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Consumer Valuation of Organic and Conventional Milk: Does Shelf Life Matter?

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Abstract

The objective of this study is to assess whether shelf life, as indicated by the processor "sell by" date, influences product attractiveness, willingness to purchase and willingness to pay for organic and conventional milk—controlling for the effect of the milk production system. A completely randomized factorial between-subject design is combined with GLM-based ANOVA to assess mean differences for production systems and shelf life values. Experimental results indicate that consumers value the production system. However, consumers also indicated that they value the length of shelf life only after being prompted. Assessment of this attribute provides information relevant to product development and in-store marketing practices, although additional study of this issue appears merited.

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Keywords: organic milk, shelf life, UHT processing, willingness to pay, experimental analysis.

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Introduction

Organic milk sales have steadily increased for the past decade. In contrast, total US per capita consumption of fluid milk produced in "conventional" (i.e., non-organic) production systems reached a record low level in 2013 of 164.6 pounds or 19.22 gallons per capita (International Dairy Foods Association 2015). In September 2016, the U.S. Department of Agriculture's Agricultural Marketing Service (USDA-AMS) reported total conventional fluid milk at 4.1 billion pounds, which was unchanged from September 2015. In comparison, organic milk products sales were reported at 218 million pounds, which is up 5.3% from the previous year (USDA–AMS 2016). In fact, sales of organic fluid retail milk in May 2016 have been the highest recorded in the history of the USDA's Agricultural Marketing Service recordkeeping system (Northeast Organic Dairy Producers Alliance (NODPA) 2016). This increased demand for organic milk reflects rising consumer concerns about health and nutrition. Many consumers perceive organic products (including milk) to be healthier and more environmentally friendly (Harper and Makatouni 2002; Dreezens et al. 2005; Winter and Davis 2006), despite sometimes limited scientific evidence to support these perceptions (e.g. Williams, Audsley, and Sandars 2006; Loder et al. 2008). Rapid growth in sales of organic products has been attributed to changes in consumer preferences for specific intrinsic attributes such as quality, freshness, and health benefits as well as extrinsic indicators such as price, packaging and labeling (Pearson, Henryks, and Moffitt 2007; Faber 2016). For the consumer, information regarding intrinsic attributes may be based on research, personal experience with the product or credence (Hammarlund 2002; Grolleau and Caswell 2005).

Previous studies have examined the patterns of organic milk consumption, the factors influencing them, and the characteristics of organic milk consumers (e.g. Glaser and Thompson 2000; Wang and Sun 2003; Dimitri and Venezia 2007; Alviola and Capps 2010; Liu et al. 2011; Li, Hanawa Peterson, and Xia 2012). In particular, these studies have focused on demographic characteristics, along with consumer perceptions of environmental, health and safety attributes. For instance, Wang and Sun (2003) found that production method and price were the most important attributes in organic milk purchasing decisions. Taken as a whole, these studies reach somewhat inconsistent conclusions about which factors are most strongly associated with organic milk consumption. However, the majority of studies indicate that consumers are willing to pay a price premium for milk produced by an organic production system.

One attribute that previous work has not assessed is whether shelf life is an important factor in the purchasing decision between organic versus conventional milk. Accordingly, the main objective of our study is to assess whether shelf life, as indicated by the processor "sell by" date, influences product attractiveness, willingness to purchase, and willingness to pay for organic and conventional milk—while controlling for the effect of the milk production system. Assessment of this attribute will be of interest to both conventional and organic milk processors and food retailers, who will value additional information relevant for product development and in-store marketing practices.

Background

Shelf life is defined as "the period of time that a product can be kept under practical storage conditions and still retain acceptable quality." The "practical storage conditions" for fluid milk mean refrigeration at temperatures of less than 7.2 degrees Celsius (45 degrees Fahrenheit). "Acceptable quality" means that the product is safe[1] to drink and that the product's flavor, odor and appearance are satisfactory to the consumer (Cornell University 2009). Thus, shelf life combines elements of safety with product quality, including the perceived freshness of milk. Most organic milk is pasteurized at ultra-high temperature (UHT). During this process, the milk is heated for two to four seconds at 280 degrees Fahrenheit and then cooled to room temperature (Johnson 1984). Heating the milk to this temperature kills more bacteria than does conventional pasteurization. This allows processors to label milk with a "sell by" date of up to six weeks after processing compared to the "sell by" dates of 14 to 21 days after processing used for conventional milk[2].

