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CONSUMERS' RESPONSES TO THE POTENTIAL USE OF BOVINE SOMATOTROPHIN IN CANADIAN DAIRY PRODUCTION

Abstract

The responses of a random sample of consumers to the use of bovine somatotrophin (BST) in milk production were elicited using a stated preference methodology. A multinomial logit model of consumer choice was developed and tested to analyse consumers' choices of milk with varying characteristics of fat content, price, freshness and BST treatment. Welfare calculations for a representative consumer indicate welfare losses with the introduction of BST which are not fully offset by preferred milk attributes such as reduced price or increased freshness levels. Welfare losses were slightly less for a male than a female consumer and were less for consumers with higher levels of income and education. Losses were greatest when a representative consumer was denied the option of choosing not to purchase milk. There was a small welfare gain when the representative consumer was offered a full range of "BST" and "non-BST" milks. The results suggest that making appropriately labelled "BST-free" milk available to consumers could decrease consumer welfare losses associated with the introduction of BST in Canada.

Introduction

The safety of food is an issue of concern for Canadian consumers and this concern seems to be growing. A survey by the Consumers' Association of Canada found that 25 percent of consumers "worry a lot" about food safety. When queried about specific food safety issues, 42 percent indicated pesticide residues as a major source of concern. Preservatives and hormones were identified as concerns by 25 percent and 21 percent of the respondents, respectively. (Consumers' Association of Canada, 1990). Subsequently, a 1995 National Angus Reid poll of Canadians found that 41 percent of respondents had concerns about food safety that had "increased a great deal" over the past few years. Food safety concerns had increased slightly for 21 percent of the respondents. An increasing level of concern was seen in all provinces.

Bovine Somatotrophin (BST) is a naturally occurring hormone that stimulates increased milk production in dairy cows. This effect of BST has been known to researchers since the 1930's. Until the development of recombinant DNA techniques the large scale production and use of BST was not commercially feasible. Recently, commercial BST products have been developed which make it possible to treat cows with BST in order to increase milk production. A proposal to license these BST products for use in Canada has met with significant opposition from dairy processors, consumers, some dairy producers and some scientists. Those in favor of licensing BST state that there may be significant gains to producers and consumers from reduced costs of milk production through the use of BST. They also emphasize that treating cows with BST does not cause any discernible change in the composition of milk, so that consuming milk from cows treated with BST should pose no human health risks.

Those opposed to the use of BST argue that the long term human health effects of milk from cows treated with BST are not known, that the use of BST will lower the demand for dairy products and that the injection of cows with BST is inhumane. It is also claimed that BST use will reduce the number of family dairy farms. The initial result of this debate was a decision to place a moratorium on the use of BST in Canada until July 1, 1995 to allow further review and study. This moratorium was extended and to date BST has not been licensed for use in Canada. As further developments in biotechnology occur, the number and frequency of these types of debates can be expected to increase.

Previous Research

While much research into the potential production effects and farm-level economic effects of BST has been undertaken, few studies have assessed consumer response to, and perceptions of, the use of BST. Most of the research on consumers' response to BST has been performed in the United States. Bovine Somatotrophin has been licensed for use in the United States and was introduced for use in February 1994.

Studies by Preston, McGuirk and Jones (1991) and by Kaiser, Scherer and Barbano (1992) surveyed consumers to determine their potential response to BST. These studies predicted possible consumption declines of 14 percent and 15.6 percent, respectively, if BST was approved for use and milk prices did not change. Fox, Hayes and Kliebenstein (1994) used experimental auction techniques to assess consumers' responses to BST. Approximately 60 percent of the subjects would purchase "BST milk" at the same price or a slightly lower price than "BST-free" milk. While the studies noted above concluded that milk consumption might decline if BST was licensed in the United States, this does not appear to have occurred.

