Factors affecting consumers' preferences for and purchasing decisions regarding pasteurized and raw milk specialty cheeses

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ABSTRACT

Eight hundred ninety consumers at a local food festival were surveyed about their specialty cheese purchasing behavior and asked to taste and rate, through nonforced choice preference, 1 of 4 cheese pairs (Cheddar and Gouda) made from pasteurized and raw milks. The purpose of the survey was to examine consumers' responses to information on the safety of raw milk cheeses. The associated consumer test provided information about specialty cheese consumers' preferences and purchasing behavior. Half of the consumers tested were provided with cheese pairs that were identified as being made from unpasteurized and pasteurized milk. The other half evaluated samples that were identified only with random 3-digit codes. Overall, more consumers preferred the raw milk cheeses than the pasteurized milk cheeses. A larger portion of consumers indicated preferences for the raw milk cheese when the cheeses were labeled and thus they knew which samples were made from raw milk. Most of the consumers tested considered the raw milk cheeses to be less safe or did not know if raw milk cheeses were less safe. After being informed that the raw milk cheeses were produced by a process approved by the FDA (i.e., 60-d ripening), most consumers with concerns stated that they believed raw milk cheeses to be safe. When marketing cheese made from raw milk, producers should inform consumers that raw milk cheese is produced by an FDA-approved process.

Key words: cheese, artisan, raw, consumer preference

INTRODUCTION

Specialty cheeses are generally defined as cheeses produced in limited quantity with a focus on quality. The domestic production of these cheeses has increased rapidly over the past decade (Johnson and Lucey, 2006; IDDBA, 2008; USDA, 2009a). The increased produc-

tion coincides with an increase in annual per capita consumption of cheese in the United States, which is currently around 15 kg (USDA, 2010). In 2008, US sales of specialty cheeses and cheese alternatives were estimated to exceed \$3.4 billion (IDDBA, 2008; Tanner, 2009).

Consumers of specialty cheeses typically have a broader knowledge of cheese, spend more money on purchasing cheese, consume a large variety of cheeses, and have little brand loyalty (McCarthy et al., 2001). In addition, these consumers tend to be within a wealthier socioeconomic group than the general population (Kupiec and Revell, 2001). Specialty cheese consumers purchase cheeses based on many characteristics, such as location of cheese producer, price, size, and quality (Monjardino and Ventura Lucas, 2001).

Another parameter of importance to specialty cheese consumers is whether the cheese is made from pasteurized or raw milk (Murphy et al., 2004), with different consumer groups preferring either raw or pasteurized milk cheeses or both. Researchers compared pasteurized and raw milk versions of several cheese types and detected significant differences, as measured by both sensory profiling and flavor chemistry (Fernández-García et al., 2002; Van Leuven et al., 2008). These differences are primarily caused by differences in indigenous milk enzymes (Hickey et al., 2007) and microbial content of the cheese milk, particularly in nonstarter lactic acid bacteria (Buchin et al., 1998; Rehman et al., 2000). In addition, physicochemical changes within pasteurized milk, such as denatured proteins (Lau et al., 1991), affect cheese flavor. Perhaps in recognition of flavor differences, specialty cheese consumers may be willing to pay more for raw milk cheeses (Murphy et al., 2000).

Safety of raw milk cheeses continues to be debated, with numerous studies and reviews pointing to the potential risks associated with raw milk cheeses (Rowe and Donaghy, 2008; Baylis, 2009). Others have demonstrated that pasteurization is not the key to risk-free cheese, due to post-pasteurization contamination (Rudol and Scherer, 2001). West (2008) examined the debate over safety of raw milk cheeses and concluded

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that food scares have driven the debate for decades, and support from raw milk cheese enthusiasts is essential to continue allowing the production and sale of raw milk cheeses. Nevertheless, consumers' preferences and attitudes toward raw milk cheeses are poorly documented, especially concerning US consumers of specialty cheese. Without data that examine consumers' attitudes toward raw milk cheese, it is difficult for raw milk cheese producers to properly position and market their cheeses.