For three related reasons, most organic milk undergoes the UHT process. First, the volume of organic milk distributed to individual retail outlets is smaller than for conventional milk. Thus, milk has to last longer because it spends more time in the commercial distribution system (Baumrucker 2008; Ray 2016). Second, UHT may result in fewer product returns due to milk not being sold before its "sell by" date, particularly with less frequent deliveries. Finally, given their smaller herd sizes, the somatic cell count in milk (an indication of the presence of pathogenic bacteria) from organic farms tends to be higher than from conventional dairy farms. A low somatic cell count is desirable, as a higher somatic cell count might indicate infections (Tikofsky et al. 2003; Zwald et al. 2004; Nauta, Baars, and Bovenhuis 2006; Cheung 2010). As such, organic milk may be more likely to have unacceptable quality attributes by the time it reaches its "sell by" date, unless it is UHT pasteurized. Thus, UHT processing and longer shelf life are beneficial (less costly) to organic milk processing companies.[3]

However, UHT pasteurization also modifies the taste of milk (Baumrucker 2008) because this process caramelizes milk sugars. This results in the milk tasting sweeter and somewhat cooked. These may not be desired product attributes. Sensory research comparing UHT-processed and conventional milks indicates that tasting panels identified more off-flavors in UHT milk and indicated that the product had lower levels of "fresh dairy flavor characteristics" (Oupadissakoon 2007). Some organic milk processors sell both conventional and UHT milk, indicating this difference on their packaging for these products. However, most packaging for organic milk processed with UHT pasteurization does not highlight its longer shelf life.

[1] Microbiologically, fluid milk shelf life is assessed by the Standard Plate Count (SPC), which is an estimate of the total number of aerobic bacteria present in a sample that are capable of growth on SPC media when incubated at 32 degrees Celsius (89.6 degrees Fahrenheit) for 48 hours. The SCP of freshly pasteurized milk is less than 500/ml, with a standard limit of 20,000/ml. Bacteria will grow as milk is held under refrigeration (Cornell University 2009).
[2] Milk processors assign "sell by" dates in the absence of federal or state regulation and, therefore, can assign dates they deem consistent with the initial quality (bacterial load) of the milk, and the spatial extent of their distribution networks.
[3] Some organic milk processors (e.g. Aurora Organic Dairy) may use UHT because they distribute milk over long distances from a single processing facility.

Studies regarding consumer awareness of the shelf life attribute for milk and its valuation are still limited. Consumer preferences for food attributes often are analyzed in a random utility discrete choice model framework (McFadden 1978; Revelt and Train 1998). In this model, longer shelf life would be considered a positive attribute. Previous studies indicate that expiration dates influence both acceptability and taste perceptions of consumers and that shelf life is considered the most important safety-related factor in milk purchase decisions (e.g. Wang, Mao, and Gale 2008; Wansink et al. 2013). Furthermore, consumers appear to relate shelf life to food safety and may value it for this reason (Wang, Mao, and Gale 2008). However, a limited number of studies have focused on consumers' valuation of the shelf life of milk (e.g. Ortega et al. 2011). Ortega et al. (2011) found that consumers in China, where the milk market is segmented into shorter shelf-life and longer shelf-life UHT products, prefer shorter shelf life milk compared to the longer-shelf life product, because they perceive it to be fresher.

Extended shelf life can provide functional utility to consumers, such as reduced waste and the need to make fewer trips to the grocery store if milk is consumed infrequently. Thus, shelf life can also be considered an attribute of convenience. Consumers valuing this factor might be willing to pay for enhanced shelf life. Lusk et al. (2001) found that consumers would be willing to pay more for corn chips with extended shelf life. Similarly, Onyango and Govindasamy (2005) found that consumers valued the attribute "stays riper longer" for a banana produced with genetic modification more than five other attributes, second only to "less chemicals and pesticides." In contrast, Grebitus et al. (2009) found that shelf life was not a statistically significant determinant of willingness to pay for ground beef with Modified Atmosphere Packaging using a non-hypothetical choice experiment.

