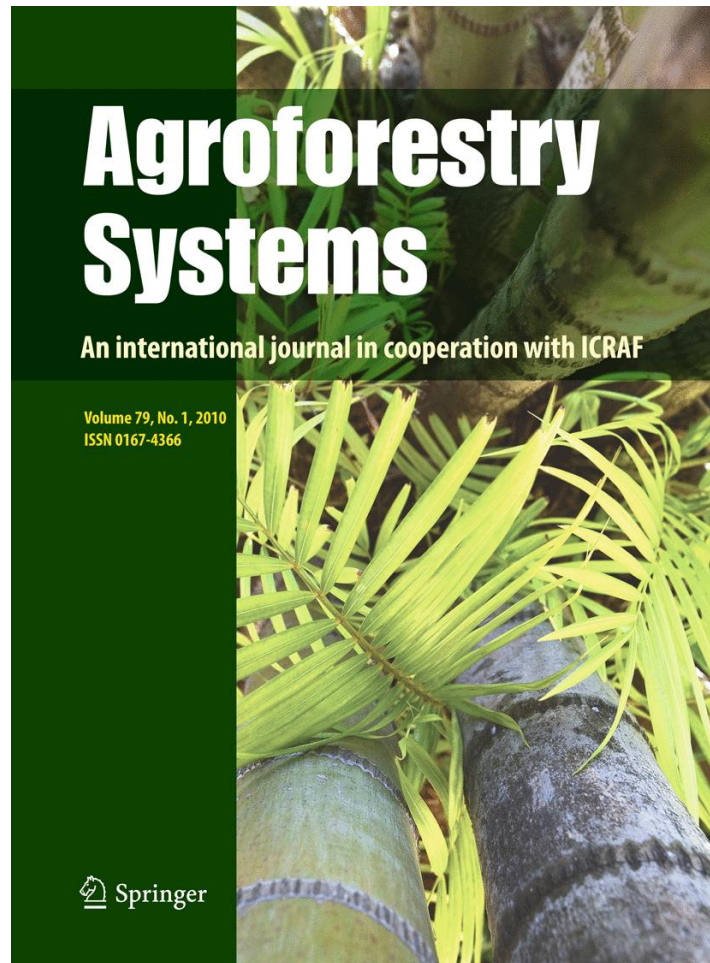


ISSN 0167-4366, Volume 79, Number 1



**This article was published in the above mentioned Springer issue.
The material, including all portions thereof, is protected by copyright;
all rights are held exclusively by Springer Science + Business Media.
The material is for personal use only;
commercial use is not permitted.
Unauthorized reproduction, transfer and/or use
may be a violation of criminal as well as civil law.**

Frequency of consumption, familiarity and preferences for chestnuts in Missouri

Francisco X. Aguilar · Mihaela M. Cernusca ·
Michael A. Gold · Carla E. Barbieri

Received: 14 July 2009 / Accepted: 9 December 2009 / Published online: 30 December 2009
© Springer Science+Business Media B.V. 2009

Abstract A study of frequency of consumption and familiarity with preparing chestnuts was conducted in the state of Missouri from 2003 to 2008. A conjoint analysis of chestnut attributes was completed in 2008 to expand on previous consumer preference research. Information from final consumers was collected during the annual Missouri Chestnut Roast festival at the Horticulture and Agroforestry Research Center in New Franklin, Missouri. The study tracks changes in frequency of consumption and consumer familiarity with preparing chestnuts. The conjoint analysis evaluated pair-wise profiles to quantify the effects of origin, production process and price on consumer preferences. Results show improvements in the frequency of consumption and familiarity with cooking chestnuts in Missouri. Findings suggest the festival has influenced consumption patterns among return

visitors. The conjoint analysis identified locality of produce and organic certification to be major drivers behind consumer preferences. Price is also an important attribute influencing consumer preferences. Conjoint analysis results indicate that chestnuts grown in Missouri or the U.S. carrying an organic label can capture price premiums.

Keywords Consumer preferences · Chestnuts (*Castanea* spp.) · Chestnut markets · Conjoint analysis · Conditional logit model

Introduction

The market for edible chestnuts (*Castanea* spp.) in the U.S. is characterized by the relative novelty of its cultivation and lack of consumer familiarity with this product. Gold et al. (2006) report that commercial chestnut production in the U.S. is still in its infancy. The majority of U.S. chestnut producers have been in business for less than 10 years and most of them just started producing chestnuts at commercial scale. Nonetheless, chestnut cultivation in the U.S. can be an attractive enterprise due to high product demand, favorable prices, and relatively low initial investment to establish plantations (Gold et al. 2006). Current U.S. demand for chestnuts exceeds national production, which is offset by imports. According to the U.S. Department of Agriculture (USDA 2009a), chestnut

F. X. Aguilar (✉)
Department of Forestry, University of Missouri,
203 Anheuser-Busch Natural Resources Building,
Columbia, MO 65211, USA
e-mail: aguilarf@missouri.edu

M. M. Cernusca · M. A. Gold
Center for Agroforestry, University of Missouri,
203 Anheuser-Busch Natural Resources Building,
Columbia, MO 65211, USA

C. E. Barbieri
Department of Parks, Recreation & Tourism, University
of Missouri, 105 Anheuser-Busch Natural Resources
Building, Columbia, MO 65211, USA

imports have fluctuated in value over recent years. For example, the value of chestnuts imported into the U.S. reached \$10.18 million in 2003, \$11.49 million in 2006 and most recently \$10.16 million in 2008. According to the USDA (2009a), chestnuts were imported from Europe (52%) and Asia (48%) in 2008.