Brinkman (1995), in a report to the Task Force appointed by the Government of Canada to review the impact of BST in Canada, stated that fluid milk consumption in the United States actually increased by 0.6 percent in the first full year of BST use. Both Preston et al. (1991) and Kaiser et al. (1992) indicated that there was a potential market for milk labeled as "BST free". Brinkman (1995) however, states: "There are no precise figures for sales of milk identified as rBST (BST) free, but it appears from discussions of knowledgeable persons in a number of states and in the USDA that these sales likely represent less than two percent of total U.S. fluid milk sales" (Report of the rBST Task

Force, 1995). This discrepancy may be due to the fact that the studies assumed that milk from cows treated with BST would be identified in some manner. In most states, however, labeling of milk from cows treated with BST has not been required.

If “BST milk” and “BST-free milk” were available to consumers at the dairy case, a different consumer response may have been observed. It is also possible that the response found by these researchers may have been due to the fact that their surveys drew specific attention to the use of BST. Supporting this possibility, a survey by Finn and Louviere (1992) of Alberta residents showed that food safety concerns rank relatively low compared to other social issues such as crime, quality medical care and poverty. When a food safety incident such as the “Alar on apples” controversy occurs, food safety becomes of more immediate concern for consumers.

The approach used in this study differs from the approaches used in previous studies of consumer response to BST use. In this study consumers were asked to choose from a hypothetical set of milks (including a non-purchase option) rather than being asked “Would you buy more, less or the same amount of milk if BST was licensed for use?” The approach of this study relates more directly to consumer behaviour and allows consumers to make trade-offs between BST and the selected attributes of fat content, milk price and milk freshness. In contrast, the previous studies appear to have incorporated a single trade-off, that of BST and milk price.

Theoretical Approach

Consumer theory assumes that consumers are rational. That is, consumers allocate their limited resources, in the form of a limited budget, among a variety of goods and services in a way that maximizes their utility. A refinement of this framework

is given by Lancaster (1966) in which he points out that consumers typically purchase attributes which are embodied in goods rather than purchasing goods for their own sake. An example would be the desire to obtain a healthy diet, which is reflected in the purchase of foods that contain relatively low fat levels. Thus a consumer might purchase a low fat yogurt to satisfy this desire, rather than for the yogurt itself.

Discrete choice theory follows the major concepts of consumer theory but allows for the consumption of discrete quantities of goods and services in a manner that permits the consumption of one or more goods to be zero. Consider a set of restaurants at a particular point in time. Trips to restaurants are mutually exclusive because one cannot visit two restaurants simultaneously. Thus, in any one time period a consumer will choose only one restaurant from the set of all restaurants. Individual n chooses restaurant i over restaurant j only if the utility of i exceeds the utility of j, for individual n. That is, i is chosen over j if

$$U_{in} > U_{jn} \qquad \textbf{(1)}$$

The utility of i and j are postulated to be functions of their attributes and the personal characteristics of individual n. Discrete choice theory is useful in examining food safety issues. Consumers cannot directly buy units of food safety. They can choose to avoid foods that they may perceive as risky, such as milk from cows that have been treated with BST. They can also choose to pay a higher price for foods that may be perceived to be less risky, such as “organically” grown fruit and vegetables. These types of choices lend themselves to analysis In a discrete choice framework.

Discrete choice models can be formulated in terms of both a deterministic and a random utility component. In such “random utility” models, the probability of an

individual choosing a particular alternative is viewed to be a function of both the attributes of the alternative and of the characteristics of that individual. It is assumed that the researcher knows some or all of the attributes of an alternative and can measure the individual's characteristics. The researcher cannot, however, know all of the preferences and characteristics of the individual. In addition, there may be unknown or unobserved attributes of an alternative that enter into the individual's utility function. Thus, there is both a deterministic component (attributes and characteristics known by the researcher) and a random component (unknown attributes and characteristics) of a random utility model. The overall utility of an alternative, i, can be expressed as the sum of the deterministic and random components (Train, 1986):

$$U_{in} = V(Z_{in}, S_n, \beta) + e_{in} \qquad \textbf{(2)}$$

where: Z = a vector of the attributes of alternative i, as experienced by consumer n
S = a vector of the characteristics of consumer n
β = a vector of parameters estimated by the researcher
e_{in} = the difference between the "true" utility and the observation of utility by the researcher

