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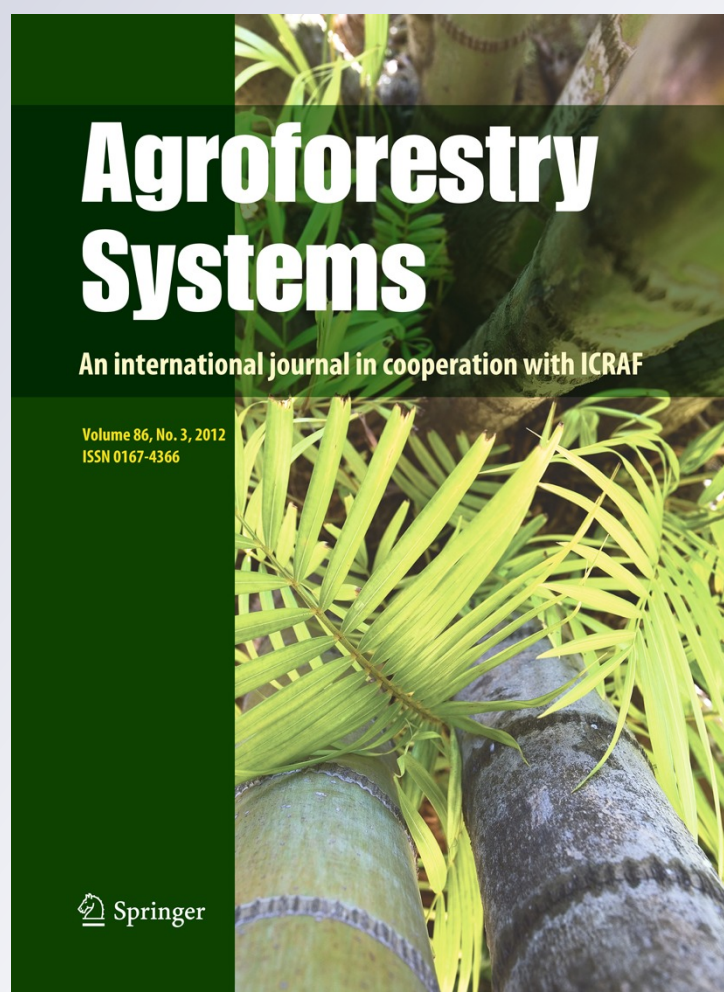
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Post-purchase evaluation of U.S. consumers' preferences for chestnuts

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Abstract A regional study of consumer satisfaction and preferences for various chestnut attributes was conducted in 2009. Surveys were distributed to five chestnut growers/sellers in Missouri, Iowa, Kansas, Ohio and Illinois to accompany chestnut sales to their individual customers. Returned surveys represented consumers from 18 states, mainly the U.S. Midwest but also from the East and West coasts. The survey measured consumer satisfaction with the chestnuts purchased (by using affective, cognitive and behavioral constructs), assessed consumer's general knowledge about chestnuts, frequency of consumption and familiarity with cooking. The survey also included a choice-based conjoint analysis to evaluate the effects of origin, production process and price on consumer preferences for chestnuts. Results show that high satisfaction with chestnuts purchased increases the likelihood of future purchase. Most consumers who buy chestnuts know that chestnuts need to be refrigerated but more educational effort is needed regarding

the low fat content of chestnuts as compared to other nuts and the gluten-free attribute of chestnut flour. Conjoint analysis of chestnut attributes (origin, production process and price) confirmed results of past studies. Holding other attributes constant, chestnut origin is the most important attribute influencing purchases, consumers strongly preferring locally grown chestnuts over U.S. grown or imported. Chestnuts grown organically or pesticide free were preferred over conventional production. Price also has a significant influence on the purchase decision but its relative effect was lowered when bundled with the other product attributes.

