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Eliciting Consumer Preference and Willingness to Pay for Mushrooms: A Latent Class Approach

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Abstract

As consumer demand for food labeling becomes increasingly important, producers and retailers can include various labeling to attract new customers. This study investigates Connecticut consumers' preferences and willingness to pay for mushrooms marketed with various labels using a latent class approach to identify classes within the market. Results reveal three market segments (price/GMO-label, locally/organically grown, and traditional mushroom varieties). Overall, only a third of consumers valued the "locally grown" or "organic" labels, so charging a premium for these labels might alienate a majority of consumers. Finally, GMO labeled mushrooms are discounted, but the non-GMO label receives little value.

Keywords: choice experiment, food labeling, latent class model

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Introduction

In 2016, the United States was the third largest producer of mushrooms in the world (839 million pounds),[1] behind China (15.5 billion pounds) and Italy (1.4 billion pounds) (Food and Agriculture Organization of the United Nations, 2016). The U.S. mushroom industry ranked fourth among vegetables and other crops' cash receipts in 2016, after potatoes, lettuce, and tomatoes (U.S. Department of Agriculture, 2018a). Per capita mushroom availability increased 15% from 2006–2007 to 2016–2017 (U.S. Department of Agriculture, 2018a). Currently, mushroom demand is near its highest-ever level (2.93 lb. per capita in 2016–2017), but it has stagnated over the last 5 years, hovering between 2.7 to 3 lb. per capita (U.S. Department of Agriculture, 2018b). Most of the demand is met with domestic production; however, imports have increased continuously over the past decade, making up 13% of per capita use in 2016–2017 compared to only 9% in 2000–2007. The increase in the share of imports on per capita use amounts to potentially over 41 million lb., or over $54 million in lost sales by domestic firms (calculated using data from U.S. Department of Agriculture, 2017).

The loss in sales to imports is not due to loss of production, as U.S. mushroom production has increased by 18% since 2006–2007. Rather, increased imports are the result of mushroom demand outstripping supply. However, as demand stagnates and production levels off, the market should return to intense competition for customers as large production areas throughout the world strive to increase sales within the U.S. market. For this reason, U.S. producers and retailers need to identify effective marketing strategies (e.g., locally grown, organic, and genetically modified organism [GMO] free labeling] as well as mushroom varieties that consumers value. As noted by *The Packer* (2017), sales of exotic varieties continue to increase.

Within the U.S. mushroom industry, the *Agaricus* category (e.g., "white button" and brown mushrooms like "cremini" and "portabella") represented 97% of sales by volume in 2016–2017, an increase of 16% since 2010 (U.S. Department of Agriculture, 2017). Increasing demand can be attributed to a number of factors, including new promotions, increased use by restaurants, and different product varieties (*The Packer,* 2016). In the United States, shiitake mushrooms have been identified as the third most preferred mushroom after white button (*Agaricus*) and portabella (brown *Agaricus*) in the retail, wholesale, and food service industry (Onianwa, Wesson, and Wheelock, 2000; Augostini, 2002; Technomic, 2005). Specialty mushrooms, such as shiitake and oyster, have seen sales increase by 67% since 2010 (U.S. Department of Agriculture, 2017). As demand has grown faster than supply, prices have risen by 48% for specialty and only 10% for *Agaricus* mushrooms. The volume of sales, and price in particular, for shiitake has increased by 74% and 41%, respectively (U.S. Department of Agriculture, 2017). Furthermore, specialty mushrooms were on average three times the price of Agaricus ($3.78/lb. compared to $1.25/lb. in 2016–2017) (U.S. Department of Agriculture, 2017). This price difference might be explained by production processes (e.g., the need for controlled room) and the length of time required to grow specialty versus *Agaricus* or due to specialty mushrooms being seen as a higher-end product, thereby garnering a price premium.

[1] The Food and Agriculture Organization of the United Nations categorizes all varieties of mushroom and truffle production.

