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Authors	Steiner, Bodo E.;Gao, Fei;Unterschultz, Jim
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Alberta consumers' valuation of extrinsic and intrinsic red meat attributes: A choice experimental approach

Bodo Steiner, Fei Gao and Jim Unterschultz[1]
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Abstract

This paper analyzes Alberta consumers' perceptions towards extrinsic and intrinsic attributes of bison and beef steaks. In contrast to published Canadian consumer studies on bison meat that were undertaken prior to May 2003, before the first BSE case of Canadian origin was identified in beef cattle, this study provides a 'post-BSE' assessment of consumer perceptions towards selected bison meat attributes. The results from an attribute-based choice experiment provide little support that simple traceability assurance schemes have value to consumers of bison and beef steaks, thus confirming similar findings of earlier beef studies that have employed different methodological approaches. The results also suggest that consumers are willing to pay significant premiums for bison steaks that are certified as being produced without genetically modified organisms, an attribute that has so far been unexplored in previous published bison studies.

Keywords: labeling, choice experiments, multinomial logit, bison, beef
JEL codes: C35, D12, Q13

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[1] Assistant Professor, former graduate student and Associate Professor respectively, University of Alberta, Department of Rural Economy. Lead author: B. Steiner, Assistant Professor, Department of Rural Economy, 515 General Services Building, University of Alberta, Edmonton, Alberta, Canada, T6G 2H1, Email: bsteiner@ualberta.ca: http://www.ualberta.ca/~bsteiner/

Introduction

Labeling as an extrinsic cue that informs buyers about intrinsic quality characteristics (Caswell 2000) is important to the functioning of food markets. This role of labeling is particularly relevant in the case of credence attributes (Nelson 1970; Darby and Karni 1973), as, for example, with meat labeled "produced with genetically modified feed" or labeled to be farm origin traceable. Therefore, it is not surprising that a large literature has emerged, which has focused on consumers' valuation of a number of beef labeling attributes (e.g. Quagrainie, Unterschultz, and Veeman 1998; Lusk and Fox 2002; Dickinson and Bailey 2002; Tonsor, Schroeder, Fox, and Biere 2005). However, relatively few studies have explored labeling issues in the context of bison meat.

For Canadian consumers, bison has the image of a heritage icon of North America (Hobbs, Sanderson and Haghiri 2006). Bison meat is leaner than beef, has a different composition of fatty acids and cholesterol (Rule et al. 2002; McClenahan and Driskell 2002; Galbraith et al. 2006), and contains more nutrients compared to beef (Galbraith et al. 2006). As a result, bison meat, an alternative red meat, compares favorably in nutrient value and health benefits to other red meats (Table 1). Since the bison industry in Canada is small but growing in size and trying to establish itself in the red meat market, it is desirable to understand key factors that influence consumers' willingness-to-pay for bison versus beef meat attributes. An attribute-based stated choice analysis (Louviere, Hensher and Swait 2000) is employed to explore Alberta consumers' economic valuation of a set of extrinsic and intrinsic bison and beef meat attributes.

Previous Canadian consumer studies on bison meat (Sanderson et al. 2002, Cunningham 2003, Hobbs, Sanderson and Haghiri 2006) were all undertaken prior to May 2003, before the first BSE case of Canadian origin was identified in beef cattle. After May 2003, we not only observe changes in Canadian red meat consumption, but we also observe that consumption of beef versus bison meat in Canada developed rather differently. Domestic per capita consumption of beef declined by about 10% after the 2003 BSE case emerged, yet rebounded to pre-BSE levels by early 2006 (Statistics Canada 2006). Canadian per capita disappearance of bison meat first increased after the May 2003 case, only to decline after 2005 (Figure 1). Consumers may value red meat labeling attributes, such as farm origin traceability and a guarantee that meat was produced without genetically modified organisms (GMO), differently after 2003, and distinctly different for beef versus bison.