A consumer test was conducted to examine whether consumers prefer raw or pasteurized milk cheeses, to provide a venue for asking consumers about their perception of the safety of raw milk cheeses, and to examine the effect of safety information about raw milk cheese on that perception. Additional objectives included collecting and evaluating information on consumers' cheese purchasing habits and preferences, and modeling their willingness to pay for specialty cheeses.

MATERIALS AND METHODS

Cheese Samples for Sensory Test

Approximately 4.5 kg each of 3 Cheddar cheese pairs produced from pasteurized and unpasteurized milk by 3 manufacturers and a pasteurized and unpasteurized milk Gouda produced by a single manufacturer were obtained. These products were chosen as examples of Pacific Northwest cheeses made using pasteurized and unpasteurized milk, affording the opportunity to test consumers' preference for cheeses made with milk of both types. The cheeses used were Beecher's Handmade Cheese Flagship raw milk Cheddar aged 24 mo, Beecher's Handmade Cheese Flagship pasteurized milk Cheddar aged 22 mo (both from Beecher's Cheese, Seattle, WA), Rogue Creamery raw milk Cheddar aged 14 mo, Rogue Creamery pasteurized milk Cheddar aged 12 mo (both from Rogue Creamery, Central Point, OR), Willamette Valley Cheese Co. raw milk Cheddar aged 5 mo, Willamette Valley Cheese Co. pasteurized milk Cheddar aged 4 mo, Willamette Valley Cheese Co. raw milk Gouda aged 10 mo, and Willamette Valley Cheese Co. pasteurized milk Gouda aged 9 mo (all from Willamette Valley Cheese Co., Salem, OR). Cheese samples were cut into 1-inch cubes, weighing approximately 3 to 4 g each, and stored in the refrigerator at 3°C 1 d before testing. On the test day, samples were stored in plastic bags on ice in a cooler. They were served on 6-inch white plates with a toothpick. Each consumer received 2 cubes of cheese per sample. The cheese was served at ambient temperature (approximately 18°C). To cleanse their palates between samples, respondents were provided with purified water.

Testing Environment and Sample and Serving Design

The respondents tested the products in Portland, Oregon, at an Oregon State University-identified canopied booth during the outdoor "Bite of Oregon" food festival. Other booths at the event featured regionally produced foods, fine wines, and microbrewed beer. Music, chef demonstrations, and competitions also took place. Although this is a busy environment, Hersleth et al. (2005) noted that location is not a factor in consumer acceptance of cheese. Testing times ran from 11 a.m. to 10 p.m. over 2 d. Consumers received one pair of samples consisting of a pasteurized and an unpasteurized milk cheese from 1 of the 3 producers. The samples were labeled with product descriptors ("pasteurized" or "unpasteurized") or with 3-digit random codes in a multiple-sample presentation served in balanced pairs across respondents. Half of the consumers saw the product descriptor labels and half saw the 3-digit random codes. The first 50 consumers received plates with 3-digit randomized code identifiers (without any product information), whereas the next 50 received plates with the labels "pasteurized" and "unpasteurized" cheese, with switching continuing after every 50 consumers throughout the test (Table 1). Consumers were asked to taste both samples from left to right and select the sample they preferred. They were also given the options of "no preference" and "I can't tell a difference" (Lawless and Heymann, 1998). Bench testing of the 8 cheeses was done ahead of time and it was determined that each of the 2 cheeses within a cheese pair was sufficiently different to conduct a preference study. Because this was an off-site study conducted at a food festival not specifically related to cheese, it was unclear if the consumers attending, who would be the participants of this study, would be frequent consumers of specialty cheese. For this reason, the "I can't tell a difference" option was added to the paired preference question to allow flexibility for those consumers who felt they could not tell the difference between the 2 samples.