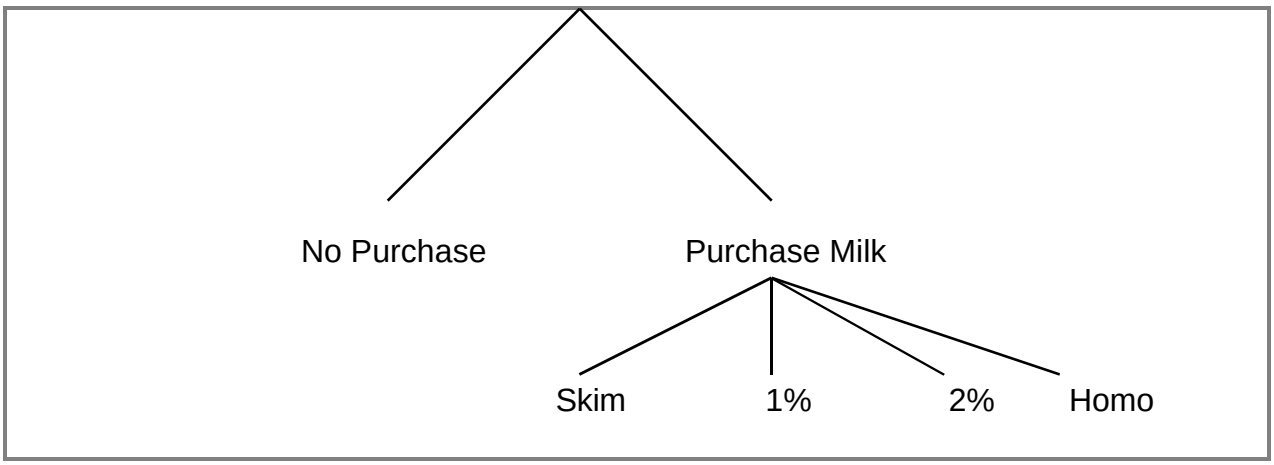
The probability that consumer n will choose i is equal to the probability that U_i is greater than the utility received from any other alternative in the set of alternatives. Random utility models are obtained by specifying a distribution for the error terms (e_{in} in equation 2). It is commonly assumed that the e terms are IID Gumbel (or Extreme Value Type 1) randomly distributed. This allows the use of the multinomial logit model (Ben Akiva and Lerman, 1985).

Methods

A Multinomial Logit Model of Milk Purchases

This study was concerned with the consumer's decision to purchase milk and the effect that BST might have on this decision. This choice can be modeled as a two step process. First, the consumer decides whether he or she will purchase milk on a particular shopping trip. Second, the consumer decides which type of milk to purchase. This two-step decision process is represented by Figure 1 below.

Figure 1: The Milk Purchase Decision



The milk purchase decision was assumed to be based on utility maximization. This decision is reflected in the indirect utility functions described below. These functions are linear in parameters and their arguments include Z_{in}, a vector of attributes of milk; S_n, a vector of socioeconomic characteristics of individual n; and β and γ, vectors of unknown parameters. The utility functions for the four types of milk are:

$$V_{1n} = ASCS + \beta' Z_{1n} + \gamma' S_n \quad \textbf{(3)}$$
$$V_{2n} = ASC1 + \beta' Z_{2n} + \gamma' S_n \quad \textbf{(4)}$$
$$V_{3n} = ASC2 + \beta' Z_{3n} + \gamma' S_n \quad \textbf{(5)}$$
$$V_{4n} = ASCH + \beta' Z_{4n} + \gamma' S_n \quad \textbf{(6)}$$

where subscript 1 denotes Skim milk, 2 denotes 1% milk (that is, milk with 1% milkfat content), 3 denotes 2% milk and 4 denotes Homogenized (Homo) milk, which has a higher level of milkfat. The alternative specific constants ASCS, ASC1, ASC2 and ASCH are intended to capture the satisfaction associated with choosing Skim, 1%, 2% and Homogenized milk, respectively.