Methods

To test whether shelf life, as indicated by the processor "sell by" date, influences product attractiveness, willingness to purchase and willingness to pay for organic and conventional milk, we designed and implemented an experiment using a 2 x 3 completely randomized factorial between-subjects design, with milk production system (conventional versus organic) and expiration date (unspecified, 2-week, and 6-week) as the factors. Between-subjects experimental designs are commonly used in behavioral marketing and applied psychology. They have the advantage that each subject's response is independent of other individuals' responses. Moreover, results are not influenced by practice or experience in other treatments, fatigue or boredom from exposure to a number of treatments, or contrast and order effects from comparing one treatment to another (Perreault 1975; Kutner et al. 2004). This design also allows for eliciting perceptions without prompting subject responses on the basis of background information typically provided in many consumer surveys. In that sense, the experimental design of this study better simulates a consumer decision in a shopping setting. Given that this study is an initial exploratory analysis of milk shelf life valuation, we opted for a simpler experimental approach rather than alternatives such as conjoint analysis or contingent valuation.

Subjects were randomly assigned to view an image of a half-gallon milk carton in one of the six aforementioned treatments (Figure S1 in Supplemental Materials) Respondents were shown an image of a half-gallon carton of either conventional or organic milk with one of three expiration dates: 1) no date indicated (as a control condition); 2) two weeks from the date of subject

participation in the experiment; and 3) six weeks from the date of participation in the experiment. The two expiration dates provided were based on current dairy processor practices for "sell by" labeling, and thus represent a realistic choice set for consumers. The scenario accompanying the image asked subjects to imagine themselves at a grocery store, facing the dairy case and preparing to make a purchase of a half-gallon of milk. This use of scenarios is consistent with the approaches used in other consumer choice experiments (e.g. Managi et al. 2008; James, Rickard; and Rossman 2009; Katare, Yue, and Hurley 2013).

Although the image contained implicit information about the container size and material, as well as more explicit information about the production system and the expiration date, the experimental design avoided explicitly directing consumers to focus on specific attributes to avoid bias effects. For the displayed carton, subjects rated product attractiveness (1-9 Likert scale, with 1 = 'Not at all attractive' and 9 = 'Extremely attractive'), their willingness to purchase the product (1-9 Likert scale, with 1 = 'Not at all willing' and 9 = 'Extremely willing"), and how much they would be willing to pay for the displayed carton ($ per half gallon), as if they were buying the product during this trip to the grocery store. The subjects also provided information about the relative importance of seven milk attributes to their willingness to pay for milk in general, including expiration date, container size, organically produced, locally produced (with the term 'locally' defined by the subjects), container material, fat content, and fresh taste. The subjects assigned importance weights to these seven attributes so that they summed to 100. Subjects indicated the price premium they would be willing to pay for a half gallon of organic milk, compared to a base price of $2.00 per half gallon for conventional milk. They also indicated the premium they would be willing to pay for extended-shelf life conventional milk compared to conventional milk with a two-week shelf life. To provide a way to identify subjects who were not paying attention to the experimental stimuli, we embedded questions within the experiment to identify subjects responding randomly[4]. Finally, we collected information on demographic characteristics, discretionary income, and milk consumption.

Subjects were recruited from a national panel of adults using Amazon's Mechanical Turk (MTurk; http://aws.amazon.com/mturk/). Panel members peruse the MTurk website until they locate a study they are interested in participating in. After expressing interest in the study, they click on an electronic link that forwards them to a specific data collection site. Each participant was paid $0.80 for participating in this twelve-minute study.

A total of 304 subjects participated in the experiment during a single day in April 2013. All participants indicated that they both purchased and consumed milk at least once per month. Twenty-six individuals were eliminated because they failed the attention check, which suggested that they were not paying sufficient attention to the experimental stimuli. This resulted in 278 usable responses. This level of subject elimination is not atypical for MTurk studies (Downs et al. 2010; Mason and Suri 2012). In order to test for differences in mean values of attractiveness, willingness to purchase, and willingness to pay for the two production systems and the three shelf lives in each of the six cells, we used ANOVA—implemented as a General Linear Model (GLM) procedure.

The experimental design model equation (following Kirk 2013) in this case is:

[4] For example, embedded within a long string of questions we asked subjects to provide the response "2." Anyone who failed to respond with the answer "2" on the nine-point scale failed the attention check.