Our study's focus on traceability stems from consultation with industry representatives, and from the desire to benchmark our results with those of previous bison and beef studies. In particular, the study by Hobbs et al. (2005) on traceback in the Canadian beef and pork meat sector, which was undertaken prior to May 2003, suggests that farm origin traceability by itself has limited value to beef and pork consumers unless it is accompanied by a credible quality indicator.[1]

Consultation with the bison industry and initial focus group work indicated continuing concerns with GMO used in food production. A small but growing body of research (Marin and Notaro 2007; Carlsson et al. 2007; Meijer et al. 2005; Rousu et al. 2003) also

suggests that consumers are concerned with GMO in animal production. Hence, another primary focus of this research is on a labeling scheme in which consumers could indicate their valuation for bison and beef meat that was guaranteed produced without genetically modified organisms (i.e. non-GM feeds). Genetically modified foods (GMF) and meats produced using GM feed may continue to be a consumer issue with increasing international trade, increasing world-wide production of GM crops and ongoing scientific advances in genomics.[2]

The objectives are thus twofold. The first objective is to evaluate consumers' willingness-to-pay (WTP) for two labeling attributes; a guarantee for farm origin traceability and a guarantee the meat is produced without using genetically modified organisms. The second objective is to compare consumers' valuation for bison versus beef meat attributes when consumers are offered hypothetical choices of bison steaks, and can trade these off with their regular beef steak purchase. This information may assist the bison industry in positioning their meat products in the Canadian market place relative to beef. A web based survey of Canadian consumers in the province of Alberta was undertaken in November 2005 to address these research objectives.

Bison Industry and Previous Bison Demand Research

The Canadian bison industry has experienced major changes over the past decade. Between 2001 and 2006, the number of bison on farms increased by nearly 35 percent

(Statistics Canada 2007a). The 2006 census reported 195,728 bison on farms in Canada, 96% of which were located in the four western provinces, with Alberta having the largest herd (Statistics Canada 2008). Export markets were closed to bison and beef cattle shortly after the first Canadian BSE case was reported in 2003. Nevertheless, export opportunities to the U.S. for beef and bison meat returned relatively quickly, whereas limited and staged (e.g., age-verified) access for live beef and bison exports began only in August 2005. From 1998 to 2003, bison slaughter prices declined to their lowest level during 2003, and started a sustained rise since then (Figure 2). However, bison meat prices are still significantly below their high levels they had achieved during the late 1990s.

Very little information is available on bison meat consumption and sales in Canada and the U.S.. The majority of Canadian bison meat sales are through the hotel and restaurant trade, specialty meat stores, and farm gate (Oliver-Lyons 1998; Full Course Strategies Inc. 2004). Most previous consumer studies on bison meat have used price auction mechanisms to assess consumer preferences and characteristic differences among bison consumers. In contrast to choice experiments (attribute-based stated choice methods, ABSCM) where consumers' WTP is derived through a sequential trade-off process between attributes in a hypothetical choice setting, experimental auctions obtain information about consumers' WTP through a bidding process that may contain actual products (Umberger and Feuz 2004). Both experimental approaches allow the researcher to control the choice environment in a manner that would not be possible in a retail-environment, for example by controlling for consumers' regular purchases (Adamowicz

and Boxall 2001; Lusk 2003). However, both approaches have their limitations, with evidence suggesting over-bidding in second-price auctions, and issues related to interactions between attributes in ABSCM (Lusk 2003).

Cunningham (2003) used 57 Canadian participants in a Vickrey second-price auction to explore the value of nutritional information, in both beef and bison sandwiches. The results suggest that nutritional information, including a statement concerning the absence of growth hormones and antibiotics in processed bison, is not important. The most recent auction-based study from 2002 uses a sample of 459 consumers in five locations across Canada to evaluate Canadian consumers' WTP for bison versus beef (Hobbs, Sanderson and Haghiri 2006). The results suggest that WTP for beef is not significantly different from that for bison, even when there are additional health quality assurances attached to bison. Consumers appear to value a positive eating experience more highly than the health-related attributes *per se*.

Sanderson et al. (2002) use conjoint analysis to analyze preferences of 154 Alberta consumers for bison meat. Their survey suggests that price is important, but consumers may be willing to pay higher prices for increased tenderness and lower fat content attributes. Additionally the authors used cluster analysis to identify potential market segments (e.g., price conscious, low fat).

In an analysis on French consumers of U.S. bison, Torok et al. (1996) employ a taste-test panel of 52 consumers to identify three different psychographic/life-style groups: “meat eaters”, “family cooks” and “image conscious consumers”. Torok et al. (1998) use non-parametric methods to analyze characteristic differences among U.S. consumers who are likely to choose bison over beef. The study identifies four characteristic dimensions: variety eaters, game meat eaters, celebrators of special occasions and consumers of healthy meats.