Keywords Chestnuts · Conjoint analysis · Consumer satisfaction study · Locally grown

Introduction

Edible chestnuts (*Castanea* spp.) are a relatively new crop for U.S. producers and a novel food for U.S. consumers. According to the 2007 Census of Agriculture, the United States had 1,200 farms growing chestnuts on more than 3,300 acres (1 acre = 0.404 ha) (US Department of Agriculture, USDA 2009). Chestnuts have favorable nutritional characteristics (e.g., low oil content, high vitamin C) (USDA 2010). Chestnut flour is sweet and gluten-free, making

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it appropriate for a growing gluten-free market. Field research in Mid-Missouri indicates that Chinese chestnuts (*Castanea mollissima*) are the best adapted species for Missouri and surrounding U.S. Midwest states (Hunt et al. 2009). Market research performed by The Center for Agroforestry at the University of Missouri (UMCA) shows that U.S. chestnut cultivation can be an attractive enterprise due to high product demand (due to growing consumer interest in healthy and gluten-free products and consumer receptivity when exposed to chestnuts), favorable prices (1 lb of chestnuts sells for \$1.50–\$4 wholesale and \$5–\$8 retail; 1 lb = 0.45 kg), environmental benefits (a perennial crop, chestnut can be grown on fertile erodible sloping lands without pesticides and can be effectively paired with vineyard production in agritourism settings), and relatively modest initial investment requirements (Gold et al. 2005b). Current U.S. demand exceeds national production which is offset by imports. The United States imported 4,910 metric tons of in-shell chestnuts valued at \$12.7 million in 2010 primarily from Italy (60%) and South Korea (25%) (USDA 2011).

UMCA has developed a comprehensive program to stimulate both production and consumption of chestnuts and create a viable chestnut industry in the U.S. Midwest. On the consumer side, activities have been directed to increase consumer awareness about chestnuts through the Missouri Chestnut Roast Festival, spinoff festivals, and chestnut sales at multiple venues. Studies have been conducted at the UMCA regarding (a) chestnut consumption behavior, (b) satisfaction with chestnuts and (c) preferences for chestnut attributes. *Chestnut consumption behavior* (e.g., frequency of consumption and familiarity with cooking chestnuts) has been monitored since 2003 during the Missouri Chestnut Roast festival (Gold et al. 2004, 2005a; Cernusca et al. 2008; Aguilar et al. 2010). The longitudinal study revealed an increase in chestnut consumption among festival participants over the 2003–2009 period. The percentage of respondents that have never tasted a chestnut decreased, while the percentage of people that consume chestnuts increased. Similar results were obtained for familiarity with cooking chestnuts. *Satisfaction with purchased chestnuts* was assessed for customers that bought chestnuts in the city of Columbia (MO) Farmers Market and Clovers Natural Market in Columbia, Missouri. Consumers that responded to the survey

were very satisfied with the chestnuts purchased in terms of quality (appearance and taste) and price and stated they would buy chestnuts again. They prefer to buy locally grown, organic chestnuts from farmers markets and health food stores. Most respondents roasted the chestnuts but some tried the recipes provided or new recipes (Cernusca et al. 2009). *Preferences for chestnut attributes* were measured through a conjoint analysis (CA) technique used in a survey conducted during the Missouri Chestnut Roast Festival in 2007 and 2009. The first study revealed that medium and large chestnuts were preferred over the small ones by consumers in Missouri (Aguilar et al. 2009). Both studies suggested a strong preference for locally and U.S. grown chestnuts compared with imports. Besides origin, organic certification was also found to be a major driver behind consumer preferences (Aguilar et al. 2009, 2010).

The present study builds upon previous studies to explore preferences from consumers outside the state of Missouri and applies CA to people who actually purchased chestnuts as opposed to potential buyers attending the Missouri Chestnut Roast. Specific objectives were to: evaluate consumers' familiarity with chestnuts, assess consumers' satisfaction with purchased chestnuts, and determine consumers' preferences for chestnut attributes.

Methods

Survey instrument and the conjoint analysis design

A survey was developed to accomplish the study objectives. The survey was comprised of three sections: questions assessing buyers' experience with the chestnuts they purchased, CA to measure consumers' preferences for various chestnut attributes (i.e., price per pound, production process and label of origin), and demographics.

The first section evaluated the type of chestnut purchase made, information about how chestnuts were cooked, satisfaction with the purchase, and familiarity with chestnuts. Satisfaction was measured using cognitive, affective, and behavioral satisfaction measures. Respondents' familiarity with chestnuts assessed frequency of consumption, familiarity with cooking and general knowledge about chestnuts. Table 1 describes each consumption dimension included in this part of

the study along the proxies used to measure these variables.