This study investigates Connecticut consumers' preferences and willingness to pay (WTP) for various mushroom types using a latent class approach to identify market segments. Given the potential for increased mushrooms production in Connecticut, this study examines the drivers of white button, brown, and specialty mushroom demand by looking at consumers' preferences for various product attributes, such as growing region, organic certification, and presence of genetic modification. Furthermore, we compare consumer preference for popular *Agaricus* mushrooms with the specialty shiitake mushroom. With respect to industry contribution, we present marketing implications that highlight how producers and retailers can tailor their marketing strategies to capture heterogeneous consumers within the market. Further, consumer valuation of a GMO label and whether a class exists that would not have negative preference for this production practice is discussed.

Several studies have examined issues within the global mushroom market. Gold, Cernusca, and Godsey (2008) used a nationwide survey of shiitake mushroom producers and provided detailed production information (revenue, longevity, type of products, start-up costs) as well as marketing strategies (branding, communication, retail outlet). Regarding marketing research, Gold, Cernusca, and Godsey (2008) outlined the production side, while Mattila, Suonpää, and Piironen (2000) described the nutritional and medicinal benefits. However, only a few studies have examined determinants of mushroom demand (Augostini, 2002; Lucier, Allshouse, and Lin, 2003), and even fewer studies have evaluated demand for specialty mushrooms (Onianwa, Wesson, and Wheelock, 2000; Gold, Cernusca, and Godsey, 2008). Outside of varietal preference, no study has examined the role of marketing strategies, such as labeling (e.g., locally grown, organic and GMO-free) on consumer preference for mushrooms even, though certain types of labeling has been shown to have increasing popularity among some U.S. consumers (Thilmany, Bond, and Bond, 2008; Adams and Salois, 2010; James, Rickard, and Rossman, 2009; Yue and Tong, 2009; Bernard and Bernard, 2010; Onozaka and McFadden, 2011; Onken, Bernard and Pesek, 2011; Campbell et al., 2014).

Materials and Methods

In an online survey administered in June/July 2015, 760 Connecticut consumers answered questions about their purchasing habits of specialty vegetables and mushrooms, including a choice experiment on several vegetables and mushrooms. The overarching goal of the project was to better understand Connecticut consumers' perceptions and valuations of various labels across several vegetables and mushrooms. Respondents were from the online panel of Global Market Insite, Inc. (GMI) (Lightspeed Research, Warren, NJ). Potential respondents from GMI's database were randomly sent an invitation to participate in the survey. Respondents that agreed to participate, were 18 years or older, had purchased fresh vegetables or mushrooms during the last year completed the survey, and resided in Connecticut were allowed to participate in the survey.

After meeting all requirements, respondents were randomly assigned to a vegetable or mushroom choice experiment. This paper focuses on respondents randomly selected into the mushroom choice experiment. The survey was administered to Connecticut residents for several reasons, notably due to the funding agency's interest in the Connecticut market. Furthermore, unlike many other states, Connecticut strictly defines local as "produced within the state or 10 miles from the point of purchase" (Connecticut Department of Agriculture, 2018).

A total of 200 consumers were randomly selected to complete the mushroom choice experiment, with 145 providing complete responses. The survey sample was representative of the Connecticut population with respect to age, race, household income, and persons per household (Table 1). Further, our sample matched the dispersion of residents throughout the state, with 80% of our sample being urban/suburban compared to U.S. census estimates of 88% (U.S. Census Bureau, 2012). Women were oversampled, which is unsurprising given that it has been reported that women are the primary household shoppers (Private Label Manufacturers Association, 2013). A caveat to our analysis is that our sample appears to be representative to the Connecticut population, but there is no way to 100% ensure it is representative. Based on the fact that our sample

Table 1. Descriptive Statistics of the Explanatory Variables Used in the Latent Class Model