Using the four indirect utility functions given above, a multinomial logit model was specified for the milk purchase decision. Based on prior discussions with numbers of consumers, the variables chosen for the vector Z were based on major attributes of milk that are directly observable by the consumer at the dairy case. The variables included in this vector are: price, freshness and the "presence" of BST. The fat contents of the milks are expressed through the four milk types.

An examination of previous studies on BST and literature related to consumers' perceptions of food safety, combined with *a priori* beliefs, led to the inclusion of the following socioeconomic variables in the model: age, gender, number of young children in the household, household income, years of education and prior knowledge of BST. Studies on food safety, such as Lin (1995), have indicated that age and gender may have a significant effect on attitudes towards food safety. Older consumers are generally expected to be more concerned about food safety. Women generally appear to be more concerned about food safety than are men. Lin (1995) also suggests that households with young children will be more concerned about food safety and that consumers with higher levels of education will be more aware of food safety issues. Households with higher incomes may feel they have greater financial resources to devote to reducing external risks. Consumers with prior knowledge of BST may be more

concerned about its use. The inclusion of these variables is supported by the studies of consumers' perceptions of BST conducted by McQuirk, Preston and Jones (1990); Kaiser, Scherer and Barbano (1992); Grobe and Douthitt (1995); and Fox, Hayes and Kliebenstein (1994). The variables used in estimating the final models are defined below.

ASCS This variable is an alternative specific constant representing the marginal utility associated with choosing to purchase Skim milk, all other variables held constant.

ASC1 This variable is an alternative specific constant representing the marginal utility associated with choosing to purchase 1% milk, all other variables held constant.

ASC2 This variable is an alternative specific constant representing the marginal utility associated with choosing to purchase 2% milk, all other variables held constant.

ASCH This variable is an alternative specific constant representing the marginal utility associated with choosing to purchase Homo milk, all other variables held constant.

PRICE This variable represents the price per litre for the milks presented in the choice scenarios. The price ranges from $0.69/litre to $0.99/litre.

BST This is a dummy variable indicating whether the milk presented in a choice scenario is from cows that have been treated with BST. Numeral 1 indicates that the milk may be from cows treated with BST, while 0 indicates that the milk is from cows that have not been treated with BST.

FRESH This variable represents the freshness of a milk presented in a choice scenario. These values range from “4 days before expiry date” to “10 days before expiry date”.

AGE This variable represents the age of the respondent.

GENDER This is a dummy variable representing the respondent’s gender, whereby 1 is equated with female, 0 with male.

YCHILD This variable represents the number of children in the household who are under the age of six.

HINC This variable represents the total household income before taxes.

EDUC This variable represents the number of years of education completed by the respondent.

PRIOR This is a dummy variable which represents whether the respondent had knowledge of BST prior to receiving the survey. Numeral 1 is equated with having previous knowledge, 0 with having no knowledge before receiving the survey.

The Data

The data for this study were collected through a mail survey of residents of Edmonton. The survey was designed to elicit information on consumers’ attitudes towards milk, consumers’ perceptions of attributes of milk, consumers’ attitudes towards the use of BST and socio-economic and demographic characteristics of the survey respondents. The final design for the contingent choice questions yielded 64 choice scenarios. These were split into four groups of 16 scenarios each. This resulted in four versions of the survey. The responses to these contingent choice questions comprise

the choice data used in this study. An example of a contingent choice question is given in Figure 2 below.