Consumption patterns for chestnuts vary around the world and seem to be changing. The *per capita* consumption of chestnuts in the U.S. is a fraction compared to that of consumers in other countries. Bodet (2001) reports that U.S. consumers eat 0.1 lb (45.5 g) of chestnuts per capita, Koreans are the world's largest chestnut consumers at 4.0 lbs (1.82 kg) per capita, while Europeans average 1.0 lb (0.45 kg) per capita. Consumers across Europe, Australia, and New Zealand are increasingly interested in chestnuts (Kelley and Behe 2002). Cernusca et al. (2008) report a growing interest among Missourians. Greater consumption of chestnuts is primarily driven by their favorable nutritional characteristics. Edible chestnuts have a low oil content that makes chestnuts virtually fat free, possess a low glycemic index, are cholesterol and gluten free, contain only one-third of the calorie content of peanuts (*Arachis hypogaea*) and cashews (*Anacardium occidentale*), and as much ascorbic acid as their equivalent weight of lemons (*Citrus limonium*; USDA 2009b).

Opportunities to meet a growing demand for chestnuts in the U.S. justify the investigation of consumer markets. U.S. consumers are still unfamiliar with chestnuts and often are not aware of their healthful properties, where to buy chestnuts and how to prepare them (Gold et al. 2005). The study of consumer preferences to better understand tastes and purchasing behavior is instrumental to provide strategic information to producers. A consumer-based pull strategy can be an effective means to increase domestic consumption up to European levels. Such strategy consists of coordinated communication and advertisement efforts targeted to customers who, as a result, ask retailers for the product of interest. Ultimately, additional demand causes a pull for more products through supply channels (Nickels and Wood 1997). Greater consumption will create the opportunity to stimulate domestic production. Growth in U.S. chestnut production can better meet local demand and partly replace imports. Understanding consumer preferences is, thus, at the core of creating a larger demand for chestnuts.

This manuscript contributes to the limited but growing literature on the study of consumer preferences for chestnuts in the U.S. The research reported in this article was specifically designed to (1) determine the frequency of consumption of chestnuts in Mid-Missouri, (2) track changes regarding familiarity with chestnuts in Mid-Missouri, and (3) quantify the effect of different product attributes on consumer preferences to develop effective marketing strategies. This project expands on previous research efforts at the University of Missouri Center for Agroforestry in the study of specialty agricultural product markets (e.g., Aguilar et al. 2009; Cernusca et al. 2008; Gold et al. 2006; Gold et al. 2005; Gold et al. 2004).

Methods

Research site

Information was collected during the Missouri Chestnut Roast (MCR) following Dillman's (2000) recommendations for conducting onsite surveys. The MCR is a festival held every fall at the University of Missouri's Horticulture and Agroforestry Research Center in New Franklin, Missouri. This one-day event is not dedicated solely to chestnuts. It provides the opportunity to introduce participants to a variety of specialty products like black walnuts, pecans, elderberry and others. The MCR is a family event targeted to people in Missouri (farmers and urban residents alike) to enjoy a day out while participating in other festival offerings. The MCR offers chestnut roasting demonstrations and free samples of roasted chestnuts; vendors offering a diversity of Missouri agricultural products (e.g., fresh chestnuts, cheese, wine, honey, pecans, black walnuts); informational booths about chestnuts and their nutritional properties as well as other resources for agricultural products and strategies to diversify farm revenues; guided tours to various agroforestry-related research projects; and a combination of entertainment offerings including cooking demonstrations with chestnuts, music, food, and children's activities. The festival is heavily advertised in the local Columbia and New Franklin area, in the Saint Louis, Kansas City areas and among people interested in sustainable agriculture across the Midwest through an electronic

announcement. Vendors and exhibitors come from Missouri and surrounding states (Iowa, Illinois and Kansas).

Survey instrument and conjoint analysis design

A survey was developed in 2008 to collect information on consumer preferences related to chestnuts. The survey was comprised of several sections that included: attendance at the MCR, frequency of chestnut consumption, familiarity with cooking chestnuts, a choice-based conjoint analysis and demographic information. Similar surveys were used from 2003 to 2007. Table 1 summarizes the lists of questions asked to collect information about attendance at the MCR, frequency of consumption and familiarity with cooking. Participants were asked about their participation in previous festivals to discern between the frequency of consuming chestnuts among first time and return visitors. This information was used as a proxy for the effect of the MCR on consumer preference towards chestnuts.

The conjoint analysis (CA) used a choice-based method to elicit preferences for selected product attributes. CA is based on the premise that consumers can judge the value of a collection of hypothetical products (defined by different attributes that constitute product profiles), and choose the one which gives them the greatest utility (Green and Wind 1975; Green and Srinivasan 1978; Carson et al. 1994). The first step in the design of the CA was the selection of product attributes and corresponding levels. The product attributes selected in this study included price, production process, and label of origin. The price of chestnuts was given in U.S. dollars per pound

and had three different levels (\$3, \$5, and \$7 per pound; equivalent to \$6.60, \$11.00 and \$15.40 per kilogram). Descriptions of production processes and origin labels were provided to participants during the survey as follows:

- Pesticide free: Chestnuts produced with minimal use of chemicals in the form of herbicides, pesticides, and hormones.
- Organic certified: Chestnuts produced using methods that maintain and replenish soil fertility without the use of potentially toxic and persistent pesticides and fertilizers, according to strict uniform standards that are verified by independent state or private organizations.
- Conventional*: Chestnuts produced using conventional methods to fertilize and chemical control of weeds and/or pests.
- Origin label: Label indicating whether chestnuts were grown in (a) Missouri, (b) in the United States, or (c) imported*.