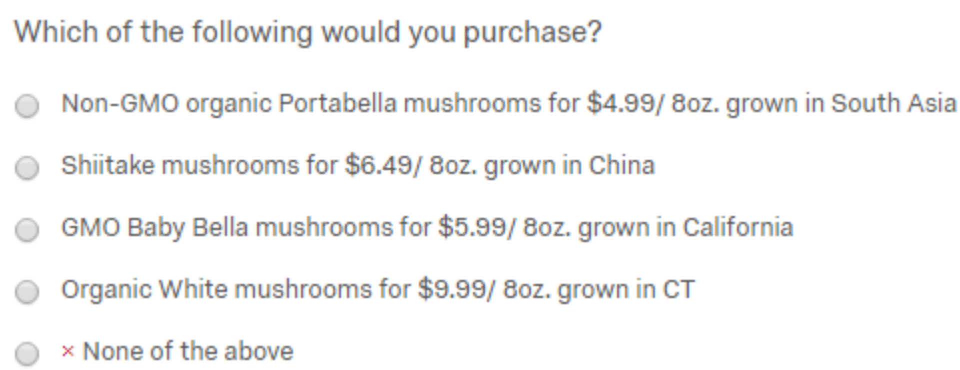
Variable	Sample Mean	Sample St. Deviation	Connecticut Mean
Mean income ($)	72,390	49,356	–
Median ($)	73,083		71,755[a]
Mean age	51.3	15.3	–
Median	51		41[a]
Children per household	1.30	0.49	–
Adults per household	2.17	0.90	–
Male	0.36	0.48	0.51
Caucasian	0.85	0.36	0.80
Location			
Metro	0.21	0.41	0.88[b]
Suburban	0.59	0.49	–
Rural	0.20	0.40	0.12
Food Neophobia Scale (FNS)	28.6	10.8	–
Mushroom experience			
Portabella	0.76	0.43	–
Shiitake	0.60	0.49	–
GMO Questions			
GMOs Safe (1 = yes)	0.15	0.36	–
GMO Issues (1 = long-term health issues)	0.25	0.43	–
No. of respondents	145		
No. of obs. (145 respondents × 10 sets × 5 products)	7,250		

[a] Mean age is not provided, so we provide the median Connecticut age provided by the U.S. Census Bureau (2012); however, the median age includes residents under 18 years of age, which is not directly comparable to our sample. The number of children/adults per household in Connecticut could not be found; however, average persons per household in Connecticut was 2.56 in 2012–2016 (U.S. Census Bureau, 2018). Income is inflation adjusted to 2016 dollars (U.S. Census Bureau, 2018).
[b] The U.S. Census Bureau includes urban and suburban together.

demographics are similar to the Connecticut population demographics, we believe that our results are generalizable to all Connecticut residents. Further, our results are generalizable to the U.S. population to the extent that Connecticut respondents in our sample share similar beliefs as the U.S. population.

Before beginning the choice experiment, each respondent was told to act as though they were in a real purchase situation and reminded to keep their budget constraint in mind. Respondents were then told that each product they evaluated would be an 8 oz. container of mushrooms. Each respondent was presented with ten choice sets consisting of four choices and an option to choose "none of the above." The choice sets and products with each choice set were randomized between respondents to help limit respondent fatigue. The optimal number of choice sets was determined based on the D-efficiency criterion (Kuhfeld, 2010). Each product within a choice set was specified as an 8 oz. package of mushrooms with varying attributes presented in the form of text describing the attributes comprising the product (Figure 1).

Figure 1. Example of a Choice Set Used in the Survey



The attributes included in the choice experiment included mushroom variety, price, origin, production type, and information on GMO content (Table 2). Attributes (and attribute levels) were chosen based on observations of mushroom packaging in retail stores throughout Connecticut as well as past literature on vegetables. Notably, in retail stores, price, origin, organic, and variety are generally provided to consumers. GMO was included due to the increasing focus on GMO labeling throughout the United States and the potential for GMOs to be introduced in mushrooms.