(1) $Y_{ijk} = \mu + \alpha_j + \beta_k + \alpha_j \cdot \beta_k + \varepsilon_{ijk}$

where Y_{ijk} is the reported value of product attractiveness, willingness to purchase or amount the subject is willing to pay, μ is an overall population mean, α_j is the treatment effect for production system (j=1,2 for conventional and organic) equal to the difference between the population mean for treatment level j and the overall mean μ, β_k is the treatment effect for the expiration date (k=1,2,3 for short shelf life, extended shelf life and no shelf life indicated, respectively), equal to the difference between the mean for treatment level k and the overall mean μ, $\alpha_j \cdot \beta_k$ is the interaction effect for the populations receiving treatment j and treatment k, and ε_{ijk} is a random error attributable to both the individual subject's responses and any other effects that had not been controlled for. This design allows us to test three null hypotheses:

H_1: $\alpha_1 = \alpha_2 = 0$ (mean values are equal for different production systems)
H_2: $\beta_1 = \beta_2 = \beta_3 = 0$ (mean values are equal for different expiration dates)
H_3: $\alpha_1\beta_1 = \alpha_1\beta_2 = \alpha_1\beta_3 = \alpha_2\beta_1 = \alpha_2\beta_2 = \alpha_2\beta_3 = 0$ (all interaction effects equal 0)

This analysis is complemented by additional descriptive analyses of the subjects and other related factors.

Results

Subject Description

The descriptive characteristics of the subjects are shown in Table 1. The subjects participating in our study were on average thirty-seven years old (with a range of eighteen to sixty-nine years), and predominantly female (59%; see Table 1). Most were the primary shopper for their household (85%). A somewhat larger proportion of our subjects were of Asian descent compared the overall population of the U.S., and a smaller proportion were White/Caucasian, African-American or Latino. The household size of the subjects was somewhat larger than the 2014 US average of 2.63 persons (U.S. Census 2015). Nearly two-thirds of households spent between $50 and $150 per week on groceries.

Forty percent of subjects reported that their households consumed between a half-gallon and a gallon of milk per week, and only 15% reported milk consumption greater than a gallon per week. As is consistent with previous studies (e.g. Dimitri and Venezia 2007), consumers of organic milk also report frequent purchases of conventional milk. Two-thirds of the study's subjects indicated that less than 10% of the milk they consume is organic. Furthermore, only 7.5% reported that organic milk comprises more than 90% of their milk purchases. The subjects grew up in diverse locations, but only 2% indicated they grew up on a farm (Table 1). On the basis of these summary statistics, we conclude that, although there are some differences between our subjects and the characteristics of the broader US population, our pool is sufficiently representative to allow cautious generalizations.

Table 1. Descriptive Characteristics of Subjects

Characteristic	Mean or Percentage
Age, years	36.9
Female, %	58.6
Race/Ethnicity, %	
White/Caucasian	66.5
Black/African-American	4.0
Hispanic/Latino	3.2
Asian/Asian-American	23.7
Other	2.5
Primary shopper for household, %	85.3
Household size, including subject, %	
1	14.0
2	25.5
3	25.5
4	23.0
5	7.6
6 or more	4.3
Average spending on groceries, $/week, %	
0 to 49.99	24.8
50 to 99.99	34.5
100 to 149.99	30.2
150 or more	10.4
Milk consumed by household per week, %	
Less than 1 quart	22.3
1 quart to ½ gallon	23.0
½ gallon to 1 gallon	39.6
1 gallon or more	15.1
Percentage of milk consumed that is organic, %	
0 (No organic milk)	50.4
10% or less	66.7
90% or more	7.5
Type of area subject grew up in, %	
Farm	2.2
Rural area	15.1
Small town	26.6
Suburb	29.5
City	26.6

Valuation of Milk Production System and Expiration Date Attributes

Mean values for all treatments in the 2 x 3 design were less than 5 (that is, less than the midpoint of the 1 to 9 rating scale) for attractiveness of the product and willingness to purchase (Table 2).