The CA included in second section of the survey measured consumer preferences for chestnut attributes. The CA used a choice-based method to obtain preferences for certain product attributes. The CA technique focuses attention on trade-offs people make between the attributes of alternative goods and services. CA is based on the premise that consumers can judge the value of several hypothetical products that are described by different attributes that make up product profiles and choose the one that gives them the most utility (Green and Srinivasan 1978; Carson et al. 1994).

Under a random utility framework, a consumer (*i*) has a utility function defined over an array of *J* possible choices of chestnut products. The respondent's utility function is broken down into two components. The first component is deterministic

and is a function of the attributes of alternatives and characteristics of individuals. The second component is a set of unobservable variables that introduce a random error element (Hanemann 1984). For the *i*th consumer faced with a total of *J* choices, the assumed utility of choice *j* can be represented by:

$$U_{ij} = V_{ij} + \varepsilon_{ij}, \quad j = 1, \dots, J$$

$$V_{ij} = x_{i1}\beta_1 + x_{i2}\beta_2 + \dots + x_{ij}\beta_j$$

The *V*s represent utility values that summarize the preference of the *i*th consumer for the *j*th product alternative. The *x*s specify values of chestnut attributes, and the β s denote importance weight parameters (partworths) that were used to determine the specific importance placed by consumers on each attribute. Vector ε_{ij} , $j = 1, \dots, J$ captures unobservable variables affecting consumer preferences, and reflects the idiosyncrasy of the individual in taste for the different

Table 1 Description of chestnut consumption dimensions evaluated

Chestnut consumption dimensions	Questions	Measures
Type of purchase	Was this your first time buying chestnuts?	Choice: yes/no
Method chestnuts were cooked	In what way have you cooked the chestnuts?	Choice: boiled/microwaved, roasted, using recipes provided by seller, using other recipes
Cognitive satisfaction: price	The price of chestnuts was:	Choice: lower than expected (1), as expected (2), higher than expected (3)
Cognitive satisfaction: visual appearance	The visual appearance of chestnuts was:	Rating scale: very bad (1), bad (2), satisfactory (3), good (4), very good (5)
Cognitive satisfaction: taste	The taste of chestnuts was:	Rating scale: very bad (1), bad (2), satisfactory (3), good (4), very good (5)
Affective satisfaction	I liked these chestnuts	5-point Likert scale: strongly disagree (1), agree (3), strongly agree (5)
Behavioral satisfaction	I would buy again; I would recommend to my friends	5-point Likert scale: strongly disagree (1), agree (3), strongly agree (5)
Frequency of consumption	How often do you consume chestnuts?	Rating scale: 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)
Familiarity with cooking chestnuts	How familiar are you with roasting chestnuts? How familiar are you preparing chestnuts using recipes?	Rating scale: not at all (1), little (2), somewhat (3), familiar (4), very familiar (5)
General knowledge about chestnuts: refrigeration	Chestnuts need refrigeration	Choice: yes/no/I don't know
General knowledge about chestnuts: fat content	Chestnuts' fat content compared to walnuts is:	Choice: lower/higher/I don't know
General knowledge about chestnuts: gluten content	Chestnut flour is gluten free	Choice: yes/no/I don't know

product alternatives. Under the assumption that random errors are independent and identically distributed, this model specification corresponds to McFadden's conditional logit model (McFadden 1974, 1986; Punj and Staelin 1978). The conditional logit model has several advantages, one of which is good model approximation even when working with small samples (Arnold et al. 1981).

Since its introduction in the early 1960s, CA has been widely used in marketing studies to measure consumer valuation of product attributes of horticultural products including apples (Novotorova and Mazzocco 2008; Wang 2010), pears (Gamble et al. 2006), bell peppers (Frank et al. 2001), citrus (Campbell et al. 2004, 2006), asparagus (Behe 2006), chestnuts (Aguilar et al. 2009, 2010), and other plants (Yue et al. 2011; Yue and Behe 2008). By using a conjoint study, researchers can gain a better understanding of the real value consumers attach to certain attributes when making purchasing decisions in a real situation (North and deVos 2002). The objective of the CA was to simulate real choice situations in order to determine how consumers will react when faced with particular choice situations. CA can be used to understand market preferences, predict market choices, in the evaluation of new product or service concepts, to develop strategies for market communication, and for market segmentation (Green and Srinivasan 1978; North and deVos 2002).