Consumer Survey

After completing the nonforced choice preference test, participants were asked why they preferred the sample they selected, based on the attributes overall appearance, color, aroma, flavor, texture, and other. Additionally, they were asked which cheese had the more complex flavor. Participants were asked to rank, from most preferred to least preferred, the following specialty cheese production characteristics: local, artisan, organic, farmstead, and sustainable. They also answered questions on numerous aspects of their cheese purchasing behavior, including the types of specialty

Table 1. Preference responses for individual cheese pairs made from raw or pasteurized milk

Panelist numbers	Cheese ¹	Labeling
1–50, 401–450	Beecher's pasteurized and unpasteurized Cheddar	Labeled with randomized 3-digit codes
51–100, 451–500	Beecher's pasteurized and unpasteurized Cheddar	Labeled using the milk type, "pasteurized" or "unpasteurized"
101–151, 501–551	Rogue Creamery pasteurized and unpasteurized Cheddar	Labeled with randomized 3-digit codes
151–200, 551–600	Rogue Creamery pasteurized and unpasteurized Cheddar	Labeled using the milk type: "pasteurized" or "unpasteurized"
201–251, 601–651	Willamette Valley Cheese Co. pasteurized and unpasteurized Cheddar	Labeled with randomized 3-digit codes
251–300, 651–700	Willamette Valley Cheese Co. pasteurized and unpasteurized Cheddar	Labeled using the milk type: "pasteurized" or "unpasteurized"
301–351, 701–751, 801–850, 901–910	Willamette Valley Cheese Co. pasteurized and unpasteurized Gouda	Labeled with randomized 3-digit codes
351–400, 751–800, 851–900	Willamette Valley Cheese Co. pasteurized and unpasteurized Gouda	Labeled using the milk type: "pasteurized" or "unpasteurized"

¹Beecher's cheese, Seattle, WA; Rogue Creamery, Central Point, OR; Willamette Valley Cheese Co., Salem, OR.

cheeses they preferred, what size and type of packaging they preferred, what features of cheese production they felt were most important, where they purchased cheese, and their willingness to pay (**WTP**) for specialty cheeses. Consumers were shown foil-wrapped packages of 6 different-sized blocks or wedges of cheese, labeled in ounces, as a reference to answer the questions about how many ounces of cheese they prefer to buy. Consumers were also asked for information on several demographic variables including age, income, sex, and location of residence.

Data Acquisition

Data were collected using Compusense Five V 5.0.49 data acquisition and statistics software (Guelph, Ontario, Canada) on touch-screen tablet computers. The paired comparison data were analyzed by the binomial (2-tailed) procedure as described in O'Mahony (1985). Analysis of the WTP models was undertaken with multinomial logit using Nlogit 3.0 Econometric Software, (Plainview, NY; Greene, 2003).

Respondents

In total, 890 consumers 18 yr and older were recruited from the food festival; they were not given an incentive. Respondents were prescreened for consumption in the past month and liking of cheese in addition to lacking food allergies. The accessible locale for downtown workers along with easy public transport drew in many locals, but attendees varied, including some from out of state.

RESULTS AND DISCUSSION

Consumers

As is commonly observed in food testing, the majority of respondents were female (58%). The age distribution of participants was younger than that of the

region's population, with 51% below 35 yr and only 14% over 55 yr of age. The respondents were generally well educated, with 65% having completed a least a 4-yr college degree. Average household income levels were widely distributed with 15% below \$20,000 per year and 19% above \$120,000 per year. Seventy percent of participants reported an annual household income above \$40,000. Thus, discussions about consumer behavior in this study likely reflect behavior of the type of consumers who attend specialty food events, are willing to try new foods, and who are generally willing to pay more for food. Therefore, we propose that the people who completed our test and survey represent a typical range of specialty cheese consumers.