Table 2. Summary of Attractiveness of Product, Willingness to Purchase and Willingness to Pay by Treatment

Variable	Production System and Outcome	Shelf Life Label		
		None	Short expiration date	Long Expiration date
Attractiveness of Product	Conventional milk			
(1-9 Likert Scale)	Mean (s.d.)	3.77 (2.35)	3.24 (2.00)	3.24 (2.24)
	N=	44	45	46
	Organic milk			
	Mean (s.d.)	4.32 (2.23)	4.39 (2.24)	4.27 (2.28)
	N=	47	44	52
Willingness to Purchase	Conventional milk			
(1-9 Likert Scale)	Mean (s.d.)	4.39 (2.55)	3.69 (2.03)	3.89 (2.45)
	N=	44	45	46
	Organic milk			
	Mean (s.d.)	4.64 (2.26)	4.73 (2.33)	4.92 (2.37)
	N=	47	44	52
Amount Willing to Pay for Product ($/half gallon)	Conventional milk			
	Mean (s.d.)	1.87 (1.02)	1.86 (0.92)	1.87 (1.15)
	N=	44	45	45
	Organic milk			
	Mean (s.d.)	2.32 (0.98)	2.26 (1.20)	2.33 (1.17)
	N=	46	44	52

Nearly three-quarters of the subjects reported values of 5 or less for attractiveness, and nearly two-thirds reported values of 5 or less for willingness to purchase. This suggests that the subjects were not strongly attracted to milk products or highly inclined to purchase them, despite universal consumption. Moreover, the distribution of values for each valuation variable was non-normal. The modal response for attractiveness was 1, and the proportion decreased as the attractiveness rating increased. A similar pattern existed in the willingness to purchase data, although the modal value was 3 and the proportion of subjects decreased less rapidly as the willingness to purchase rating increased.

The mean amount subjects were willing to pay for a half gallon of the product displayed ranges from $1.86 to $2.33. Table 2 shows the mean value for conventional milk was $1.87, while it was $2.32 for organic milk. These values are roughly consistent with the average US retail fluid milk price in April 2013 of $3.43 *per gallon* reported by the Bureau of Labor Statistics (2013).[5]

[5] BLS does not report national average retail prices for half gallons of milk. Retail prices in New York during this period ranged from $1.74 to 2.74 per half gallon in paper containers (New York Department of Agriculture and Markets 2012), while retail prices in Pennsylvania ranged from $1.77 to 1.98 per half gallon (Commonwealth of Pennsylvania 2013).

The overall distribution of willingness to pay values was also non-normal, skewed to the left of the mean and with significant kurtosis.

GLM Analysis of Milk Production System and Expiration Date Attributes

Profile plots (Appendix Figures A1, A2 and A3 in Supplemental Materials) indicated it was appropriate to assess interaction terms, in addition to the main effects of production system and expiration date. The GLM model in (1) was run with the full factorial design (including intercept and interaction terms). All interaction terms were not statistically significant. Thus, the GLM was re-run omitting the interaction and intercept terms, consistent with common practice (Kirk 2013). The model results were robust with respect to these changes, and regarding the inclusion of the "no date" treatment (which would not be a choice faced by milk consumers but which served as a control condition).

The results for each of our three valuation variables are similar. Statistically significant differences ($p<0.05$) exist in the mean values for the production system treatment but they do not exist for the expiration date (Appendix B, Table B1).

Thus, consumers find organic milk more attractive than conventional milk. The results show they are more willing to purchase organic milk, and their willingness to pay is higher. These findings are broadly consistent with the findings of previous studies (Dhar and Foltz 2005; Bernard and Bernard 2009). These results also suggest that mean attractiveness, willingness to purchase, and the amount consumers are willing to pay do not differ based on shelf life. This is in conflict with our initial hypothesis that shelf life is a determinant of valuation. The mean difference in attractiveness for organic milk, relative to conventional milk, was nearly 1 point on the 1 to 9 rating scale. The mean difference for willingness to purchase was less than 0.8 (Table 3).

Table 3. Summary of Mean Differences for Conventional and Organic Conditions. Three Value Indicators

Value Indicator	Mean Difference (Organic less Conventional)	SE	Prob.	Lower Bound	Upper Bound
Attractiveness (1-9 scale)	0.91	0.27	0.001	0.38	1.43
Willingness to Purchase (1-9 scale)	0.77	0.28	0.006	0.22	1.32
Amount Willing to Pay ($/half gallon)	0.44	0.13	0.001	0.18	0.69

The mean difference in the amount that subjects were willing to pay for organic compared to conventional milk was $0.44 per half gallon. This amount is substantially lower than values reported in previous studies (e.g. Kanter, Messer, and Kaiser 2009; Brooks and Lusk 2010). It is also less than the existing price differential between organic and conventional milk at most food retailers.