Product attributes selected for this study included price, production process and label of origin, the same attributes used in one of our previous studies (Aguilar et al. 2010). Each attribute had three levels. The attributes and the definition for each attribute level as provided in the survey are presented below:

- Price in U.S. dollars per pound with three different levels (\$4, \$5.50 and \$7).
- Production process:
 - Unknown—chestnuts may or may not use agrochemicals for fertilization and weed/pest control.
 - Pesticide free—chestnuts produced with minimal use of chemicals in the form of herbicides and pesticides.
 - Certified organic—chestnuts produced using methods that maintain and replenish the soil fertility without the use of potentially toxic and persistent pesticides and fertilizers. Growers

follow strict uniform standards that are verified by independent state or private organizations.

- Origin label:
 - Local—chestnuts grown locally (within a 300-mile radius) (1 mile = 1.6 km).
 - USA—chestnuts grown in the U.S.
 - Imported—chestnuts imported from outside the U.S.

The survey indicated that all products met the same standards of quality that guarantees freshness, good flavor, and nuts free of fungal or bacterial damage.

A random combination of attributes and levels were produced to generate product profiles. The profiles were generated using the Bretton–Clark designer program following a fractional factorial design. Profiles were then paired to present choice-based questions to participants. The survey contained nine pairs of hypothetical chestnuts products. The respondents were asked to review the nine pairs of hypothetical chestnut products and select one product (A or B) that they would be most likely to purchase. An opt-out option was included (Neither) that allowed the respondent to *not* choose any of the alternatives in the choice set. The Neither option in this study represented the *status quo* that corresponded to the average alternative for fresh chestnuts sold on the national market: \$5.50 per pound, unknown production process and grown in the USA (Fig. 1).

The third section of the survey gathered demographic information. It included data about age of the respondent, his/her level of education, gross annual household income, gender, marital status, and rural or urban residence.

Data collection

Five chestnut growers/vendors were approached and asked to include a booklet that contained recipes and nutritional information about chestnuts plus a survey and a postage paid return envelope with each sale in the 2009 season. One hundred surveys were provided to each producer/seller, for a total of 500 surveys. Customers purchased chestnuts from the five producers/sellers, and received the booklet containing the survey. They completed the survey and returned it in the postage-paid envelope if they choose so. This customized survey methodology did not permit

Box 7.	A	B		Box 8.	A	B	
Price per pound	\$7	\$4		Price per pound	\$4	\$5.50	
Production process	Pesticide free	Unknown		Production process	Pesticide free	Organic Certified	
Origin label	Local	Local		Origin label	U.S.A.	Imported	
Please check your preferred choice →	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> Neither *	Please check your preferred choice →	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> Neither *

*Neither option suggests you prefer the average national market alternative for chestnuts: \$5.50 per pound, unknown production process and grown in the USA

Fig. 1 Example of conjoint analysis instrument used to gather consumer preferences for chestnut attributes

reminders to be sent to respondents. In the conjoint section, each respondent reviewed nine pairs of hypothetical products and every comparison generated three choice observations (A, B or Neither), a complete questionnaire providing 27 observations per respondent.

Data analysis

PASW Statistics (SPSS) 17.0 was used to analyze the data. Frequencies, cross tabulation and linear regression analysis was used to analyze the first part of the survey. For the CA, data was analyzed using a conditional logit model. Since in SPSS the conditional logit model is not directly available, the Cox Proportional Hazard model with the same likelihood function was used instead.

Results

Fifty-nine surveys were returned in 2009 which generated 1,593 observations for the CA. The response rate was relatively low (~12%) likely due to the particular delivery format (no direct interaction with respondents) used to conduct the survey. Dillman (2000) suggests that response rates can be improved by offering tangible and intangible rewards, and sending reminder surveys or notices to non-respondents. The survey contained an incentive in the form of the drawing of a \$100 gas card. No follow-up mailing was possible because information about people that

purchased the chestnuts was not available since most of the sellers sold their chestnuts in farmers markets or grocery stores. Customers would buy chestnuts, get the booklet with the survey, and choose to send the survey back or ignore the survey. Information obtained is nonetheless valuable because it was the first time the research was extended beyond Missouri. In addition, people that actually purchased chestnuts were surveyed and not only potential buyers attendees at the Missouri Chestnut Roast Festival. Results of the survey were used to confirm previous research findings based on data collected in Missouri.