Figure 2: Example of A Choice Scenario

If the 4 milks listed below were available at all stores and were the only milks available

Feature	***Skim***	***1 %***	***2 %***	***Homo***
Price ($/litre)	0.99	0.79	0.99	0.89
BST	No	no	Yes	no
Freshness	4 days before expiry date	8 days before expiry date	10 days before expiry date	8 days before expiry date
I would buy:	__litres of skim milk	__litres of 1% milk	__litres of 2% milk	__litres of Homo milk
___I would not buy any milk				

As can be seen from Figure 2, the respondent could choose to buy more than one milk. That is, the respondent could choose to buy Skim milk, 1%, 2% and Homogenized milk in the same choice scenario. This is an extension of previous choice surveys where the respondent could only choose one of the alternatives in a choice scenario. The data generated by this technique are converted into proportions. That is, the choice probabilities are calculated based on the proportion of each milk type chosen in a given choice scenario. For example, consider a consumer that chooses to purchase 4 litres of Skim milk and 4 litres of 2% milk in the scenario given in Figure 3.1. The proportions of the milk types chosen are: 0.5, 0, 0.5, and 0 for Skim milk, 1% milk, 2% milk and Homo milk respectively.

The survey was relatively lengthy (16 pages) for a mail survey. The survey was designed using the Total Design Method to maximize the response rate (Dillman, 1978). The distribution of the survey was conducted by Advantage Field Research in the spring

of 1996. Based on current Edmonton telephone listings, a random sample of four hundred Edmonton households was recruited for the survey by telephone. Two hundred and ninety four households completed and returned the survey, for a return rate of 73.5%.

The survey was completed by 191 women and 88 men. Fifteen individuals did not indicate their gender. The higher number of female respondents was not unexpected. The cover letter included with the survey indicated that the survey should be completed by the person in the household that makes the majority of the food purchases. Household food purchases continue to be made primarily by women. The sample was reasonably representative of Edmonton residents in terms of age and milk purchasing patterns.

Results and Discussion

In multinomial logit models it is necessary to express the socioeconomic variables as alternative specific variables. That is, the variables denoting age, gender, etc. are each expressed as constants that are specific to each alternative. Thus, there are four age coefficients in the model: AGES, AGE1, AGE2 and AGEH. The coefficient AGES expresses the effect of age on the probability of choosing to purchase Skim milk relative to the base case (choosing not to purchase any milk) while AGE1, AGE2 and AGEH express the effect of age on the probability of choosing 1%, 2% and Homo milk, respectively. PRICE, BST and FRESH are already expressed as alternative specific variables. Table 1 gives the name of each variable in each alternative.

Table 1: Alternatives and Variables

Coefficient	Alternative			
	Skim	**1%**	**2%**	**Homo**
CONSTANT	ASCS	ASC1	ASC2	ASCH
PRICE	PRICE	PRICE	PRICE	PRICE
BST	BST	BST	BST	BST
FRESH	FRESH	FRESH	FRESH	FRESH
AGE	AGES	AGE1	AGE2	AGEH
GENDER	GENDERS	GENDER1	GENDER2	GENDERH
YCHILD	YCHILDS	YCHILD1	YCHILD2	YCHILDH
HINC	HINCS	HINC1	HINC2	HINCH
EDUC	EDUCS	EDUC1	EDUC2	EDUCH
PRIOR	PRIORS	PRIOR1	PRIOR2	PRIORH

The coefficients of the model described in Equations 3 through 6 were estimated using LIMDEP, Version 7.0 (Greene, 1995). The results are given in Table 2. The chi-squared statistic shows that the model is highly significant. The value of the adjusted McFadden's pseudo R^2 is 0.183[1]. The estimated coefficients display the expected signs. PRICE is negative and significant, indicating that increasing price decreases the probability of a consumer purchasing milk. The coefficient on BST is also negative and significant. This indicates that the probability of a consumer purchasing milk decreases if the milk is from cows that are treated with BST. In contrast, the coefficient on FRESH is positive and significant. An increase in the freshness of milk increases the probability of a consumer purchasing milk. The effect of the variable AGE is positive for all types of milk, that is, each of the coefficients AGES, AGE1, AGE2 and AGEH are positive and AGE is significant for skim and 1% milk. Thus, the probability of a consumer purchasing skim and 1% percent milk increases as the age of the consumer increases. The coefficients on GENDERS and GENDER1 are also significant. Female consumers are more likely to purchase skim and 1% milk than are male consumers. Coefficients on YCHILD2 and YCHILDH are positive and significant in the model. Households with