Table 2. Attributes and Levels Included in the Choice Experiment

Price ($)	Mushroom type	Label	Location produced	Production type
4.99	Portabella	GMO	Connecticut	Organic
5.99	Baby bella	Non-GMO	California	Not organic
6.99	Shiitake	No label	United States	
7.99	White mushroom		South Asia	
9.99			China	

Four mushroom varieties were included in the choice design, including white mushrooms, portabellas, baby bellas, and the specialty shiitake mushrooms. Prices varied within a range of $4.99 to $9.99 per 8 oz. package to incorporate the dispersion of prices found in various Connectict grocery stores at the time of the survey. Mushroom origin specified the location of production, including Connecticut, California, United States, China, and South Asia. The "Connecticut" label was the local label (as defined by Connecticut law). Use of the "California" and "United States" labels represented domestic products, while "China" and "South Asia" represented imported products. China was included due to the size of their production volume, while South Asia was included given their increasing volume of production. California was chosen given their production volume and their reputation for being a major agricultural producer.

Organic and GMO labeling are becoming increasingly important. In 2015, organic and non-GMO food sales outpaced overall store sales at Whole Foods by 54% (Schweizer, 2015). U.S. organic food sales topped $47 billion in 2017, was up 6.4% from 2016 (Organic Trade Association, 2018). In 2016–2017, certified organic sales of all mushrooms represented 8% of total mushroom sales (U.S. Department of Agriculture, 2017). Reasons for purchasing organic generally focus on environmental and safety concerns (Ritson and Oughton, 2007; Essoussi and Zahaf, 2008), with numerous studies finding that consumers are willing to pay a premium for organically produced foods (Batte et al., 2007; Campbell et al., 2010). To capture consumer preference and WTP for organic, we included an organically grown label or provided no information. We did not provide any other information about the definitions of organic, as most retail stores do not provide this type of information.

Currently, there are no USDA-approved GMO mushroom varieties available on the market, though mushrooms that have been gene edited are moving toward the consumer market (Waltz, 2016). Even though no GMO-approved mushroom varieties are currently available, there has been a move by states to mandate GMO labeling of foods and businesses to utilize non-GMO labeling to ensure consumer awareness regarding their product. For instance, several states in the United States have passed laws requiring specific labeling restrictions on genetically modified (GM) foods, including Connecticut (in 2013), Maine (in 2013), and Vermont (in 2014). However, in 2016 the United States passed the National Bioengineered Food Disclosure Law establishing a U.S. standard for labeling GMO products while also nullifying the state laws (Jaffe, 2017). Past studies have reported that consumer WTP declines when a food is labeled as genetically modified (Huffman et al., 2003; Loureiro and Hine 2004; Hu, Veeman, and Adamowicz, 2005; Lusk et al., 2005; Dannenberg, 2009; Lewis, Grebitus, and Nayga, 2016; McFadden and Lusk, 2017) and that mandatory GM labeling can act as a market barrier, preventing GM products from reaching supermarket shelves (Carter and Gruère, 2003). To evaluate consumer preference and WTP for GMOs, we utilized labeled mushrooms in the study as GMO, non-GMO, or no information was provided. We did not provide any other information about the definitions of GMO, as most retail stores do not provide this type of information.

Econometric Model

To account for potential heterogeneity in consumer taste and preferences, we used a Latent Class Model (LCM) to analyze our survey data (Boxall and Adamowicz, 2002; Greene and Hensher, 2003). The LCM postulates that individual behavior depends on observable attributes and on latent heterogeneity that varies with factors that are unobserved by the analyst (Greene and Hensher, 2003). In LCMs, the population of respondents is divided into a set number of classes, or groups, with varying preferences such that, although groups are different from each other, all members of the same group share the same parameters. We used Bayesian Information Criteria (BIC) to determine the number of consumer groups (Table 3). The unobserved heterogeneity is then captured by these latent classes in the population, which are associated with different parameter vectors in the model.