In sum, previous bison consumer research has explored several extrinsic and intrinsic labeling attributes, but no published work has, to the best of our knowledge, examined traceability or GMF issues in the context of bison. Further, the methodological approaches used by researchers analyzing bison meat were experimentally based auctions or surveys, but none of the bison studies used stated choice experiments.

Methods

The following analysis focuses on the survey results from choice experiments. Choice experiments (Louviere, Hensher and Swait 2000), sometimes called stated preference or stated choice methods have been used extensively to evaluate WTP for labeled meat products. In 1996, Quagrainie, Unterschultz, and Veeman (1998) conducted choice experiments among Canadian consumers for origin labeling (beef and pork) and biopreservatives in packaging. The authors find a significant price premium for Canadian

over US beef, and establish that Canadian consumers view biopreservatives negatively in packaging. Lusk and Schroeder (2004) conducted choice experiments in 2002 in the US, in order to explore hypothetical biases in consumers' valuation of beef steak attributes, including steaks that were guaranteed 'natural'. More recently, Tonsor et al. (2005) conducted three choice experiments in 2002 in London, Frankfurt and Paris, to analyze how consumers value beef steaks with attributes including GM-free, farm-specific source verification, and domestic origin. Consumers were found to be significantly heterogeneous across regions in their WTP for these beef steak attributes.

As in the above choice-experiment-based studies, consumers' unordered responses in the choice experiments employed in this study are assumed to follow the standard assumptions of random utility theory. An individual *n*'s utility for alternative *i* can be written as:

$$U_{ni} = V_{ni} + \varepsilon_{ni} \tag{1}$$

where the utility of an alternative consists of a deterministic component V (the meat attributes), and a random error term ε (unobservables and measurement error). The probability that individual n chooses alternative i from a specific choice set of J alternatives can then be expressed as:

$$P_{ni} = P(U_{ni} > U_{nj},\ \forall\ i \neq j \in J) = P(\varepsilon_{nj} > \varepsilon_{ni} + V_{ni} - V_{nj,}\ \forall\ i \neq j \in J) \tag{2}$$

McFadden (1974) shows that, by assuming that the random error terms follow an extreme value Type I distribution and are independently and identically distributed across alternatives, the choice probabilities in equation (2) can be expressed as a multinomial logit model:

$$P_{ni} = \exp(\mu\beta^T X_{ni}) / \sum_{j=1}^{J} \exp(\mu\beta^T X_{nj}) . \quad (3)$$

The deterministic part of the utility function, $V_{ni} = \mu\beta^T X_{ni}$, is assumed to be linear in parameters, μ denotes a scale parameter of utilities normalized to μ=1, and β is a parameter vector associated with the explanatory vector of variables X_{ni}. The attributes enter the utility function through X_{ni}.

A basic model where X_{ni} contains only attributes of the alternative chosen together with alternative-specific constants can be estimated; this basic model is referred to as model 1 below.[3] An extended model where X_{ni} contains interaction terms between socio-economic variables of the respondent and the alternative-specific constants, as well as interactions between socio-economic variables and attribute-specific variables (model 2), is also estimated. These interaction terms allow for consumer heterogeneity and thus the identification of specific market segments.

Data and experimental design

Consumer survey data were collected as part of a bison industry-funded project, which explored consumers' valuation for quality traits in bison relative to beef. Four focus groups, each varying between 8 and 12 consumers, were held in Edmonton, Alberta, to identify key attributes, develop the survey and pretest successive versions of the web based survey. The first two focus groups consisted of undergraduate and graduate students from the University of Alberta who were recruited by email. Consumers for the final two focus groups were recruited by a professional marketing company using random digital dialing and accounting for a proportionate population representation (gender, age, rural/urban). Exclusion criteria were vegetarianism and under 18 years of age. All focus group participants received a small money incentive payment.

The focus groups were presented with a number of intrinsic steak attributes, as well as extrinsic attributes related to traceability and GMF. In additional to guided discussions, five-point Likert scales were used to identify meat features that would be important to consumers. Besides exploring the importance of the use of GM feeds in meat production, the scales initially explored attributes such as:

- animal welfare guarantee/ certification for animal welfare,
- frozen vs. fresh, [4]
- country of origin,
- food-safety certification,

- cooking recommendations on packaging.