Consumer Preferences Between Raw and Pasteurized Samples

Of the 890 consumers, 104 indicated they could not detect a difference between the raw milk cheese (**RMC**) and pasteurized milk cheese (**PMC**), and 41 indicated no preference (Figure 1). A larger portion of consumers indicated preference for the RMC when the cheeses were labeled and thus consumers knew which samples were made from raw milk ($P < 0.05$; Figure 2). However, a test evaluating whether a significant difference existed in the mean proportion preferring RMC between the 2 treatments (labeled and unlabeled) was not significant, and thus the data were pooled to evaluate overall preference. This test showed that a significant difference existed in preference between the cheeses made with pasteurized and raw milk ($P < 0.001$), with 426 consumers preferring RMC and 319 preferring PMC. The results were less consistent when looking at the individual cheeses and showed that consumers may not always prefer an RMC version of a particular cheese maker (Table 2). One of the unlabeled cheese pairs tested (Cheddar 1) actually had more individuals preferring the PMC version, although this

Table 2. Preference responses for individual cheese pairs made from raw or pasteurized milk ($n = 891$)

Response	Not labeled					Labeled				
	All	Cheddar			Gouda	All	Cheddar			All
		1	2	3			1 ^a	2	3	
Raw milk	426*	34	45	48*	74	201	45	50	52*	78*
Pasteurized	319	52	34	29	58	173	35	39	29	43
P -value for $H_0: \mu = 0.5^1$	<0.0005	0.052	0.216	0.030	0.164	0.148	0.264	0.244	0.011	0.001
No preference	41	3	3	5	5	16	6	3	7	9
Cannot tell	105	10	13	18	19	60	14	7	10	14

^aIndicates that the different mean preference is significantly different for those sampling unlabeled versus labeled ($P < 0.05$).

¹ H_0 is the null hypothesis that $\mu = 0.5$ a standard for the test.

*Indicates preference mean significantly different from 0.5 (based on average calculated for preference assigning a value of 1 for reporting a raw milk cheese preference and 0 otherwise) [$P < 0.05$], based on those who had a preference.

was not quite significant at the 0.05 level ($P < 0.052$). Although, as stated above, the test of whether labeling changed the proportion preferring RMC in aggregate was not significant, the proportion preferring the RMC sample they tasted was higher for 3 of the cheeses evaluated when the cheeses were labeled. Tests of whether these higher numbers are drawing more from those with no preference or those noting no difference were not significant. These results suggest that a raw milk label on cheese may enhance consumer perception of quality.

Overall, the consumers tested stated that their preferences were based primarily on flavor, followed by texture, with other factors being less frequently selected (Figure 3). Significantly more consumers preferred RMC based on the attribute aroma ($P < 0.05$), with no significant differences for other attributes.

Two of the raw milk cheeses tested were assessed as being significantly ($P < 0.05$) more complex when unlabeled, and all 4 were assessed as such, once labeled (Table 3). Although complex flavor was generally considered as a positive flavor attribute, there were

exceptions. One of the raw milk cheeses (Cheddar 1) was rated significantly more complex but was preferred less often when unlabeled and more often when labeled. Because a descriptive analysis assessment of these products was not done, it is unknown what is meant by the term “complex” to the consumers tested. Two pairs of the unlabeled PMC (Cheddar 3 and Gouda 1) were considered as complex as their RMC counterparts when unlabeled. Thus, complexity alone is insufficient to explain a flavor preference and may not always be obvious to consumers.

Consumers tested were asked to select among a pre-developed list of terms and choose which characteristics applied to the PMC and RMC. For PMC samples, the terms selected by over 30% of consumers tested were “more safe,” “large industrial production,” and “less complex flavor profile” (Figure 4). For RMC, over 30% of consumers tested selected “small production/farmstead/artisan,” “more complex flavor profile,” “less safe,” “higher price,” and “better quality” (Figure 5).

Figure 1. Overall preference for one cheese within a pair of cheeses with one made from raw milk and the other made from pasteurized milk. The graph represents pooled data for both labeled and unlabeled cheese pairs. Columns with different letters are significantly different ($P < 0.05$).