Table 3. Summary of Latent Class Models up to Five Classes

Classes	LL[a](*K*)	BIC[b]	CAIC[c]
2	−1447.54	3084.20	3122.20
3	−1382.50	3083.51	3147.51
4	−1324.03	3095.97	3185.97
5	−1270.91	3119.13	3235.13

Note: Estimation is based on 7,250 choices from $N = 145$ survey participants.
[a] LL is the log-likelihood values at the convergence. K is the number of parameters.
[b] BIC is Bayesian Information Criteria, calculated as $-2 \times \text{LL} + [K \times \ln(N)]$.
[c] CAIC is Consistent Akaike Information Criteria, calculated as $-2 \times \text{LL} + [\ln(N) + 1] \times K$.

The LCM is based on Random Utility theory, in which consumer i's utility, conditional on class s, from choosing product j can be presented by

$$U_{ij|s} = X_j \beta_s + \epsilon_{ij|s}, \tag{1}$$

where X_j represents the vector of product attributes [e.g., mushroom varieties, production location, production technology used (organic and GMO), and price]; β_s represents class-specific taste and preferences, and $\epsilon_{ij|s}$ is the error term that is conditionally *i.i.d.* extreme value type 1 within class. The unconditional probability that consumer i is sorted in class s based on socio-demographic characteristics is given by

$$P_{is} = \frac{\exp(\theta_s Z_i)}{\sum_s \exp(\theta_s Z_i)}, \tag{2}$$

where Z_i represents the socidemographic characteristics of consumer i and θ_s is a parameter vector that determines the probability of class membership. After a consumer i is assigned to their most probable class, the probability of consumer i choosing product j is found by

$$P_{ij|s} = \frac{\exp(\mu_s X_j \beta_s)}{\sum_s \exp(\mu_s X_j \beta_s)}, \tag{3}$$

where μ_s is the scale parameter for class s and is normalized to 1. Finally, the joint probability of a consumer i in class s choosing product j is given by

$$P_{ijs} = P_{ij|s} \times P_{is} = \frac{\exp(\mu_s X_j \beta_s)}{\sum_s \exp(\mu_s X_j \beta_s)} \times \frac{\exp(\theta_s Z_i)}{\sum_s \exp(\theta_s Z_i)}. \tag{4}$$

Equation 4 is used to estimate the class-specific utility and class probability parameters using maximum likelihood estimation method. Previous studies have shown that race, sex, income, age and household composition are important determinants of mushroom consumption (Lucier, Allshouse, and Lin, 2003; Jiang et al., 2017; Boin and Nunes, 2018). In our model, in addition to the above-mentioned factors, the class membership equation includes living areas (metro, suburban, and rural), an index of food neophobia, previous purchasing behavior for shiitake and portabella mushrooms, and safety and health perceptions of GMO products. Food neophobia is defined as a "reluctance to eat" unfamiliar foods (Dovey et al., 2008). Pliner and Hobden (1992) developed a Food Neophobia Scale (FNS) consisting of a survey of five positive and five negative statements regarding food consumption. Participants respond to the 10 questions on a seven-point Likert scale ranging from "strongly disagree" to "strongly agree." A lower score on the FNS represents low neophobia, implying those participants are more likely to try new food and food technology. Regarding the purchasing behavior, participants were asked whether and how frequently they bought portabella or shiitake mushrooms. Participants were also asked about their perceptions regarding GMO products, whether the participants considered GMO to be safe, and whether GMO caused long-term health issues.

LCM coefficients were used to calculate consumer WTP for each group:

$$WTP_j = -\left(\frac{\beta_j}{\beta_{price}}\right), \tag{5}$$

where β_j is the estimated coefficient for each attribute j and β_p is the estimated coefficient for the price attribute. We used the delta method in STATA to obtain 95% confidence intervals for the WTP estimates.

Results and Discussion

Regarding respondents' mushroom purchasing behavior, it is worth highlighting the lack of familiarity with shiitake mushrooms. About 40% of the respondents had never purchased shiitake mushrooms, compared to only 24% for portabella mushrooms (Table 1). Among those who had purchased shiitake at least once, about 67% shopped at large chain grocery stores, while only a small fraction, about 12%, shopped at a farmers' market. Of the shiitake purchases, almost 56% were produced locally, and 27% were imported from East Asia. Potential consumers of shiitake (about 11% of our sample) were interested in purchasing but had never purchased, due to "not being able to purchase locally grown" as their main concern for not buying shiitake mushrooms. Consumers were also concerned about shiitake being "too expensive."