(*Denotes a base level for estimation purposes).

Each product attribute (price, production process and label of origin) had three different levels. This research design was followed to keep a balanced model in order to avoid bias in the estimation of standard errors in the empirical model. A random combination of attributes and levels was produced to generate different product profiles. Profiles were then paired to present choice-based questions to participants. This method was selected primarily because it adds more realism to the product selection process compared to ranking or rating scales (Hair et al. 1998).

The profiles of chestnuts were generated using the Bretton-Clark designer program following a fractional

Table 1 List of questions used to collect information on attendance to the Missouri Chestnut Roast, frequency of consumption, and familiarity with cooking chestnuts

| Construct | Scale |
|--|--|
| Have you attended this event before? (Check all that apply) | Yes in 2003; Yes in 2004; Yes in 2005; Yes in 2006; Yes in 2007; No |
| How often do you consume chestnuts? | Never (0); Less than once a year (1); Once a year (2); 2-3 times a year (3); More than 3 times a year (4) |
| How familiar are you with roasting chestnuts? | Not at all (1); Little (2); Somewhat (3); Familiar (4); Very familiar (5) |
| How familiar are you with preparing chestnuts using recipes? | Not at all (1); Little (2); Somewhat (3); Familiar (4); Very familiar (5) |

Values in parenthesis represent ordinal scales

| Box 1. | A | B | |
|--------------------------------------|----------------------------|----------------------------|----------------------------------|
| Price per pound | \$3 | \$5 | |
| Production process | Pesticide free | Organic certified | |
| Origin label | U.S.A. | Imported | |
| Please check your preferred choice → | <input type="checkbox"/> A | <input type="checkbox"/> B | <input type="checkbox"/> Neither |

Fig. 1 Example of the conjoint analysis choice-based profile instrument used to gather consumer preferences for chestnuts' attributes in 2008. The 'Neither' option corresponds to the *status quo*

factorial design. This program produces a subset of hypothetical profiles based on the attribute levels provided by the researcher. Eighteen profiles for a total of nine comparisons were produced and included in the survey questionnaire. Respondents were asked to review pairs of hypothetical chestnut products and select one product (A or B) that they would be most likely to purchase (Fig. 1). An option (neither) was introduced in the study to represent what is commonly known as the *status quo* or opt-out option (Louviere et al. 2000). In this case the *status quo* option represented a chestnut priced at \$5 per pound produced in the U.S. with conventional methods. A complete questionnaire provided 27 observations per respondent. Each respondent reviewed 9 pair-wise comparisons and every comparison generated three choice observations (e.g., preferred profile was identified with a '1' and the other two profiles with a '0').

Demographic information gathered in the study included age, gender, education, rural or urban residence, and household income. Information on motivational factors behind attendance was collected but is not reported in this manuscript. Barbieri et al. (2009) suggest that the most important motivations drawing attendance to MCR are enjoying a day out, the uniqueness of the festival, and tasting chestnuts and other Missouri specialty products. The questionnaire was pre-tested before administration with a sample of 15 individuals.

Sample and data collection

We used a convenience sample selected from visitors to the MCR. We relied on personal intercepts to

obtain a sample of respondents. Interviewers randomly selected festival attendees, explained the purpose of the study, and asked for their participation. Those who agreed to participate completed the survey on site. The sample generated by this method is representative of MCR participants, hence, caution should be exercised in generalizing the results to the entire population of consumers in Missouri. Each participant took from 5 to 10 minutes to complete the questionnaire. No monetary reward was offered to study participants. Data on frequency of consumption and familiarity with cooking chestnuts was collected in 2003, 2004, 2006, 2007 and 2008. An exploratory CA was first tested in 2007. Results of the CA reported in this paper come from data collected in 2008 only.

Analysis

Using SPSS 16.0, frequency distribution, cross tabulation and *t*-test statistics were estimated to analyze data for frequency of consumption and familiarity with chestnuts. The influence of attendance at the MCR on frequency of consumption was assessed by comparing the proportion of first-time and return visitors who indicated they consume chestnuts more than once a year. Statistically significant differences were estimated using a *z*-test for equality of proportions (Agresti 2002).

For the CA, data was analyzed using a conditional logit model in Stata 10. Details of the model and data entry are available in Aguilar et al. (2009), an explanation of the conditional logit model is provided by McFadden (1974, 1986) and applications using

Stata 10 are described by Long and Freese (2006). Maximum likelihood estimation was used to calculate parameters and standard errors. Implications regarding preferences for chestnut attributes cannot be interpreted directly from the value of the model coefficients as in traditional linear models. Therefore, odds ratios were calculated that are interpreted as follows: An odds ratio of 1 indicates that there is no difference in consumer preference between that attribute and the base level, while an odds ratio of five suggests that consumers like a given attribute five times better than the base level. As previously indicated, base levels in the production process and origin label categories are conventional and imported, respectively. The conditional logit model also allows for the estimation of probabilities of consumption based on the profile of products. Probabilities were estimated for a selected group of product profiles. Products with the highest probabilities of selection are reported in the Results section.

In addition to the product attributes (production, origin and price) interaction terms were generated to detect differences in consumer preferences between selected demographic groups. Differences in model parameters were explored between place of residence (urban, rural) and gender. The selection of these two variables is based on previous reports of consumer preferences in Missouri. Brown (2003) found that rural residents in Missouri are more willing to seek out locally produced food than urban residents but household location did not significantly influence the price consumers are willing to pay for locally grown food. Aguilar et al. (2009) also detected differences for chestnut preferences between males and females and in the willingness to pay greater price premiums among rural residents in Missouri.