Profile of respondents

Table 2 presents the socio-demographic characteristics of respondents. Respondents were preponderantly over 45 years old (74%), female (60%), and married (75%). They were also highly educated, the vast majority (76%) with at least a college degree, and almost half (44%) holding a graduate degree. The majority of respondents (66%) reported over \$50,000 household income and about a third (36%) over \$75,000. The majority of respondents live in or close (less than 30 miles) to an urbanized area (78%).

Sellers who distributed the survey were from Missouri, Iowa, Kansas, Illinois, and Ohio and returned surveys represented consumers from 18 states, mainly the U.S. Midwest but also from the East and West coasts (i.e., AL, AR, CA, FL, IA, IL, KS, KY, MD, MI, MO, NC, ND, NJ, OH, PA, and WI).

Table 2 Demographic information of respondents

	%
Age	
25 or less	0
26–35	10
36–45	16
46–55	24
56–65	21
Over 65	29
Total household income	
Less than \$35,000	20
\$35,000–\$49,999	14
\$50,000–\$74,999	30
\$75,000–\$99,999	10
\$100,000 or more	26
Gender	
Female	60
Male	40
Level of education	
High school	12
Technical school	9
College degree	32
Graduate degree	44
Other	4
Marital status	
Married	75
Not married	25
Residence distance from an urbanized area of at least 50,000 people	
We are located in an urbanized area	51
Less than 5 miles	9
5–9 miles	5
10–29 miles	13
30–59 miles	13
60 miles or more	9

Familiarity with chestnuts

Sixty-nine percent of respondents had previously purchased chestnuts while 24% were first time buyers (7% did not answer). Five percent of respondents had never consumed chestnuts before, 19% consumed less than once a year, 33% once a year, 12% two–three times a year, and 31% more than three times a year. Nineteen percent of respondents were not familiar with roasting chestnuts, 7% had little familiarity, 17%

were somewhat familiar, 24% were familiar and 33% were very familiar with roasting chestnuts. Thirty-nine percent of respondents were not at all familiar with cooking chestnuts using recipes, 18% had limited familiarity, 14% were somewhat familiar, 20% familiar, and 9% very familiar with using recipes in cooking chestnuts.

Ninety percent of respondents knew that chestnuts need refrigeration, 52% knew that chestnuts are low in fat, and 40% knew that chestnut flour is gluten-free. A small number of respondents gave incorrect answers (0–7%), most of the respondents preferred to choose the “I don’t know” option if they were uncertain.

Most respondents (65.5%) roasted chestnuts, 43% boiled or microwaved them, 24% used recipes provided in the booklet, and 33% cooked the chestnuts using other recipes. By cross-tabulating the ways of cooking with how familiar people are with chestnuts in terms of frequency of consumption, familiarity with roasting, and familiarity with cooking using recipes, we observed that people with high familiarity of consumption, high familiarity with roasting, and high familiarity with cooking preferred to roast the chestnuts. Those with low frequency of consumption were very innovative and roasted or cooked with recipes other than just microwaving. People with low familiarity with roasting preferred to microwave or use recipes. All of the people with average familiarity with cooking cooked with recipes (Table 3).

Satisfaction with chestnuts purchased

Satisfaction was measured using cognitive measures (evaluation of price, visual appearance and taste of chestnuts), affective (“I liked these chestnuts”) and behavioral (“I would buy again” and “I would recommend to my friends”). Price was considered as expected by 57% of respondents, higher than expected by 19% and lower than expected by 12%. Most respondents evaluated the taste and appearance of chestnuts as very good (74% for taste and 72% for appearance) while 19% of respondents evaluated taste and appearance as good.

About half of respondents strongly agreed with the statements: “I liked the chestnuts”, “I will buy chestnuts again” and “I would recommend buying chestnuts to my friends”. Only 4–7% of respondents rated the statements with neutral and none with disagree or strongly disagree.