Figure 2. Preference (%) for one cheese within a pair of cheeses with one made from raw milk and the other made from pasteurized milk. Gray columns: cheeses were labeled as pasteurized or unpasteurized; black columns: cheeses were labeled only with 3-digit codes. No significant difference in preference was found between cheese labeled as pasteurized or unpasteurized ($P < 0.05$).

Figure 3. Reasons selected for preference for pasteurized cheese sample (black columns, $n = 319$) and for preference for unpasteurized cheese sample (gray column, $n = 426$). Reasons were requested only for consumers who indicated a preference. *Attributes are significantly different between those who preferred pasteurized versus raw milk ($P < 0.05$).

Perception of Safety of RMC and Information on Safety

When asked if RMC purchased in the United States are less safe than PMC, 32% of consumers answered yes, 39% answered no, and 29% answered that they did not know. After being asked this question, consumers who considered RMC to be less safe than PMC or who did not know were presented with a brief educational message that stated: “Considering that all unpasteurized (raw) milk cheeses purchased in the U.S. are by law aged over 60 days as certified by the FDA to mitigate any harmful effects that bacteria, etc. may have had, do you still feel that raw milk cheeses are less safe than pasteurized milk cheeses?” Subsequently, 64% of those who had been concerned or did not know indicated that they no longer felt that RMC were less safe. The fact that one-third of consumers might feel that RMC are less safe could be a serious obstacle to

Figure 4. Characteristics of pasteurized milk cheeses: answers provided by all consumers tested ($n = 890$).

marketing of RMC, although the educational message needed seems straightforward. Once consumers realize that RMC are made using an FDA-certified process, their apprehension will likely mostly disappear. Hence, RMC producers would benefit from informing consumers that their cheeses are made with raw milk, but they should also inform consumers that RMC are produced by an FDA-approved process.

Cheese Production Characteristics Influencing Consumers' Purchasing Decisions

When the survey participants were asked to rank characteristics pertaining to specialty cheese production (artisan, organic, farmstead, sustainable, and local), the term “local” had a significantly higher average rank than the other characteristics of cheese produc-

Table 3. Cheese flavor complexity¹

Cheese type selected	All		Cheddar 1		Cheddar 2		Cheddar 3		Gouda 1	
	Labeled		Labeled		Labeled		Labeled		Labeled	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Raw milk cheese	216 ^a	278 ^b	51 ^c	58 ^c	58 ^d	73 ^d	36 ^e	63 ^f	71 ^g	84 ^h
Pasteurized	155	100	31	28	21	16	38	18	65	38
No difference	19	17	7	0	3	3	8	7	1	7

^{a-h}For each pair in the row, different letters for Labeled-No and Labeled-Yes indicate a significant difference in proportion rating raw more complex ($P < 0.05$) when labeled.

¹Consumers tested were asked to determine which cheese (in pair of cheeses made from raw and pasteurized milk) had the most complex flavor. Half the consumers rated cheese pairs that were labeled as pasteurized and raw, whereas the other half rated cheeses that were labeled with random 3-digit codes ($n = 786$).

*Significantly greater (1-tailed test) at $P < 0.05$.

Figure 5. Characteristics of unpasteurized cheeses: answers provided by all consumers tested ($n = 890$).

tion (Figure 6). The average rank of terms “organic” and “artisan” were not significantly different from each other but were ranked significantly higher, on average, than either “sustainable” or “farmstead.” Because farmstead cheese makers are also artisan cheese makers, these data indicate that they would benefit from labeling their cheeses as “artisan” rather than “farmstead,” perhaps because consumers do not recognize or understand the term “farmstead.” A later question indicated that only 6% of the consumers in the sample looked for third-party certification including organic, sustainable, or natural when buying specialty cheese. These findings appear to be consistent with observations made by specialty cheese distributors (anecdotal observations; data not published), who report that consumers are reluctant to pay the premium price for organic cheeses. Napolitano et al. (2010), on the other hand, found a positive willingness to pay a premium for organic cheeses, although those authors studied Italian consumers, who may respond differently than American consumers.