Results

Table 2 summarizes demographic information collected since 2003 and presents the distribution of respondents according to their reported demographic characteristics (age, household income, gender, marital status, and level of education). Compared with the demographic characteristics of the state of Missouri, the following population segments were overrepresented: people over 46 years old, female, higher education (college or graduate studies) and

people with household income between 35,000 and 75,000. People with a household income higher than 75,000 were underrepresented in the survey sample. In 2008, about 50% of the participants were from the Columbia and New Franklin area, 5% from St. Louis area and 5% from Kansas City area. Ninety-four percent of visitors were from Missouri. The remaining 4% were from Arkansas, Iowa, Illinois, Kansas, Minnesota, and Oklahoma.

Frequency of consumption

Results of the survey indicate an increase in chestnut consumption among festival participants from 2003 to 2008. The percentage of participants that has never tasted a chestnut decreased while the percentage of people that increased chestnut consumption has grown since 2003 (Fig. 2). It is worth a note of caution concerning the 2007 data as it might be skewed towards individuals who consume chestnuts more frequently. This situation was due to severe weather conditions that might have had a selective effect toward people with a stronger interest in chestnuts and for whom rain was not an impediment to their participation in the MCR that year. Notice that 2007 is the year with the highest percentage of 'More than once a year' responses and the lowest with 'Never' answers.

Although frequency of consumption in 2008 seems to be lower than in 2007, comparing first-time MCR visitors to return visitors revealed a statistically significant difference in frequency of chestnut consumption ($t = -7.74$, P -value < 0.0001). Using a 0–4 scale where 0 = 'never' and 4 = 'more than three times a year', the mean frequency of consumption in 2008 was 0.92 for first-time visitors and 1.89 for return visitors (Fig. 3). Fifty-three percent of first-time visitors had never eaten chestnuts compared to 15% of return visitors. Only 15% of first-time visitors consumed chestnuts once a year compared to 37% of return visitors. Twenty-seven percent of return visitors consumed chestnuts twice a year or more as compared with 12% first time visitors.

The two groups identified in Fig. 3 (first-time visitors and return visitors) significantly differed in their reported frequency of consumption categories, from 'Never' to 'More than three times a year' ($\chi^2 = 67.30$, P -value < 0.0001). The proportion of responses for the 2-times a year or more frequency of

Table 2 Demographic characteristics of Missouri Chestnut Roast festival participants

| Variable | 2003 (<i>n</i> = 232) Percent of respondents (%) | 2004 (<i>n</i> = 217) | 2006 (<i>n</i> = 487) | 2007 (<i>n</i> = 132)† | 2008 (<i>n</i> = 524) | Missouri census 2006–2008 % |
|--|---|---------------------------|---------------------------|----------------------------|---------------------------|-----------------------------------|
| Age | | | | | | |
| Under 25 | 9 | 6 | 4 | 5 | 10 | 7 |
| 26–35 | 8 | 19 | 13 | 9 | 19 | 13 |
| 36–45 | 13 | 18 | 14 | 11 | 15 | 14 |
| 46–55 | 23 | 23 | 27 | 28 | 20 | 15 |
| 56–65 | 24 | 16 | 20 | 27 | 20 | 11 |
| Over 65 | 23 | 18 | 22 | 20 | 16 | 14 |
| Household income | | | | | | |
| Less than \$35,000 | * | 26 | 31 | 21 | 26 | 27 |
| \$35,000–\$50,000 | * | 27 | 14 | 14 | 18 | 15.4 |
| \$50,000–\$75,000 | * | 27 | 31 | 30 | 25 | 22.2 |
| \$75,000–\$100,000 | * | 16 | 14 | 11 | 13 | 15 |
| > \$100,000 | * | 4 | 10 | 24 | 18 | 20.4 |
| Gender | | | | | | |
| Male | 40 | * | 38 | 46 | 40 | 49 |
| Female | 60 | * | 62 | 54 | 60 | 51 |
| Marital status | | | | | | |
| Married | 77 | * | 74 | 81 | 69 | 51.7 |
| Unmarried | 23 | * | 26 | 19 | 31 | 48.3 |
| Education | | | | | | |
| High school | 25 | 16 | 25 | 21 | 16 | 33.1 |
| Technical school | 7 | 8 | 7 | 8 | 4 | 6.5 |
| College degree | 52 | 61 | 34 | 41 | 37 | 15.7 |
| Graduate degree | * | * | 30 | 29 | 37 | 8.9 |
| Other | 16 | 15 | 3 | 1 | 6 | NA |
| Current residence | | | | | | |
| Large City (population more than 250,000) | * | * | * | 6 | * | NA |
| Medium-sized City (50,000–250,000 population) | * | * | * | 34 | * | NA |
| Small City (10,000–50,000 population) | * | * | * | 14 | * | NA |
| Very Small City, town, or village (2,500–10,000 population) | * | * | * | 9 | * | NA |
| In a rural area (population less than 2,500) | * | * | * | 37 | * | NA |
| Distance from an urbanized area of at least 50,000 people | | | | | | |
| We are located in an urbanized area | * | * | * | * | 51 | NA |
| Less than 5 miles | * | * | * | * | 9 | NA |
| 5–9 miles | * | * | * | * | 5 | NA |
| 10–29 miles | * | * | * | * | 17 | NA |
| 30–59 miles | * | * | * | * | 12 | NA |
| 60 miles or more | * | * | * | * | 6 | NA |

NA not available

† Low number of responses due to severe weather conditions. * Question was not offered in survey that year