We asked subjects directly about the importance they place on various milk attributes that might affect their willingness to pay, including expiration date. In allocating 100 points to assess each attribute's relative importance, the product's expiration date was the most highly rated attribute, and was statistically significantly larger than the mean ratings for the six other attributes (Table 4).

Table 4. Importance of Characteristics Affecting Willingness to Pay for Milk

Characteristic	Minimum	Maximum	Mean	SD	Mean Difference with Expiration Date	t value
Expiration date, %	0	100	27.45	19.13	–	–
Fresh taste, %	0	100	23.33	18.09	4.12	2.61
Fat content, %	0	80	14.80	14.11	12.65	8.87
Container size, %	0	75	11.90	11.59	15.55	11.59
Organic, %	0	80	9.74	14.49	17.71	12.31
Produced locally, %	0	50	7.74	8.92	19.71	15.57
Container material, %	0	45	5.12	6.52	22.33	18.42

Note. N=278 except for Fresh Taste, for which N=277.

When subjects were evaluating the importance of overall milk attributes (as opposed to the specific carton image they viewed for the treatment), the expiration date was a critical component of the decision. Fresh taste, an attribute more likely to be associated with conventional milk, was the second most highly-ranked attribute. This apparent inconsistency regarding the contribution of the expiration date to the valuation of the product between the treatments and the response to direct questions is all the more curious given that more than 80% of subjects agreed or strongly agreed with the statement "I always pay attention to the expiration dates on dairy products." This is consistent with Tsiros and Heilman (2005), who found that 99% of milk consumers are aware of expiration dates and 93% claim they "always/usually check the expiration dates."

Finally, subjects indicated the price premium they would be willing to pay for organic milk and long-shelf life conventional milk, compared to conventional milk with a standard shelf life and a price of $2.00 per half gallon. Consistent with the hypothesis that consumers value longer shelf lives, the mean premium for longer shelf life conventional milk was $1.30 per half gallon. This is statistically significantly greater than zero ($p < 0.01$) but is not statistically significantly different from the mean premium for organic over conventional milk (Table 5).

Table 5. Premium Willing to Pay Milk Organic or Long Shelf Life Milk Compared to Conventional Milk at a Price of $2 per Half Gallon, $/half gallon

Characteristic	Minimum	Maximum	Mean	SD	Mean Difference with Organic	t value
Organic	0.00	4.00	1.41	1.13	–	–
Long shelf life	0.00	4.00	1.30	1.16	0.11	1.08

Note. N=278 for both.

Conclusions

Previous work on consumer valuation of organic milk has not controlled for the potential impact of longer shelf life due to UHT processing, in addition to the perceived attributes of the milk production system. Our results are consistent with previous studies, indicating that consumers value attributes of the organic production system, although our estimates of the difference in willingness to pay for organic compared to conventionally-produced milk are smaller. In contrast, our results are inconsistent with regard to consumer valuation of milk shelf life. We found no statistically significant differences in product attractiveness, consumer willingness to purchase or willingness to pay among the three shelf-life categories (none, short, long) using the 2x3 between-subjects experimental design. However, when prompted, subjects placed a significant value on the length of shelf life, ranking it as the most important of seven product attributes. This confirms the findings by previous research. Shepherd, Mangusson, and Sjödén (2005) found that consumers rated taste and shelf life of great importance, but respondents did not think that organic products tasted better or had a longer shelf life than their conventional counterparts. In our study, subjects indicated a willingness to pay a price premium for milk with a longer shelf life that is not statistically different from the price premium for organic rather than conventionally-produced milk. The importance of shelf life also suggested that more than 80% of subjects indicated that they check shelf life for dairy products when making purchases.