Table 3 Cross-tabulation of way of cooking and familiarity with chestnuts

	Boiled (%)	Roasted (%)	Cooked w/recipes (%)	<i>n</i>
Frequency of consumption				
Low	48	57	57	33
High	35	77	42	26
Familiarity w. roasting				
Low	66	27	67	15
Average	45	64	36	11
High	30	84	48	33
Familiarity w. cooking				
Low	44	62	37	32
Average	44	56	100	9
High	31	81	56	16

A linear regression between “I would buy again” as dependent variable and “I liked the chestnuts” as independent variable indicate that high satisfaction with chestnuts purchased increases the likelihood of future purchase, $t = 7.29$, $P < 0.001$, accounting for about 50% of variance ($R^2 = 0.501$). The analysis indicated that as the rating of satisfaction with chestnuts (“I liked the chestnuts”) increases by one unit (e.g., from *Agree* to *Strongly agree*), the likelihood to buy chestnuts again increases by 0.67 (95% CI 0.49–0.86).

Conjoint analysis of preferences for chestnut attributes

The estimated attribute coefficients of the conditional logit models, along with *P*-values and odds ratios, are presented in Table 4. The model was estimated using 1,593 observations. Odds ratios are interpreted as changes in the odds of a consumer choosing a product with a given attribute level over the base level. An odds ratio of one indicating that there is no difference

in consumer preference between that level of the attribute and the base level while an odds ratio of “*n*” for example indicates that consumers prefer a given attribute level “*n*” times than the base level (with values less than 1 indicating a negative preference).

Results show that all product attributes were statistically significant at $\alpha < 0.001$ and had a positive sign except for price. The most salient product characteristic was label of origin. If consumers are offered chestnuts at the same price and grown using the same production process, the odds of consumers choosing locally produced chestnuts over imported ones are 15.6 times higher; and the odds of choosing U.S. produced chestnuts over imported are 4.2 times higher. If price and origin were the same across products available, the odds of consumers choosing organically grown chestnuts over conventionally grown are 5.2 times higher and the odds of choosing pesticide free chestnuts over conventionally grown are 4.3 times higher. Increasing the price by \$1 per pound for a given product decreases the odds of choosing the product by a factor of 0.622 (37%), holding the values

Table 4 Conditional logit coefficients, *P*-values and odds ratio estimates of chestnut product attributes

Attributes	Coefficient	<i>P</i> > <i>z</i>	Odds ratio
Price (continuous variable)	−0.474	<0.001	0.622
Conventional	Base level		
Organic	1.650	<0.001	5.206
Pesticide free	1.460	<0.001	4.307
Imported	Base level		
Produced locally	2.750	<0.001	15.650
Produced in the US	1.437	<0.001	4.209

Chi square = 227.27;
P < 0.001

of the other alternatives constant. Results support previously reported results based on similar surveys conducted in Missouri during the Missouri Chestnut Roast festival (Aguilar et al. 2009, 2010) and are consistent with other findings in the literature. Brown (2003) indicated that marketing local products should stress quality and freshness and those consumers are willing to pay a premium price to support local farmers. It was reported that 16% of their study respondents would pay a 5% premium, and 5% of respondents would pay a 10% premium for local foods. Similarly, Schneider and Francis (2005) found that consumers were willing to pay a 10% price premium for locally grown foods. Consumers are also increasingly concerned about the origin of products they buy and how they were produced and willing to pay a premium for locally grown or sustainably produced products (Yue and Tong, 2009).

Other models were tested and statistically significant interactions with consumer characteristics were detected. First time buyers were more price sensitive than repeat buyers. A unit increase in price, decreased the odds of purchasing the product for first time buyers by 33%, all others being equal (Odds = 0.67, $P < 0.05$). Repeat buyers valued local production more than first time buyers. The odds of purchasing a product that was locally produced as compared to imported is 2.3 times higher for customers that have purchased chestnuts before as compared to first time buyers (Odds = 2.3, $P < 0.10$). With every one year increase in age, people valued more locally grown goods (Odds = 1.6, $P < 0.01$) and U.S. grown chestnuts (Odds = 1.5, $P < 0.01$) as compared to imports. With every one unit increase in education, the odds of preferring organic over conventional increased 1.75 times if everything else was held constant ($P < 0.01$). With every 1 year increase in age, customers were more price sensitive too, the odds of purchasing more expensive chestnuts decreasing by a factor of 0.85 (14%), $P < 0.05$.