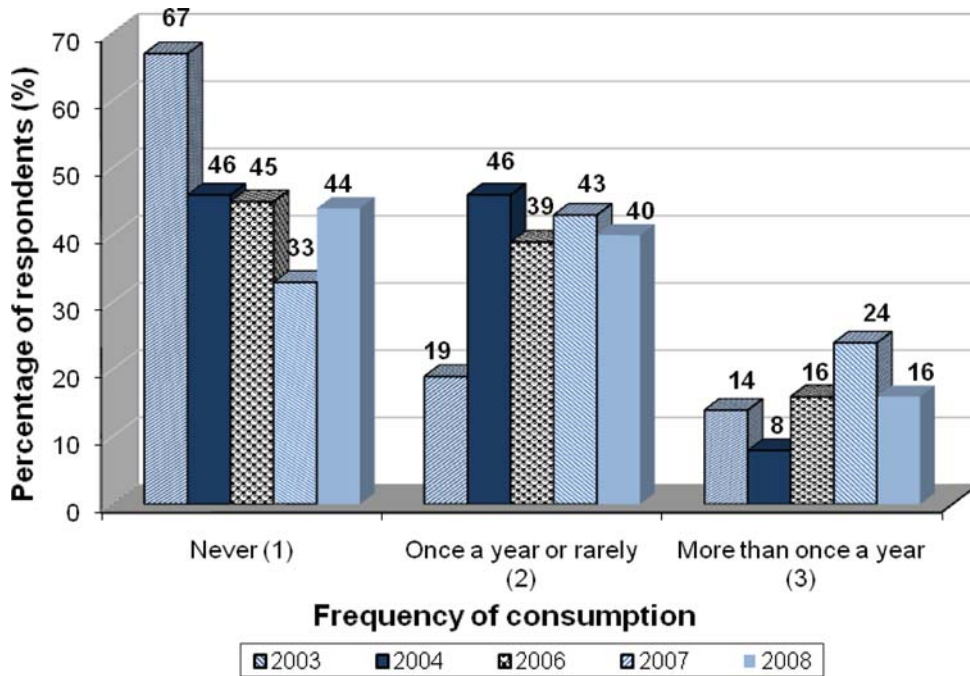


Fig. 2 Frequency of chestnut consumption between 2003 and 2008

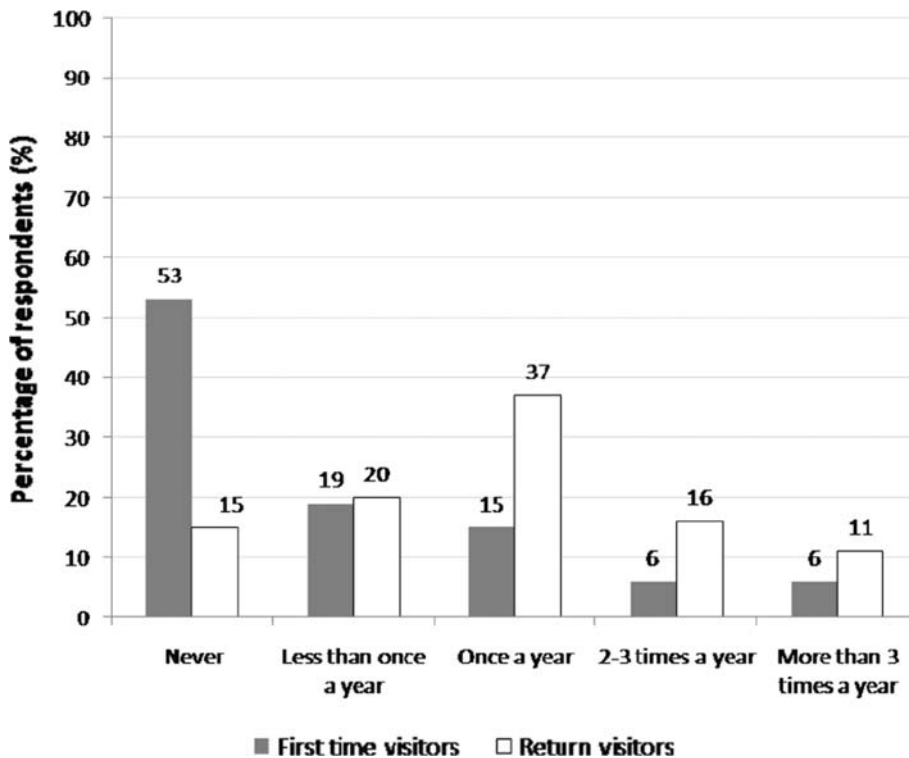


Fig. 3 Frequency of consumption in 2008: first-time ($n = 390$) versus return visitors ($n = 123$)

consumption is significantly different for first time and return visitors. Using a two-tail z -test statistic, we rejected the hypothesis of equality of proportions for ($z = 4.10$) at $\alpha = 0.05$. From these results it can be inferred that increased exposure to information about chestnuts through the MCR has influenced participants to seek out chestnuts and consume them more frequently.