Our findings suggest that promotion of production system attributes (primarily through product labeling) is appropriate for organic milk processors, but the benefits of highlighting longer shelf life are uncertain. Our results that shelf life is not valued without prompting could arise from study design factors (e.g. the simplicity of the carton designs or the specific shelf-life values used in this study) or it could be an indication that the current expiration date label on milk may not serve as an effective visual signal to consumers. Future research could usefully assess this by modifying the amount and type of information provided on the carton images used in an experimental design. For example, the researchers' specific choice of expiration dates may have affected the outcomes. Consumers did not place a different value on the two-week and six-week expiration dates. This may have occurred because both are longer than the time required for many households to consume milk. Thus, it might be of advantage to use a broader range of expiration dates than those employed in this study. A future study could also modify the amount of information provided on the milk carton to assess consumers' ability to perceive and use information provided. In addition, alternative analytical approaches such as conjoint analysis and contingent valuation could be used to assess whether the consumer valuation of milk shelf life is sensitive to the method used. A broader set of additional studies will help to clarify the role that processing technology and shelf life play in the consumption of both organic and conventional milk, and may also provide additional insights about the influence of label information on consumer purchasing decisions. This information would be relevant for product development by fluid milk processors and marketing efforts by food retailers. Given the rising imports of organic milk and organic milk powder, and the increasing consolidation in organic dairy production, there are multiple challenges ahead for agribusiness companies operating in the dairy value chain (NODPA 2016). Greater general awareness of diet-health issues and various trends have increased consumer demand for more products with identifiable product attributes. This trend towards "nutritionism" (Scrinis 2013) will demand significant adjustments on the side of stakeholders along many agri-food value chains. Thus, estimates of existing consumer behavior, and their impacts on purchasing behavior, will become even more relevant to industry.

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Consumer Valuation of Organic and Conventional Milk: Does Shelf Life Matter?

Christiane Schroeter, Charles F. Nicholson and Margaret G. Meloy

SUPPLEMENTAL MATERIALS

Figure S1. Milk Carton Images Displayed Under the 2x3 CRF Treatment Design

Appendix A.