As for other terms that affect purchasing behavior, “taste,” “quality,” “milk type,” “price,” “brand,” “origin,” “safety,” and “packaging” were selected in decreasing order of importance. Fifty-six percent of consumers tested preferred cheese made with milk from a specific animal species. Those with specific preferences expressed a significant preference for cow ahead of goat followed by sheep milk cheese. Mixed-milk cheeses were rated in third place along with sheep milk cheeses. This distribution reflects the availability of these cheeses in the market place.

Figure 6. Ranking of cheese marketing descriptors. Lowest number reflects preference ($n = 890$). Columns with different letters are significantly different ($P < 0.05$).

Fifty-four percent of consumers tested preferred aged cheeses (such as Cheddar and Gouda) over “fresh” cheeses (such as fresh goat cheese, Brie, and Camembert). Fresh cheeses were preferred by 16%, and the remaining 30% of consumers had no preference. This finding might be biased because the cheeses offered for tasting were aged cheeses; hence, consumers who only liked fresh cheeses, or preferred them, may have chosen not to try the samples of Cheddar and Gouda.

Cheese Shopping Locations

The tested consumers purchased cheeses at many different locations. When asked where they were most likely to buy a new cheese, consumers most frequently selected natural foods grocery stores, conventional grocery stores, and farmers’ markets. Although the number of farmers’ markets in the United States is increasing (USDA, 2009b), it is surprising that farmers’ markets ranked so highly. However, 75% of consumers surveyed at a conventional supermarket in the Portland, Oregon, area reported regular (at least once a month in summer) shopping at farmers’ markets (Durham, 2007), and a 2006 survey by the same author (C. A. Durham, Food Innovation Center, Oregon State University, Portland; personal communication) across a set of 6 conventional stores found 41% of consumers reporting regular farmers’ market shopping. For artisan cheese makers, an advantage of farmers’ markets is that they provide an opportunity to offer cheese samples, which is known to drive cheese sales (Reed and Bruhn, 2003).

Product Selection

When asked if they knew what cheese they wanted in advance of a shopping trip or purchasing cheese based

on what they saw in a store, the participants were split in almost equal numbers. Fewer than half as many said they asked for advice from the retailer. With the majority deciding what cheese to buy while in the store, opportunities exist for cheese makers to differentiate their products through the appearance of the cheese, packaging, and labeling, and by educating the sales people working for the retailer.

Packaging

One strategy for differentiating cheese is to present the uncut cheese wheel in the cheese counter and let sales people cut and wrap the cheese following the request from a consumer. Seventy-one percent of consumers tested stated that they were willing to pay more for cheese with a natural rind that was cut to order rather than precut and wrapped in plastic. This strategy is limited because it only works at farmers' markets and at stores with a cheese counter. Furthermore, many washed rind cheeses and all bloomy rind cheeses must be prewrapped to retain moisture.

For prepackaged cheeses, one-third of consumers tested stated that packaging had no influence on their purchasing decision, leaving two-thirds affected by the packaging in some way. No clear preference was reported for packaging material such as paper or plastic, shape of the cheese, or the possible inclusion of a picture of the animal species. Thirty-one percent of consumers were influenced by a story about the cheese maker. This interest in knowing the cheese maker has been noted in other surveys (Reed and Bruhn, 2003) and provides marketing opportunities that cheese makers should not ignore.

The testers were shown 6 cheese blocks or wedges of different sizes when being asked how many ounces they preferred to purchase of either nonspecialty cheese or specialty cheese. Fifty-three percent of the sampled consumers preferred to buy specialty cheeses in sizes of 6 oz or less, and another 21.5% preferred the 7- to 9-oz category. For nonspecialty cheeses, only 28% preferred packages of less than 7 oz, and fewer than 50% chose sizes less than 10 oz.