Results from latent class analysis reveal three classes with varying preferences in the market for the four types of mushrooms. From Table 4, we see that all the classes have significant and negative coefficients associated with the "none" option, which reflects the fact that a respondent experienced an increase in utility level from making a product choice other than the "none" option. Consistent with economic theory, we find negative coefficients with respect to the "price" attribute. The attribute is significant for all three classes. A negative and significant coefficient indicates that the respondents prefer a lower price for their products to a higher price.

Table 4. Latent Class Model Results

	Class 1 Price and GMO Sensitive Class		Class 2 Labeling Oriented Class		Class 3 Traditional Mushroom Buyer Class	
% share	34.70%		37.20%		28.10%	
Parameter estimates						
Baby bella	0.347	(1.04)	−0.214	(−0.85)	0.568**	(2.72)
Portabella	−0.127	(−0.31)	−0.190	(−0.79)	0.505*	(2.45)
Shiitake	−0.454	(−1.21)	−0.254	(−0.95)	−0.003	(−0.02)
GMO	−0.921**	(−2.84)	−1.431***	(−4.54)	0.007	(0.03)
Non-GMO	−1.109*	(−2.33)	−0.234	(−1.01)	0.042	(0.24)
Connecticut	0.168	(0.50)	0.959***	(4.93)	−0.107	(−0.54)
South Asia	−1.183**	(−2.78)	−2.224***	(−5.44)	−0.999***	(−4.05)
China	−2.792***	(−4.21)	−2.877***	(−5.95)	−0.637**	(−2.89)
California	−0.751**	(−2.84)	−0.621**	(−2.71)	−0.221	(−1.18)
Organic	0.038	(0.13)	0.726***	(3.55)	0.069	(0.38)
Price	−1.538***	(−7.88)	−0.515***	(−6.22)	−0.399***	(−6.83)
None option	−8.953***	(−6.81)	−5.270***	(−6.75)	−5.487***	(−7.52)
Class membership equation						
Age	0.048***	(3.29)	0.019	(1.31)		
Male	−0.952	(−1.69)	−0.497	(−0.85)		
White	−0.041	(−0.06)	−0.574	(−0.87)		
Household adults	0.273	(0.99)	−0.201	(−0.69)		
Household kids	0.020	(0.03)	−0.614	(−0.99)		
Metro	0.195	(0.23)	0.118	(0.12)		
Suburban	−0.667	(−1.16)	−0.051	(−0.09)		
Income	0.000	(0.86)	0.000	(1.62)		
FNS	−0.024	(−1.17)	−0.048*	(−2.32)		
GMO perceived as safe	0.408	(0.60)	−0.802	(−1.05)		
GMO causes long term health issues	0.280	(0.45)	0.389	(0.63)		
Experience with shiitake	−0.485	(−0.82)	1.467*	(2.25)		
Experience with portabella	0.072	(0.10)	−1.835**	(−2.58)		
Constant	−1.673	(−1.44)	2.405*	(2.18)		

Notes: Single, double, and triple asterisks (*, **, ***) indicate significance at the 10%, 5%, and 1% level, respectively. Numbers in parentheses are *t*-statistics.

Latent Class One: Price and GMO Sensitive Class

Latent class one makes up 34.7% of the sample. The magnitude of class one's price coefficient implies that this class is more price sensitive than classse two and three. Consumers in class one showed no preference across mushroom varieties. Interestingly, class one consumers did not have a preference for locally labeled (i.e., Connecticut grown) mushrooms compared to mushrooms marketed with a generic label of "produced in the U.S." However, this group of consumers showed a significant negative preference toward products imported from China and Southeast Asia as well as mushrooms grown in California. The disutility is higher for imported labels compared to the

California label. This group of consumers was also sensitive to the GMO label in their purchase decisions, as indicated by the negative and significant coefficients for both the GMO and non-GMO labeled mushrooms. This result is important given GMO mushrooms are moving toward being available on the consumer market (Waltz, 2016) and new labeling requirements for GMO foods. Class one consumers showed no preference toward organically produced mushrooms. With respect to the class membership equation, class one tended to be made up of older consumers and have fewer male household members compared to class three (Table 4).