young children have a higher probability of purchasing 2% and Homo milk than choosing the base case of not purchasing any milk.

Table 2: Multinomial Logit Estimates

Log-Likelihood			-5256.830
Restricted (slopes=0) Log- L			-6449.018
Chi-Squared (X)			2358.376
Significance Level			0.000
Adjusted Pseudo R^2			0.183
Variable	**Coefficient**	**Standard Error**	**T Ratio**
PRICE	-0.91997*****	0.19518	-4.713
BST	-1.7021*****	0.04550	-37.412
FRESH	0.07311*****	0.00867	8.436
ASCS	-0.54708	0.32422	-1.687
AGES	0.00561*	0.00315	1.778
GENDERS	0.54097*	0.12611	4.290
YCHILDS	-0.07441	0.09878	-0.753
HINCS	0.00349	0.00212	1.642
EDUCS	0.03547*	0.01591	2.229
PRIORS	0.80332*	0.26403	3.043
ASC1	1.1907*	0.26689	4.461
AGE1	0.00534*	0.00286	1.868
GENDER1	0.31910*	0.11108	2.873
YCHILD1	-0.02744	0.08882	-0.309
HINC1	0.00372*	0.00187	1.985
EDUC1	-0.02768*	0.01210	-2.270
PRIOR1	1.2020*	0.22982	5.230
ASC2	1.6235*	0.27232	5.962
AGE2	0.00234	0.00289	0.809
GENDER2	0.04011	0.11072	0.362
YCHILD2	0.35783*	0.08501	4.209
HINC2	-0.00331*	0.00193	-1.716
EDUC2	-0.02242*	0.01235	-1.815
PRIOR2	0.48521*	0.24558	1.976
ASCH	0.57049*	0.30089	1.896
AGEH	0.00099	0.00385	0.259
GENDERH	-0.05888	0.13487	-0.437
YCHILD	0.74931*	0.09652	7.763
HINCH	-0.00358	0.00235	-1.526
EDUCH	-0.03812*	0.01607	-2.372
PRIORH	1.1709*	0.27686	4.229
***** denotes significance at the α = 0.05 level.			

[1] Following Ben-Akiva and Lerman (1985), the calculation for McFadden's adjusted R^2 is: R^2 = 1 - [(Log-L of the unrestricted model - the number of coefficients in the unrestricted model)/Log-L of the restricted (slopes=0) model)].

The coefficient on EDUCS is positive and significant. Consumers with higher education levels are more likely to purchase skim milk. EDUC1, EDUC2 and EDUCH are negative indicating that more educated consumers are less likely to purchase 1%, 2% or Homo milk. Because of the possibility of correlation between education and income, the variable HINC was excluded in one test of the model. This exclusion did not affect significantly the coefficients on EDUCS, EDUC1, EDUC2 and EDUCH, suggesting that if a correlation between household income and education does exist in the data, this does not seem to have a significant effect on the estimated coefficients.

The coefficient on HINCH is negative and significant indicating that households with higher incomes are less likely to purchase Homo milk. HINC1 is positive and significant while HINC2 is negative and significant. Households with higher incomes are more likely to purchase skim and 1% milk and less likely to purchase 2% milk. The coefficient on PRIOR is significant and positive for all milk types. That is, consumers who had heard or read about BST prior to receiving the survey were more likely to purchase at least one type of milk than to purchase no milk at all. It may be that people who are more likely to purchase milk also tend to purchase larger amounts of milk and are more informed on issues relating to milk. ASCS is negative in all three models. This could be taken to indicate that there is some disutility associated with purchasing skim milk, all other things held constant. The alternative specific constants, however, cannot be interpreted separately from the other estimated parameters of the model.