Willingness to Pay for Specialty Cheese

The consumers tested were also asked "What is the most you would be willing to pay to try a 4-oz (1/4 pound, see example) specialty cheese?" Four possible responses were allowed, with price ranges beginning at \$2 and ending at \$9 for the 4-oz sample. Thus, the lowest price would start at a value equal to \$8 and the highest would end at \$36 per pound. Twenty-four percent of respondents selected the lowest price range,

43% the second range, 23% selected the third, and 10% selected the highest range. A multinomial logit model was estimated to determine whether the price that consumers were willing to pay for specialty cheese could be explained by their favorite type(s) of milk for cheese, the styles of cheeses they like, their cheese buying habits, and other information they disclosed about themselves.

Several models were evaluated for analysis of what price a consumer was willing to pay. The multinomial logit model was reported because it does the best job of predicting the price range selected by the consumer. The most likely alternative model, ordered logit, was rejected as inappropriate because it failed the test of the proportional odds assumption based on the Score test in the SAS 9.1.3 Surveylogistic procedure (SAS Institute, 2003). The multinomial logit model is designed to examine choices between alternatives, such as the well-known travel mode model, which may be a function of a product's various attributes and the chooser's characteristics (Greene, 2003, p.719). In this case, with only a single attribute, the choice depends on the consumer's characteristics. Results report how explanatory variables affect the probability of a choice. After examining results for a model that included all 4 of the possible price ranges, it was decided that the top 2 price ranges would be combined for analysis: the improved results suggest that the explanatory variables were insufficient to explain the difference between the top 2 price ranges. This action was further justified by the fact that the top price range suggested a price starting at over \$30 per pound, making such a price range not very relevant or not likely to be within the normal experience of the respondents. The multinomial logit was able to correctly predict 50% of the WTP specialty cheese price ranges the consumers selected. It also distributed correct predictions evenly across the 3 price categories, with 30% correctly predicted choices of the lowest price range, 66% correctly predicted in the middle range, and 44% correctly predicted in the highest category. Table 4 presents the explanatory variables means and the parameter estimates for the model.

For interpretation, the multinomial logit parameter estimates shown in Table 4 must be converted into marginal effects on the probability of choosing each price category. Although the parameters only contrast between the first category and the other 2 categories, the marginal effects will also differentiate between the second and third categories. Those variables with a significant effect on WTP, at the 5% level, on what price range was selected are shown in Figure 7. Note that a consumer attribute that increases the probability of one choice must decrease that of another and so the probabilities' effects will sum to zero.

Table 4. Willingness to pay (WTP; willingness to pay for 4 oz) model results

Variable	Mean (SD)	Multinomial logit parameter estimates	
		Middle price	High price
Constant		0.4012	−0.0417
Binary variables			
Most preferred milk for cheese is goat	0.1375	−0.1581	0.1999
Most preferred milk for cheese is sheep	0.0417	0.9394	1.5600*
Likes sharp cheeses (e.g., aged Cheddar or goat)	0.7813	−0.1639	0.2703
Likes cheeses with strong/pungent smell	0.3811	0.0928	0.6272*
Likes cheese with herbs	0.6347	0.1831	0.1052
Likes cheese with spices	0.4972	−0.4735*	−0.3586
Likes cheese with a bloomy rind	0.5152	0.6179*	0.6737*
Buys cheese at conventional supermarkets	0.4532	−0.1572	−0.5209*
Buys cheese at natural foods supermarkets	0.6020	0.4973*	0.2536
Buys cheese at farmers markets	0.4340	0.1165	0.0929
Buys cheese at food coop	0.1759	−0.1591	−0.1153
Buys cheese at specialty cheese shops	0.2943	0.2921	0.5442*
Buys cheese at warehouse stores	0.1274	−0.3531	−0.3330
Annual income <\$40,000	0.2988	−0.6925*	−0.8515*
Annual income >\$60,000	0.5276	0.0414	0.0980
Male = 1, female = 0	0.4149	−0.0413	−0.2080
4-Yr college education	0.3563	0.3373	−0.1790
Graduate school education	0.2852	0.0996	−0.1128
Continuous variables			
Size prefers to buy in ounce deviations from mean	0 (6.83)	−0.0093	−0.0453*
Age entered in years in deviations from mean	0 (14.2)	0.0002	−0.0130†
Chi-squared test		145.22 (df = 40, $P = 0.0000$)	

* $P < 0.05$; † $P < 0.10$.