Latent Class Two: Labeling Oriented Class

Latent class two includes 37.2% of the sample (Table 4). Class two consumers are distinguished from the other classes by the positive and significant coefficient for the "Connecticut" attribute, implying that this group has a direct preference for locally grown products. Consumers in class two prefer Connecticut-grown mushrooms compared to those grown elsewhere, consistent with other studies that used stated preference methods to estimate the WTP for locally grown food (Brown, 2003; Giraud, Bond, and Bond, 2005; Thilmany, Bond, and Bond, 2008; Carpio and Isengildina-Massa, 2009; Yue and Tong, 2009; Grebitus, Lusk, and Nayga, 2013). Among the origins, South Asia and China were the least preferred, followed by California. Consumers in class two preferred an organically grown label compared to no label. Similar to class one consumers, class two consumers also showed a negative preference toward a GMO label compared to the baseline of "no label" product, and the magnitude of the coefficient associated with the GMO label is higher than that of class one. With respect to the mushroom varieties, class two consumers also did not show any preference toward any specific variety, similar to class one consumers.

Demographically, class two has a lower FNS score compared to class three, implying that class two consumers are relatively more willing to try new food products and food technologies. This group also has more experience purchasing shiitake mushrooms and less experience purchasing portabella mushrooms compared to class three consumers. Overall, it is worth stressing that although some of the consumers did have previous purchasing experience of shiitake mushrooms, they showed no preference toward shiitake mushrooms compared to traditional white button or brown mushrooms.

Latent Class 3: Traditional Mushroom Buyer Class

Latent class three consists of 28.1% of our sample. Consumers in class three showed a preference toward purchasing portabella and baby bella mushrooms compared to the baseline product (the white button variety). Similar to the other two classes, class three consumers also showed a dislike for imported mushrooms. Overall, class three consumers' purchase decisions were not influenced by production methods, be they organic or GMO. Demographically, this group of consumers are younger and have more male household members than class one consumers. Class three consumers have more purchasing experience with portabella mushrooms and less experience with shiitake mushrooms compared to class two consumers. This group also has higher income compared to class two members, which is borderline significant (p-value = 0.105). Class three consumers have a higher FNS score compared to class two consumers, consistent with the fact that class three consumers showed a significant preference toward more traditional mushroom varieties like baby bella and portabella. We also find a negative preference for shiitake mushrooms for class three, but the coefficient is not statistically significant.

Willingness to Pay

Table 5 presents the mean WTP estimates for each class. Only class three consumers are willing to pay a premium of $1.42 and $1.27 per 8 oz. package for baby bella and portabella mushrooms, respectively. Regarding the GMO attributes, consumers of both classes one and two discounted mushrooms with an explicit GMO label, $0.60 for class 1 and $2.78 for class two. This discount differential could indicate that more class one consumers perceive GMO to be safe and not cause long-term health effects, although those factors were not statistically significant in the class membership equation. Among production method attributes, only class two consumers are willing to pay a premium of $1.40 for mushrooms with an “organic” label.

Regarding origin attributes, class two consumers are willing to pay a premium of $1.86 for an 8 oz. package of mushrooms grown in Connecticut. Consumers of all classes discounted mushrooms grown outside Connecticut. For example, for class one consumers the retailers need to discount the price by $0.48–$1.81 for mushrooms produced in California, South Asia, and China. The discount is higher for class two and class three consumers, $1.20–$5.58 for class 2 and $0.55–$2.50 for class three.