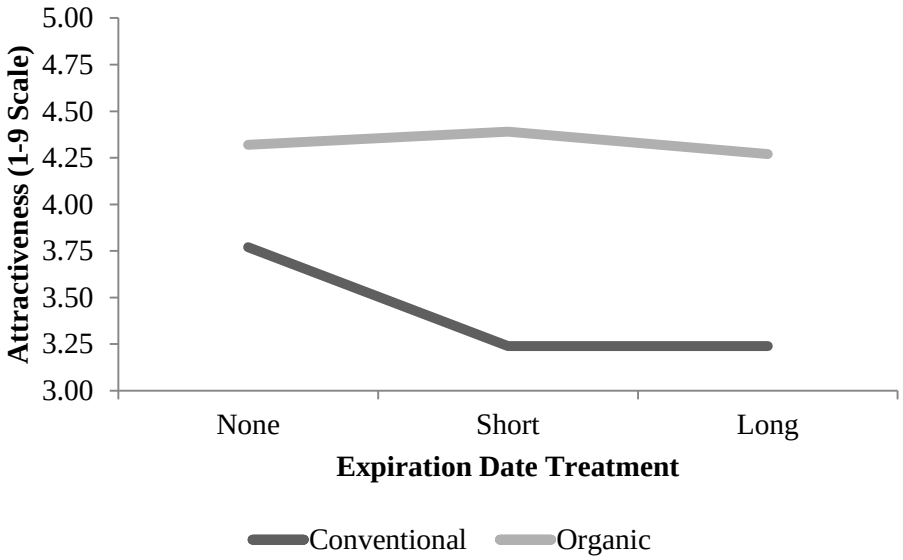

Figure A1. Profile Plot of Mean Attractiveness Values, By Treatment

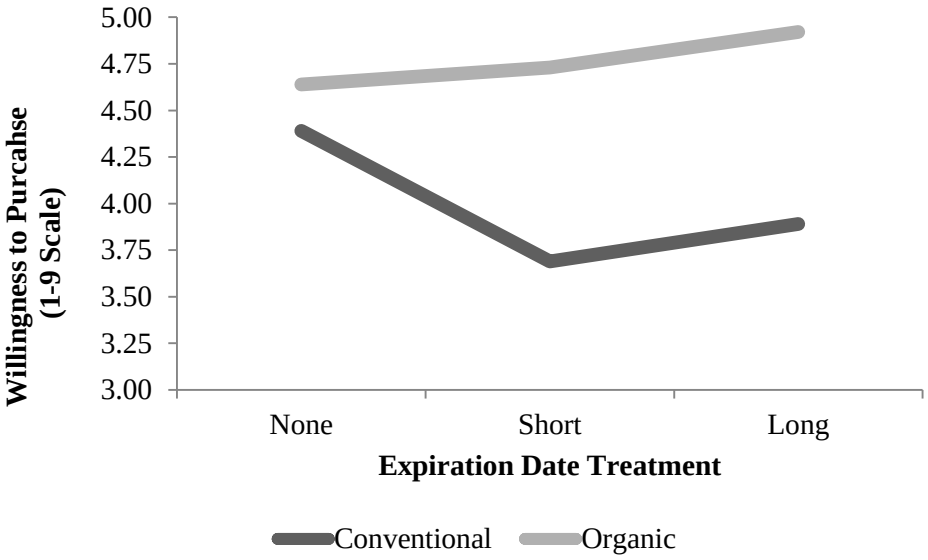

Figure A2. Profile Plot Mean Willingness to Purchase Values, By Treatment

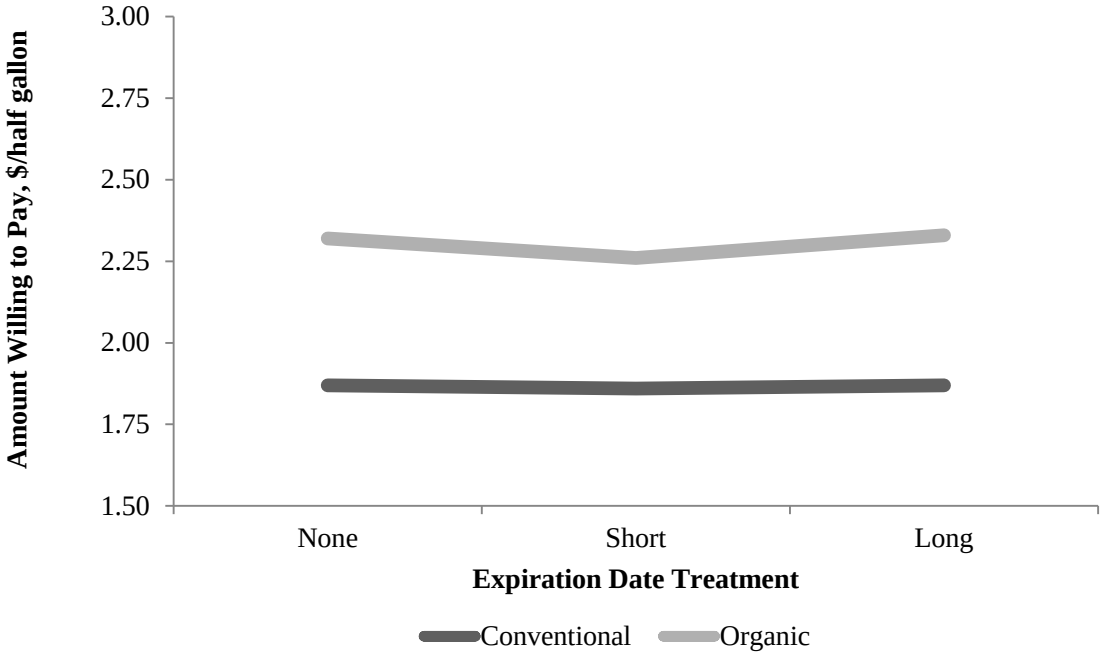

Figure A3. Profile Plot of Mean Amount Willing to Pay Values, By Treatment

Appendix B.

Table B1. GLM/ANOVA Analysis of Product Attractiveness, Willingness to Purchase, and Amount Willing to Pay

Variable	Source	Type III Sum of Squares	df	Mean Square	F-statistic	Prob.	Observed Power (α=0.05)
Attractiveness of Product (1-9 Likert Scale) R Squared = .758 Adj. R Squared = .755	Model	4249.1	4	1062.3	214.7	.00	1.00
	Production System	57.1	1	57.1	11.5	.00	.92
	Expiration Date	4.1	2	2.1	0.4	.66	.12
	Error	1355.8	274	4.9			
	Total	5605.0	278				
Willingness to Purchase (1-9 Likert Scale) R Squared = .783 Adj. R Squared = .780	Model	5400.8	4	1350.2	247.8	.00	1.00
	Production System	42.0	1	42.0	7.7	.01	.79
	Expiration Date	4.2	2	2.1	0.4	.68	.11
	Error	1493.2	274	5.450			
	Total	6894.0	278				
Amount Willing to Pay for Product ($/half gallon) R Squared = .795 Adj. R Squared = .792)	Model	1225.0	4	306.2	263.8	.00	1.00
	Production System	13.1	1	13.1	11.3	.00	.92
	Expiration Date	0.1	2	.1	0.0	.96	.06
	Error	315.8	272	1.2			
	Total	1540.8	276				