Familiarity with chestnuts

In 2003, familiarity with cooking or preparing chestnuts was low; 74% of respondents were not at all familiar (Gold et al. 2004). In 2004 and 2006–2008, two questions addressed this subject: familiarity with roasting chestnuts and familiarity with cooking chestnuts using recipes. Results indicate that since 2004, the overall familiarity with roasting and cooking has remained low, but return visitors have become more familiar with roasting. Based on 2008 data, recorded on a 1–5 scale, where 1 = ‘Not at all’ and 5 = ‘Very familiar’, mean familiarity with roasting for first time visitors was 1.64 while for return visitors was 2.42 ($t = 6.57$, P -value < 0.0001). These findings show significant differences in familiarity as a result of cooking workshops and free samples offered at the MCR. Sixty-seven percent of first-time visitors were not at all familiar with roasting chestnuts, compared with 33% of return visitors ($z = 6.54$ for $\alpha = 0.05$; Fig. 4). Ten percent of first-time visitors were familiar and very familiar with roasting chestnuts, compared to

23% of return visitors ($z = 3.923$ for $\alpha = 0.05$). First-time visitors and return visitors significantly differed in their distribution of responses across the familiarity with roasting categories, from not at all to very familiar ($\chi^2 = 48.99$, P -value < 0.0001).

Conjoint analysis of preferences for chestnuts

Table 3 presents the results of the conditional logit model with product attribute effects only and with the inclusion of interaction variables. It is noticeable that the variable with the greatest effect is the disclosure of product information grown in Missouri. The value of the coefficients is followed by organic production, produced in the U.S., and pesticide-free production. All of these coefficients have positive signs indicating greater preferences for these attributes over the base levels (imported chestnuts and conventional production). The estimation of odds ratios for example, suggests that if a consumer is faced with identical products in terms of price and production process, the product that carries a label indicating it was produced in Missouri is 20.731 times more likely to be chosen over an imported one (base level). Likewise, an average consumer is 4.280 times more likely to choose chestnuts produced organically over those grown with conventional practices when remaining attributes are equal. These results confirm consumer preferences for locally grown products previously reported in Ohio (Darby et al. 2006), Delaware (Gallons et al. 1997), Indiana (Jekanowski et al. 2000) and Arizona (Patterson et al. 1999). In a study conducted in New England, Giraud et al. (2005) found that favorable attitudes toward local goods are positively correlated with the probability of their purchase. It is worth emphasizing that the above variables are categorical. Price, a continuous variable, has a negative sign and an odds ratio less than 1. This result suggests that a product that is 1 dollar more expensive, and everything else equal, is 26.4% less likely to be selected by the average consumer.

When including interaction variables, the greatest variation on the effect of attribute coefficients is on the Missouri produced attribute (i.e., ‘Produced in Missouri’ coefficient changed from 3.032 to 2.791). When adding variables that capture the effects of gender (female vs. male) and residence (rural vs. urban), the model suggests statistically significant differences (at

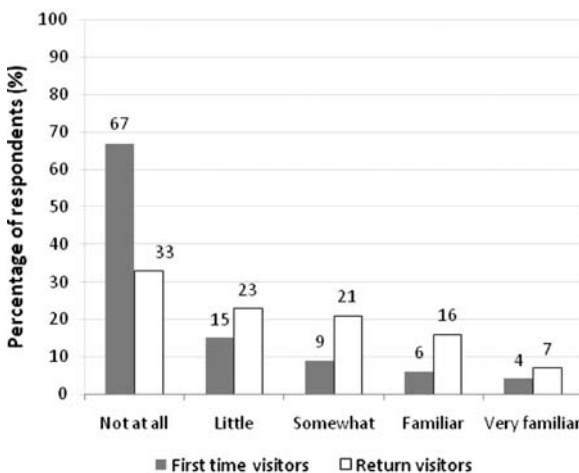


Fig. 4 Comparison of familiarity with roasting chestnuts between first-time ($n = 394$) and return visitors ($n = 124$) in 2008

Table 3 Conditional logit coefficients, standard errors, *P*-values and odds ratio estimates of chestnut product attributes derived from a conjoint in 2008

| Attributes | Model 1: Attributes model | | | Model 2: Attributes + demographic interactions model | | |
|---|---------------------------|---------------------|------------|--|---------------------|------------|
| | Coefficient (std. error) | <i>P</i> > <i>z</i> | Odds ratio | Coefficient (std. error) | <i>P</i> > <i>z</i> | Odds ratio |
| Produced in Missouri ^a | 3.032 (0.083) | <0.001 | 20.731 | 2.791 (0.136) | <0.001 | 16.289 |
| Produced in the U.S. ^a | 1.449 (0.073) | <0.001 | 4.257 | 1.275 (0.119) | <0.001 | 3.580 |
| Organic production ^b | 1.454 (0.089) | <0.001 | 4.280 | 1.546 (0.151) | <0.001 | 4.694 |
| Pesticide-free production ^b | 1.358 (0.062) | <0.001 | 3.888 | 1.239 (0.103) | <0.001 | 3.454 |
| Price | -0.307 (0.020) | <0.001 | 0.736 | -0.332 (0.033) | <0.001 | 0.718 |
| Produced in Missouri × female ^c | - | - | - | 0.372 (0.178) | 0.037 | 1.451 |
| Produced in the U.S. × female ^c | - | - | - | 0.138 (0.156) | 0.377 | 1.148 |
| Organic production × female ^c | - | - | - | -0.044 (0.192) | 0.817 | 0.957 |
| Pesticide-free production × female ^c | - | - | - | 0.234 (0.133) | 0.079 | 1.264 |
| Price × female ^c | - | - | - | 0.035 (0.043) | 0.422 | 1.036 |
| Produced in Missouri × rural ^d | - | - | - | 0.267 (0.254) | 0.294 | 1.307 |
| Produced in the U.S. × rural ^d | - | - | - | 0.548 (0.233) | 0.019 | 1.730 |
| Organic production × rural ^d | - | - | - | -0.432 (0.240) | 0.073 | 0.649 |
| Pesticide-free production × rural ^d | - | - | - | -0.021 (0.184) | 0.908 | 0.979 |
| Price × rural ^d | - | - | - | -0.027 (0.060) | 0.658 | 0.974 |