Table 5 presents estimates of the probabilities of consumer preferences for selected bundles of products. Probabilities are the likelihood that a given product profile is selected by a consumer when the products defined in a bundle are the only ones available in the market. The value of the probability for each product is contingent on the profile of the other two alternatives (probabilities within bundle add up to 1.000). In bundle 1 for example, for the same

Table 5 Estimated probabilities for selected product profiles

Product bundle	Price	Production process	Origin	Prob.
1	\$4.00	Conventional	Local	0.714
	\$4.00	Conventional	US	0.192
	\$5.50	Conventional	US	0.094
2	\$7.00	Organic certified	US	0.453
	\$4.00	Pesticide free	Imported	0.370
	\$5.50	Conventional	US	0.177
3	\$7.00	Conventional	Imported	0.024
	\$5.50	Conventional	Local	0.769
	\$5.50	Conventional	US	0.207
4	\$5.50	Conventional	Local	0.375
	\$5.50	Organic certified	US	0.525
	\$5.50	Conventional	US	0.101
5	\$7.00	Organic certified	US	0.558
	\$5.50	Pesticide free	Imported	0.224
	\$5.50	Conventional	US	0.218
6	\$4.00	Organic certified	Imported	0.194
	\$7.00	Organic certified	Local	0.730
	\$5.50	Conventional	US	0.077
7	\$7.00	Pesticide free	Local	0.478
	\$4.00	Conventional	Local	0.461
	\$5.50	Conventional	US	0.061
8	\$4.00	Pesticide free	US	0.797
	\$5.50	Organic certified	Imported	0.112
	\$5.50	Conventional	US	0.091
9	\$5.50	Pesticide free	Imported	0.247
	\$7.00	Pesticide free	US	0.511
	\$5.50	Conventional	US	0.242

production process, the highest probability of selection is obtained by alternative 1 which is a product produced locally for the lowest price. In bundle 4, for the same price, the highest choice was obtained by an organic certified product. That price is not the single driver behind consumer preferences. In product bundle 5 and 9, the most expensive product is preferred because it is produced in U.S. and carries organic certification or is pesticide free if compared with the less expensive alternatives which are imported or produced conventionally. 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 joint effect of various attributes.

Conclusions

The majority of the respondents to our study had purchased chestnuts in the past (69%), had a frequency of consumption on the low side (57% less than once a year), were familiar with roasting chestnuts (57% were highly familiar) but not so familiar with cooking them using recipes (29% highly familiar). In general, most of the respondents were very satisfied with the chestnuts they purchased and satisfaction increased the likelihood of future purchase.

Conjoint analysis on price, place of origin, and production process confirm results of previous studies performed in Missouri (Aguilar et al. 2009, 2010), and suggest that chestnuts grown locally are most likely preferred by consumers. Older consumers tend to place a greater weight on this attribute. Organic and pesticide free grown chestnuts are also preferred over conventionally produced ones. Since price has a lower impact on consumer choice compared to origin and production process, there is an opportunity to increase profits of local producers if they can effectively promote awareness and loyalty towards locally produced chestnuts, especially if they use caution with regard to chemicals in the production process. However, distinctive results between first-time and repeat consumers suggest the former are more price sensitive. Hence, a strategy to introduce chestnuts to novel markets must carefully assess the impact of prices and possibly offer chestnuts at price levels that motivate consumers to try them for the first time. Once a market is established higher-level prices may be possible to attain if produce carry local and organic or pesticide free labels.