The majority of explanatory variables were binary (data entered as 0 or 1), so that the effect was readily observed as going from the false to the true condition. The most important consumer characteristics affecting WTP was ranking sheep milk cheese as the top milk cheese (4% of consumers in the sample), which increases the probability of being willing to pay the highest price range by 20%, decreasing the probabilities of choosing the lowest range by 15% and the middle range by 5%. Among styles of cheese, a liking for pungent cheeses had the greatest effect on the probability of selecting the high category at 13%, decreasing the probability of selecting the other 2 categories about equally. Consumers who like bloomy cheeses were about equally likely to have chosen the middle or high category. A liking for cheese with spices influenced selection toward the low and away from the middle price range without changing the probability of the high range being selected. Liking of other styles of cheese, such as sharp cheese or cheese with herbs, or milk base did not significantly influence price range selected. Income below \$40,000 greatly increased the likelihood of choosing the first range and decreased the probability of being WTP for higher prices. Not surprisingly, shopping at specialty cheese stores raised the probability of being WTP the highest prices. Shoppers who buy cheese at natural food stores were less likely to select either of the end

categories and more likely to select the middle WTP range. Note that a consumer could check more than one location, potentially offsetting their effect. Like natural food store shopping, a 4-yr college degree decreased the probability of selecting the highest or the lowest price categories and increased the probability of selecting the middle category.

In Figure 7, the first 2 columns for each price range show the effect of the 2 continuous variables. The variation in probability of selection is portrayed by multiplying their marginal probability across a range from 1 SD below to 1 SD above their mean, if their effects on probability were displayed across the full range of size and age, they would increase by a factor of 2.5 for preferred size (1–3 oz. to 3–3.5 lbs.) and increase by a factor of 1.7 for age (21 to 70 yr of age). Across preferred size, this would be greater than the effect of a preference for sheep milk cheese, thus having the greatest effect on price WTP.

CONCLUSIONS

To the extent that this population was representative of specialty cheese buyers, producers of raw milk cheeses would benefit from clearly labeling their cheeses as being made from raw milk, if other concerns such as safety are met. Safety concerns of consumers were

Figure 7. Effects of consumer explanatory variables on probability of selecting willingness to pay ranges for a 4-oz specialty cheese.

significantly reduced after they read a short script explaining regulations for raw cheese production and aging practices. Cheese consumers who purchased cheeses in specialty food stores and farmers' markets and who liked sheep's milk and pungent cheeses were willing to pay higher prices per pound of cheese. Those who purchased cheese in conventional supermarkets or had lower incomes had a higher probability of selecting a lower WTP for cheese. As consumer age or usual purchase size increased, consumers had a lower probability of selecting a high-priced cheese. Although this study identified an overall preference for RMC for the set of cheeses sampled, the limited sample size and the use of only 4 cheese pairs makes the study far from definitive, and the collection of further preference information would be of great interest to manufacturers of artisan cheeses. The increase in the proportion of consumers preferring the RMC with labeling, although significant in this study for only one of the cheeses evaluated, de-

serves further study from a larger and more diverse sample. Such a study should be designed to examine the underlying reason for this change: does labeling increase expectation of superior flavoring or is labeling perhaps inducing a more careful assessment of the cheese? In addition, using a trained descriptive analysis panel to define the qualities of the cheeses would be helpful to decode what is meant by "complexity" among other attributes in the cheeses.

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