Attribute-only-effects model: Total number of entries(*n*) = 12,172. Log likelihood ratio test: -3,204.7545. Prob > Chi2 < 0.001

Interaction-effects model: Total number of entries (*n*) = 10,129. Log likelihood ratio test: -2,660.4908. Prob > Chi2 < 0.001

^a Base level value for comparison: Imported chestnuts

^b Base level value for comparison: Conventional production

^c Base level value for comparison: Male respondents

^d Base level value for comparison: Respondents living less than 30 miles from an urbanized area of at least 50,000 people

$\alpha = 0.10$) between female/male and urban/rural consumers and their preferences for place of origin and production process. Females are more likely than males to prefer Missouri-grown and pesticide free produced chestnuts while rural consumers are more likely to prefer U.S. grown chestnuts and less likely to prefer organic chestnuts than urban consumers. Although the model used in this study is slightly different from the exploratory CA of Aguilar et al. (2009), substantial consumer preference for locally and organic produced chestnuts is still evident. However, this study did not find differences between female and male preferences for organic-grown chestnuts, nor price sensitivity between rural and urban consumers as Aguilar et al. (2009) did.

Table 4 reproduces estimates of the probabilities of consumer preferences for selected bundles of products. Product bundles were chosen from the nine comparisons included in the survey of which six were

selected ad hoc by the authors to illustrate particular findings. Probability estimation of a conditional model followed McFadden (1974, 1986) and calculated using Stata 10 (Long and Freese 2006). The value of the probability for each product is contingent on the profile of the other two alternatives (notice that the probabilities within bundles add up to 1.000). This is exemplified by the changing probability value of the third profile of each bundle that corresponds to the *status quo* option (\$5/pound, conventional, produced in the U.S.). Probabilities should be interpreted as the likelihood that a given product profile has to be chosen by an average consumer when the products defined within a bundle are the ones available in the market.

The effects of place of origin, certification and price on consumer preferences are expressed by higher selection probabilities. It is worth noticing that when there is no difference in the production process (i.e., product bundles 1 and 2), the most preferred

Table 4 Estimated probabilities for selected product profiles using attributes-only model

| Sample Bundle | Product | Price (\$/pound) | Production process | Origin | Probability |
|---------------|---------|------------------|--------------------|----------|-------------|
| 1 | | \$3.00 | Conventional | Missouri | 0.760 |
| | | \$3.00 | Conventional | U.S. | 0.156 |
| | | \$5.00 | Conventional | U.S. | 0.084 |
| 2 | | \$7.00 | Conventional | Imported | 0.021 |
| | | \$5.00 | Conventional | Missouri | 0.812 |
| | | \$5.00 | Conventional | U.S. | 0.167 |
| 3 | | \$3.00 | Organic certified | Imported | 0.131 |
| | | \$7.00 | Organic certified | Missouri | 0.798 |
| | | \$5.00 | Conventional | U.S. | 0.071 |
| 4 | | \$3.00 | Pesticide Free | U.S. | 0.782 |
| | | \$5.00 | Organic certified | Imported | 0.109 |
| | | \$5.00 | Conventional | U.S. | 0.109 |
| 5 | | \$7.00 | Organic certified | U.S. | 0.548 |
| | | \$5.00 | Pesticide free | Imported | 0.216 |
| | | \$5.00 | Conventional | U.S. | 0.236 |
| 6 | | \$5.00 | Pesticide free | Imported | 0.227 |
| | | \$7.00 | Pesticide free | U.S. | 0.524 |
| | | \$5.00 | Conventional | U.S. | 0.249 |

product is the one originated in Missouri and with the lowest price. However, price is not the single driver behind consumer preferences. As noted in product bundle 3, the product with the highest probability of being chosen is the most expensive one, grown in Missouri and carrying organic certification. However, as shown in product bundle 4, the most preferred product is the pesticide-free chestnuts grown in the U.S. selling at the lowest price. Product bundle 5 shows that the product most highly priced is preferred when it has been organic certified and grown in the U.S. when the other two options are a product at \$5 a pound, pesticide-free imported, and the *status quo* product. The estimation of probabilities denotes the strength of the model to estimate the likelihood of consumer preferences compared to other alternatives available in the market and the conjoint effect of different attributes.

Conclusions

A longitudinal analysis indicates that frequency of chestnut consumption has increased among the pool of study participants since the Missouri Chestnut Roast festival was launched in 2003. Similarly,

familiarity with cooking chestnuts has increased over the last 5 years. A conjoint analysis of price, place of origin and production process suggests that chestnuts grown in Missouri using organic methods are the most likely to be preferred by consumers when product prices are the same. Changes in overall preferences were detected between males and females and respondents from rural and urban areas. Furthermore, regardless of demographic differences, the coefficients with highest values were associated with local (Missouri), and organic production attributes. A lower level of coefficient on prices than other product attributes suggests that U.S. certified producers may be able to exercise premiums over prices prevalent in the market for non-certified or imported chestnuts. Nonetheless, the marketability of products is dependent on other product options available in the market. The econometric model used in this study allows the comparison of different probability estimates based on product profiles. Several examples illustrated that even higher priced chestnuts might be preferred over lower priced products when local or national origin and production certification are disclosed. Our findings suggest that producers in Missouri should clearly identify the origin of their products and seek organic certification

as two marketing tools to have a greater impact among consumers. The evidence of potential price premiums should be interpreted as an important incentive to establish new chestnut plantations. Efforts to increase consumer awareness of the healthful characteristics of chestnuts along with information on how to prepare them can also have substantial impacts on the amount of chestnuts consumed in Missouri and the U.S. Changes in consumer preferences and long-term effect of festivals such as the MCR on consumption will continue to be assessed. Future steps in this research endeavor include the expansion of research to urban markets and other regions of the country.