Conclusions

It is important for producers and retailers to identify their consumer base to make critical production and marketing decisions. We elicited consumer WTP for various labels that could be used to market and to sell mushrooms in the United States, including organic, local, and non-GMO labels. Based on the results of this study, stakeholders in the mushroom industry can adapt their marketing strategies to capture heterogeneous consumers at farmers’ markets, restaurants, gourmet groceries, and other specialized outlets.

We find three distinct classes in the market for popular *Agaricus* and specialty mushrooms among Connecticut consumers of mushrooms. Consumers of class two (“label-oriented class”), about 37.2% of the sample, are willing to pay a significant premium for organic and local (Connecticut-grown) labeled products, with the latter bringing in a higher premium in our results. This finding is consistent with previous studies, in which a “local” label was worth more than an “organic” label to consumers (Hu, Woods, and Bastin, 2009; Yue and Tong, 2009; Costanigro et al., 2011; Hu et al., 2011; Onozaka and McFadden, 2011). Consumers of all three classes showed an indirect preference for local (Connecticut-grown) products in terms of not being willing to pay a higher price for imported products or mushrooms grown in California. Consumers of classes one and two showed a negative preference for an explicit GMO label. This finding is important as it shows that, despite USDA approval of GM foods, many U.S. consumers still want their produce to be free of any GMO content. Overall, our results show that if mushrooms were appropriately labeled either “locally grown” or “organic,” producers and retailers could increase their mark-up for a select group of consumers. Notably, mushroom producers and retailers that targeting our label-oriented class should focus on promoting their mushrooms as locally grown given the preference for local mushrooms. With respect to firms preemptively labeling mushrooms as non-GMO, we find that

Table 5. Willingness-to-Pay Estimates from the Latent Class Model Results.

	Class 1	**(CI)**	**Class 2**	**(CI)**	**Class 3**	**(CI)**
Baby Bella	0.226	(−0.206, 0.692)	−0.415	(−1.415, 0.581)	1.426**	(0.361, 2.767)
Portabella	−0.082	(−0.554, 0.508)	−0.368	(−1.256, 0.594)	1.268**	(0.234, 2.502)
Shiitake	−0.295	(−0.721, 0.172)	−0.494	(−1.527, 0.516)	−0.009	(−1.057, 1.144)
GMO	−0.599***	(−1.007, −0.184)	−2.777***	(−4.294, −1.599)	0.016	(−0.878, 1.152)
Non-GMO	−0.721***	(−1.162, −0.126)	−0.454	(−1.147, 0.535)	0.105	(−0.686, 1.071)
Connecticut	0.109	(−0.329, 0.486)	1.861***	(1.090, 3.245)	−0.270	(−1.317, 0.768)
South Asia	−0.769**	(−1.486, −0.197)	−4.317***	(−6.292, −2.812)	−2.505***	(−3.897, −1.187)
China	−1.815	(−2.509, −1.116)	−5.585***	(−7.545, −4.050)	−1.597***	(−2.892, −0.514)
California	−0.488***	(−0.851, −0.142)	−1.206***	(−2.083, −0.347)	−0.555	(−1.450, 0.394)
Organic	0.025	(−0.349, 0.342)	1.408***	(0.621, 2.546)	0.173	(−0.652, 1.109)

Notes: CI = confidence interval. *, **, ***Significant at the 0.1, 0.05, and 0.01 levels, respectively.

there was little advantage compared to no information being provided about the product. This finding indicates that producers and retailers should not concentrate on GMO-related labels, as consumers most likely assume no label means non-GMO.

We also find that Connecticut consumers do not have a preference for specialty mushrooms, like shiitake, compared to more traditional mushrooms. According to our study, producers and retailers selling shiitake mushrooms, and perhaps other specialty mushrooms, should focus their efforts on locally grown and organic (class two) consumers to receive price premiums, which tended to have lower FNS scores and more experience with shiitake mushrooms. Further, class three (traditional mushroom buyers) should most likely be avoided, as they prefer baby bella and portabella mushrooms. Class two (price and GMO sensitive) may offer a market for shiitake mushrooms, but educational efforts are most likely needed given this class has less experience with shiitake mushrooms.

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