Welfare Implications

Changes in economic welfare of consumers arising from the possible use of BST were calculated according to Hanemann's (1982) method. This method calculates

economic welfare as the compensating variation associated with a change in the quality of a good. The change in welfare, C, was calculated as:

$$C = 1/\mu[ln\Sigma e^{X1\beta1} - ln\Sigma e^{X2\beta2}] \quad \textbf{(7)}$$

where:
- μ = the marginal utility of money (the coefficient on PRICE is used to represent the marginal utility of money)
- X_1 = the values of the variables in the current situation (i.e. BST = 0, AGE = 40, etc)
- X_2 = the values of the variables when the milks may be from cows treated with BST (i.e. BST = 1, AGE = 40, etc)
- β_1 = the coefficients for the current situation (i.e. where all milk is "BST-free")
- β_2 = the coefficients that apply when all the milks may be from cows treated with BST.

This equation describes the change in a representative consumer's welfare when BST is introduced. It was assumed that milk from cows that have not been treated with BST is clearly identified as such at the retail shelf. Because the coefficient on BST was negative, its introduction can be expected to decrease consumers' welfare if BST-treated milk replaces all non-BST treated milk. The welfare calculations were performed for a representative consumer. This representative consumer is a woman, aged 40, with 1 young child, a household income of $40, 000.00 and 12 years of education, who has not previously read or heard about BST. This consumer was chosen as being broadly representative of the consumers in the sample.

Table 3 shows the estimated changes in welfare for the representative consumer in six different situations. The base case (i.e. X1β1) was specified as milk that is known to be "BST-free", costs $0.79/litre and has 8 days remaining before the expiry date. In Situation 1 there is a change from the current situation (all milk is "BST-free") to all the milk being "BST milk". In Situation 2 the same change occurs but the "BST milk" is

fresher (12 days to expiry date). In Situation 3 the “BST milk” is 16 days from its expiry date. In Situation 4 both “BST-free milk” and “BST milk” have the same freshness level but “BST milk” is less expensive ($0.49/litre). In Situation 5 the “BST milks” are priced even lower, at $0.29/litre. In Situation 6 all the milks available are “BST milks” but the “no purchase” option is not available to the consumer. That is, the consumer must purchase at least one type of milk.

Table 3: Welfare Changes, Situations 1 to 6

Situation	**Welfare Change ($/shopping trip)**
1 (all milks are “BST milk”)	-1.53
2 (“BST milks are 2 days fresher)	-1.42
3 (“BST milks” are 4 days fresher)	-1.30
4 (“BST milks” are $0.49/litre)	-1.32
5 (“BST milks” are $0.29/litre)	-1.16
6 (all milks are “BST milks” but the no purchase option is not available)	-1.85

In all six situations, the consumer experiences a loss in welfare. The loss decreases with increasing freshness for the “BST” milk but this effect levels off when freshness is at 12 days before the expiry date. The consumer does not appear to be willing to trade-off freshness for BST after a gain in freshness of 4 days. This is likely due to the fact that milk is usually consumed quickly rather than being stored for future use. The consumer likely gains little from increased freshness levels greater than 12 days before expiry. The results indicate that the representative consumer is willing to make a trade-off between BST and price. A decreasing price does reduce the welfare loss to the consumer. There still is a welfare loss when “BST milk” is $0.50/litre cheaper than “BST-free” milk (Situation 5). A significantly reduced price for “BST milk” does not appear to completely offset the consumer’s concern about the use of BST. When the consumer is denied the option of not purchasing any milk (Situation 6), the welfare loss

is the greatest. It appears that the representative consumer has a negative perception of the use of BST and clearly wishes to avoid “BST milk”.