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References

- Aguilar FX, Cernusca MM, Gold MA (2009) Conjoint analysis of consumer preferences for chestnut attributes. *HortTechnology* 19(1):216–223
- Aguilar FX, Cernusca MM, Gold MA (2010) Frequency of consumption, familiarity and preferences for chestnuts in Missouri. *Agrofor Syst* 79:19–29
- Arnold SJ, Roth V, Tigert DJ (1981) Conditional logit versus MDA in the prediction of store choice. *Adv Consum Res* 8(1):665–670
- Behe BK (2006) Conjoint analysis reveals consumers prefer long, thin asparagus spears. *HortScience* 41(5):1259–1962
- Brown C (2003) Consumers' preferences for locally produced food: a study in southeast Missouri. *Am J Altern Agric* 18:213–224
- Campbell BL, Nelson RG, Ebel RC, Dozier WA, Adrian JL, Hockema BR (2004) Fruit quality characteristics that affect consumer preferences for Satsuma mandarins. *HortScience* 39(7):1664–1669
- Campbell BL, Nelson RG, Ebel RC, Dozier WA (2006) Mandarin attributes preferred by consumers in grocery stores. *HortScience* 41(5):664–670
- 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. *Mark Lett* 5(4):351–367
- Cernusca MM, Gold MA, Godsey LD (2008) Influencing consumer awareness through the Missouri Chestnut Roast. *J Ext* 46(6). <http://www.joe.org/joe/2008december/rb7.php>. Accessed 1 June 2011
- Cernusca MM, Gold MA, Godsey LD (2009) After purchase survey report. UMCA Internal report
- Dillman DA (2000) Mail and Internet surveys. The tailored survey method. Wiley, New York
- Frank CA, Nelson RG, Simonne EH, Behe BK, Simonne AH (2001) Consumer preferences for color, price, and vitamin C content of bell peppers. *HortScience* 36(4):795–800
- Gamble J, Jaeger SR, Harker R (2006) Preferences in pear appearance and response to novelty among Australian and New Zealand consumers. *Postharvest Biol Technol* 41(1):38–47
- 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 (2005a) Update on consumers' preferences for chestnuts. *HortTechnology* 15(4):904–906
- Gold MA, Cernusca MM, Godsey LD (2005b) Chestnut market analysis: producers' perspective. <http://www.centerforagroforestry.org/pubs/chestnutmarketreport.pdf>. Accessed 30 June 2011
- Green PE, Srinivasan V (1978) Conjoint analysis in consumer research: issues and outlook. *J Consumer Res* 5:103–123
- Hanemann WM (1984) Discrete/continuous models of consumer demand. *Econometrica* 52(3):541–561
- Hunt K, Gold M, Reid W, Warmund M (2009) Growing Chinese chestnuts in Missouri. University of Missouri Center for Agroforestry. AF 1007-2009. <http://extension.missouri.edu/explorepdf/agguides/agroforestry/af1007.pdf>. Accessed 30 June 2011
- McFadden DL (1974) 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
- North E, deVos R (2002) The use of conjoint analysis to determine consumer buying preferences: a literature review. *J Fam Ecol Consumer Sci* 30:32–39

- Novotorova NK, Mazzocco MA (2008) Consumer preferences and trade-offs for locally grown and genetically modified apples: a conjoint analysis approach. *Int Food Agribus Manag Rev* 11(4):31–53
- Punj GN, Staelin R (1978) The choice process for graduate business schools. *J Mark Res* 11:588–598
- Schneider ML, Francis CA (2005) Marketing locally produced foods: consumer and farmer opinions in Washington County, Nebraska. *Renew Agric Food Syst* 20:252–269
- US Department of Agriculture (USDA) (2009) 2007 census of agriculture. United States Summary and State Data. AC-07-A-51. http://www.agcensus.usda.gov/Publications/2007/Full_Report/index.asp Accessed 30 June 2011
- US Department of Agriculture (USDA) (2010) National nutrient database for standard reference. http://www.nal.usda.gov/fnic/foodcomp/cgi-bin/list_nut_edit.pl. Accessed 30 June 2011
- US Department of Agriculture (USDA) (2011) US trade imports. <http://www.fas.usda.gov/gats/default.aspx> Accessed 30 June 2011
- Wang Q (2010) Consumer preferences and willingness to pay for locally grown organic apples: evidence from a conjoint study. *HortScience* 45(3):376–381
- Yue C, Behe BK (2008) Estimating U.S. consumers' choice of floral retail outlets. *HortScience* 43(3):764–769
- Yue C, Tong C (2009) Organic or local? Investigating consumer preference for fresh produce using a choice experiment with real economic incentives. *HortScience* 44(2):366–371
- Yue C, Dennis JH, Behe BK, Hall CR, Campbell BL, Lopez RG (2011) Investigating consumer preference for organic, local, or sustainable plants. *HortScience* 46(4):610–615