0.323
Consume pecans in restaurant	0.094	0.331	0.342	0.399	0.342	0.421
Buy raw black walnuts from farmers' markets	0.324	0.490	0.470	0.351	0.309	0.402
Buy semi-prepared black walnuts	0.432	0.605	0.587	0.507	0.530	0.571
Consume black walnuts in restaurant	0.436	0.649	0.648	0.535	0.574	0.601

^zn = 232

^yAll correlations are significant at the 0.01 level (2-tailed).

Table 5. General model of a multiple linear regression analysis performed to identify significant relationships among the dependent variables: interest in buying raw nuts from farmers' markets and grocery stores, interest in buying prepared/semi-prepared products that contain nuts in grocery stores, and interest in consuming prepared food that contains nuts in restaurants, and the independent variables: price, quality, taste, locally grown, ease of preparation, and nutrition-diet-health.^z

Dependent variables	Adjusted R ²	F
Buy raw chestnuts from farmers' markets	0.199	9.092***
Buy semi-prepared chestnuts	0.272	13.272***
Consume chestnuts in restaurant	0.204	9.332***
Buy raw pecans from farmers' markets	0.160	7.482***
Buy semi-prepared pecans	0.108	5.136***
Consume pecans in restaurant	0.204	9.703***
Buy raw black walnuts from farmers' markets	0.225	10.972***
Buy semi-prepared black walnuts	0.391	23.145***
Consume black walnuts in restaurant	0.446	28.930***

^zn = 232.

***Significant at $P < 0.001$.

in consuming prepared black walnuts in restaurants (Table 5). Quality was the only significant attribute for the interest in buying raw black walnuts. Quality and nutrition-diet-health were both significant for buying black walnuts in a semi-prepared form or consuming them in a restaurant (Table 6).

Correlation and regression analyses strengthened and confirmed results from descriptive analysis with regard to consumer perception of quality and nutrition, diet, and health benefits. The results are similar to the findings of the Food Marketing Institute in their consumer attitudes study (Food Marketing Institute, 2001). In the case of pecan, correlation and regression analyses also indicated that locally grown is an important attribute. The substantial growth in local farmers' markets across the U.S. provides further evidence of consumer interest in

buying locally grown food (Kremen et al., 2004).

Conclusions

This research provides a baseline for our comprehensive marketing program. It offers a benchmark of consumer preferences and provides a direction to follow in future research and marketing efforts.

The results of the survey confirmed our assumption, and that of other studies, that consumers are far less familiar with chestnuts compared to pecans and black walnuts. They do not know how chestnuts taste, how to prepare them or what to use them for.

While fewer participants expressed interest in buying chestnuts, compared with pecans and black walnuts, the highest preference was for consuming them in restaurants. This tracks with the recommendations made by

Wahl (2002) and Smith et al. (2002) to promote the use of chestnuts in restaurants in order to create a positive experience for consumers that should lead to an increased interest in consuming chestnuts.

Quality and nutrition-diet-health are important attributes that influence purchase and consumption decisions of chestnuts and eastern black walnuts. For pecans, locally grown was identified as the most important attribute. We intend to use these attributes to promote and position chestnuts in the market. However, more research is needed to identify other attributes that may have a stronger influence on the decision to consume and buy nuts. Future surveys will be refined to look into these questions in more detail.

In our sample, price had little influence on purchase decisions. We believe that this occurred because the participants were well educated and willing to pay a premium price for this category of products. Recent studies of organic consumers also indicate that quality is important, that consumers who earn higher incomes (e.g., organic shoppers) are more educated and spend more on groceries (Food Marketing Institute, 2001). Based on our findings, we propose to target the educated (and likely less price sensitive) segment of the population as early adopters, and use their experience as an example that will help later to penetrate the whole market.

Most participants did not know that chestnuts need to be refrigerated, or that chestnuts are very low in fat. This demonstrates that the public knows little about chestnuts and needs

Table 6. Test of the partial regression coefficients when regressing the interest of buying and consuming nuts from farmers' markets, grocery stores or restaurants with the following independent variables: price, quality, taste, locally grown, ease of preparation, and nutrition-diet-health.^z

Dependent variables	Independent variables					
	Price	Quality	Taste	Locally grown	Ease of preparation	Nutrition-diet-health
	----- Standardized regression coefficients: -----					
Buy raw chestnuts from farmers' markets	0.046	0.437**	0.066	-0.045	-0.172	0.101
Buy semi-prepared chestnuts	0.069	0.317*	-0.060	0.032	0.020	0.242*
Consume chestnuts in restaurant	0.005	0.309*	0.021	0.042	-0.020	0.171
Buy raw pecans from farmers' markets	-0.055	0.158	0.110	0.269*	-0.259*	0.150
Buy semi-prepared pecans	-0.063	0.012	0.125	0.178*	-0.058	0.188
Consume pecans in restaurant	-0.081	-0.072	0.155	0.213*	0.031	0.256*
Buy raw black walnuts from farmers' markets	-0.023	0.487*	-0.026	0.027	-0.157	0.175
Buy semi-prepared black walnuts	0.027	0.453*	-0.083	0.070	0.012	0.213*
Consume black walnuts in restaurant	-0.053	0.349*	0.082	0.015	0.117	0.207*

^zn = 232

*Significant at $P < 0.05$ or 0.01, respectively.

to be educated about how to buy, store, and prepare chestnuts as well as to be informed on the nutritional and health benefits.

People expressed interest in obtaining nutritional information and recipes. Through an educational campaign about chestnuts combined with offers of free samples, we plan to increase awareness and even change the image of chestnuts from that of a holiday tradition to a healthy year-round food.

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