Table 4 presents five more situations. In Situation 7, skim milk is “BST-free” while the other milk types are not. In Situations 8, 9 and 10 respectively, 1%, 2% and Homo milk are “BST-free”. In Situation 11 the representative consumer is presented with a full variety of BST and non-BST milks. That is, the dairy case is assumed to contain skim, 1%, 2% and Homo milks that are “BST-free” and skim, 1%, 2% and Homo milks are “BST milks”. When Skim, 2% and Homo milk are “BST-free”, respectively, the welfare loss is $0.67. When 1% milk is “BST-free” the welfare loss is $0.26. Skim milk purchasers may be more health conscious than other consumers. Homogenized and 2% milk are often purchased for children. This might explain the higher welfare losses in Situations 7, 9 and 10.

Table 4: Welfare Changes, Situations 7 to 11

Situation	**Welfare Change ($/shopping trip)**
7 (skim milk is “BST-free”)	-0.67
8 (1% milk is “BST-free”)	-0.26
9 (2% milk is “BST-free)	-0.67
10 (Homo milk is “BST-free”)	-0.67
11 (full variety)	0.24

When the consumer is presented with a full variety of milks, (Situation 11), there is a welfare gain of $0.24 per shopping trip. This result contrasts with the welfare changes estimated when all the milks are “BST milks” or when only one of the milk types is “BST-free” (Situations 1 through 10). Situation 11 allows consumers that are concerned about the use of BST to avoid it altogether without changing their milk purchasing habits, and this may be reflected in the welfare estimate. Consumers that are not concerned about BST use can be expected to be unaffected by Situation 11.

When the gender of the representative consumer was changed to male, the welfare losses decreased slightly. Increasing the age, education level and household income of the consumer also decreased the welfare losses but the behaviour pattern reflected in the welfare estimates did not change. The identified use of BST, under the assumptions of this study, resulted in welfare losses that were not entirely offset by increases in the freshness of milk or by decreasing the price of milk. When the representative consumer was offered a full selection of BST and non-BST milks, a small welfare gain resulted.

Conclusions

This study examined Edmonton consumers' choices of milk in a hypothetical market situation. This hypothetical market included milk that was identified as possibly being from cows that have been treated with BST. The study was designed to examine the trade-offs that consumers appear to be willing to make between four milk attributes of fat content, price, freshness and BST. The effects of selected socioeconomic variables on these trade-offs were also examined. A multinomial logit model of consumer choice was developed to examine the choice between milks that varied in price, freshness and the use of BST. The four fat contents of milk available (Skim, 1%, 2% and Homo) were used as the choice alternatives or "brands" in the study. Welfare calculations for a representative consumer were calculated using the coefficients estimated by the multinomial logit model. A number of different situations were postulated and economic welfare impacts were calculated for a representative consumer.

In all but one of these situations, the representative consumer experienced welfare losses with the introduction of BST. A reduced price or increased freshness level for “BST milk” was not sufficient to offset the welfare losses. The welfare losses were slightly less for a male consumer than for a female consumer. Increased levels of education and income also reduced the welfare losses slightly. These welfare losses were greatest when the representative consumer was denied the option of choosing not to purchase any milk at all. When the representative consumer was offered a full range of “BST milks” and “non-BST milks” a small welfare gain was observed. That is, when Skim, 1%, 2% and Homo milks were offered as both “BST-free” and as “BST milk” there was a small welfare gain. It appears that making appropriately labeled “BST-free” milk available to consumers could decrease negative reactions to the introduction of BST. Even so, evidence on milk consumption patterns in the United States following the licensing of BST suggests that there has been little actual impact on consumer behaviour. An examination of how consumers screen, use, accept or reject information on food safety and modifications in food production and processing would aid in understanding how consumers’ perceptions are formed. Further study of the factors that influence consumers’ perceptions of food safety would be helpful in assessing how these influence the consumption of food.

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