Acknowledgments The authors acknowledge research assistants: C. Tew, Y. Katsube, S. Xu, J. Chen (Department of Parks, Recreation and Tourism), Z. Cai, A. Saunders (Department of Forestry) and I. Staiculescu (Department of Public Health) at the University of Missouri Columbia, who were instrumental during data collection and entering. Ms. Cai Zhen assisted with data management and econometric analysis. This work was funded, in part, through the University of Missouri Center for Agroforestry under cooperative agreements 58-6227-1-004, 58-6227-2-008 and 58-6227-5-029 with the ARS. Any opinions, findings, conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of the U.S. Department of Agriculture.

References

- Agresti A (2002) Categorical data analysis. Wiley, New York, p 734
- Aguilar FX, Cernusca MM, Gold MA (2009) Conjoint analysis of consumer preferences for chestnut attributes. *Horttechnology* 19(1):216–223
- Barbieri C, Cernusca M, Gold M, Aguilar FX (2009) Attendance motivations behind the Missouri chestnut roast festival. In: Gold MA, Hall M (ed) 11th North American agroforestry conference. May 31–June 3, 2009. Columbia, MO, pp 505–512
- Bodet L (2001) The international marketing situation. A summary of the literature and existing data. In: Ernst M, Allan D, Woods T (eds) Univ. of Kentucky, Dept. of Agr. Econ
- Brown C (2003) Consumers' preferences for locally produced food: a study in southeast Missouri. *Amer J Altern Agr* 18(4):213–224
- Carson RT, Louviere J, Anderson D, Arabie P, Bunch D, Hensher D, Johnson R, Kuhfeld W, Steinberg D, Swait J, Timmermans H, Wiley J (1994) Experimental analysis of choice. *Mktg Lett* 5(4):351–367
- Cernusca MM, Gold MA, Godsey LD (2008) Influencing consumer awareness through the Missouri Chestnut Roast. *J Ext* 46(6). Available via <http://www.joe.org/joe/2008/december/rb7.php>. Accessed 1 Nov 2009
- Darby K, Batte MT, Ernst S, Roe B (2006) Willingness to pay for locally produced foods: A customer intercept study of direct market and grocery store shoppers. The American agricultural economics association annual meeting. Long Beach California. Available via <http://aede.osu.edu/programs/VanBuren/pdf/AAEA%20Selected%20Paper-156532.pdf>. Accessed 13 July 2009
- Dillman DA (2000) Mail and internet surveys. The tailored survey method. Wiley, New York
- Gallons J, Toensmeyer UC, Bacon JR, German CL (1997) An analysis of consumer characteristics concerning direct marketing of fresh produce in Delaware: a case study. *J Food Distrib Res* 28:98–106
- Giraud KL, Bond CA, Bond JJ (2005) Consumer preferences for locally made specialty food products across northern New England. *Agr Resour Econ* 34(2):204–216
- Gold MA, Cernusca MM, Godsey LD (2004) Consumer preferences for chestnuts, eastern black walnuts, and pecans. *Horttechnology* 14(4):583–589
- Gold MA, Cernusca MM, Godsey LD (2005) Update on consumers' preferences for chestnuts. *Horttechnology* 15(4):904–906
- Gold MA, Cernusca MM, Godsey LD (2006) Competitive market analysis: chestnut producers. *Horttechnology* 16(2):360–369
- Green PE, Srinivasan V (1978) Conjoint analysis in consumer research: issues and outlook. *J Consum Res* 5:103–113
- Green PE, Wind Y (1975) New way to measure consumer judgments. *Harv Bus Rev* 53(4):107–117
- Hair JF, Anderson RE, Tatham RL, Black WC (1998) Multivariate data analysis. Macmillan, New York
- Jekanowski MD, Williams DR, Schiek WA (2000) Consumers' willingness to purchase locally produced agricultural products: an analysis of an Indiana survey. *Agr Resource Econ* 29(8):43–53
- Kelley KM, Behe BK (2002) Chef's perceptions and uses of colossal chestnuts. *Horttechnology* 12(1):172
- Long JS, Freese J (2006) Regression models for categorical dependent variables using Stata. Stata Press, College Station
- Louviere JJ, Hensher DA, Swait JD (2000) Stated choice methods. Cambridge University Press, Cambridge
- McFadden DL (1974) Chapter 4: conditional logit analysis of qualitative choice behavior. In: Zarembka P (ed) *Frontier in econometrics*. Academic Press, New York
- McFadden DL (1986) The choice theory approach to market research. *Mark Sci* 5(4):275–297
- Nickels WG, Wood MB (1997) Marketing: Relationships, quality, value. Worth Publication, Irving Place
- Patterson PM, Olofsson H, Richards TJ, Sass S (1999) An empirical analysis of state agricultural product promotions: a case study of "Arizona Grown". *Agribus* 15:179–196
- US Department of Agriculture (2009a) U.S. trade imports. Available via <http://www.fas.usda.gov/ustrade/USTImFatus.asp?Q1>. Accessed 8 Feb 2009
- US Department of Agriculture (2009b) National Nutrient Database for Standard Reference. Available via <http://www.nal.usda.gov/fnic/foodcomp/search/index.html>. Accessed 9 Nov 2009