Due to the leanness of bison meat, particular emphasis was placed on determining a meaningful descriptor for fat while accounting for health and taste issues. Therefore, the focus groups explored descriptors such as "*Low Cholesterol and fat*" and "*Tenderness and flavour*". The focus group research suggested that consumers were able to distinguish between the health and the taste aspects associated with the attributes presented. It was therefore deemed sufficient to focus on "fat" during the choice experiments, and not to add further complexity by emphasizing health aspects, for example through a joint descriptor "*Low Cholesterol and fat*". The fat description in percentage terms, as finally used in the choice experiments, was initially developed based upon consumers' responses during the focus groups to photos with different meat marbling, and to different categories of fat with the following written descriptions: (i) fat percentages, (ii) "visible fat layer"/ "no visible fat layer", and (iii) "No visible outside fat trim/ Trace of outside fat trim".[5]

After consultation with representatives from the bison industry, and in view of the significant importance that focus group participants placed on information about the use of GMO in bison and beef production, the stated choice experiment in the final survey focused on GM labeling, traceability and fat. Respondents for the final web-survey were recruited from Alberta by an international marketing company, using a random digit dialing computer assisted telephone interviews screener. Consumers were offered a $5

gift voucher for survey participation. Overall, 210 usable surveys were employed for the data analysis.

The web-survey consisted of three parts and 22 questions. First, consumers were asked various rating and ranking questions related to the consumption of beef and bison meat. Although consumers were not given additional information about bison meat characteristics or the bison industry as part of the survey, they were asked about their previous experience with bison meat. This first part of the survey was followed by the choice-based experiment, which in turn was followed by socio-economic and demographic questions. The results presented in this paper focus on the stated choice experiment.

An orthogonal main-effects only design (Louviere, Hensher and Swait 2000) was used for the choice experiment. To reduce the number of treatment combinations (i.e., the combination of attributes and their associated attribute levels), a fractional factorial design was generated (Hensher, Rose and Greene 2005).

Before consumers proceeded to the choice experiment, they specified their regular beef steak purchase (Figure 3). The beef steak was characterized in terms of four steak attributes with four different attribute levels in each case. First, consumers could choose between four prices ($/kg) for their beef steak purchase. Second, they could choose between four fat features: trimmable fat, 1-5% visible fat (not trimmable), 6-15% visible

fat (not trimmable) and 16-50% visible fat (not trimmable). Third, consumers could specify their regular steak with or without a label that guarantees farm origin traceability. Fourth, consumers could choose between a steak that was labeled "Guaranteed produced without genetically modified organisms (GMO)" and a steak that was not labeled in this manner. This information was used to define the status quo meat (consumers' regular beef steak) in the choice experiment. It was deemed desirable to allow a status quo choice, since consumers were expected to be less familiar with bison steak options than with beef steak options.

Once consumers had specified their regular beef steak purchase, they proceeded to a repeated stated choice experiment. Each consumer answered four choice sets, similar to the choice set shown in Figure 4. Following Hensher et al. (2005), we used SPSS to generate the choice sets, and assigned these sets to four blocks (independent subsets of the overall design), such that each respondent had only to answer four choice sets. For each block consisting of four choice sets, we randomized the order of the choice sets. The individual respondents were also randomly assigned to a particular block. Assuming independence of choice sets, the sample size of 210 (i.e. 840 responses) is deemed sufficiently large to ensure robust estimates.[6]

Survey results

Summary statistics of consumers' demographic and socio-economic characteristics are displayed in Table 2. Slightly more females than males answered the survey. The 2006

Census (Statistics Canada 2007b) shows that the 59.3 percent of Alberta's population above the age of 15 is married, and this is slightly higher than the survey sample of 53 percent. The survey population had a median income in the range of $50,000-69,999, which is lower than the 2005 median income of $71,000 for Alberta households (Statistics Canada 2007b). In 2001, 26% of those aged 15 and over had a University degree or a higher level of education as compared to 27% in the survey sample (Statistics Canada). Most of the survey participants are non-smokers, claim to exercise regularly, have less than one child under 18 in their household, and do not purchase organic produce (fruit, vegetables or meat) regularly (three to five times over the past four weeks). The sample is considered a reasonable representation of households in Alberta.

The majority of respondents (82.3%) had not consumed bison meat in a restaurant in the last six months, and only 16.3% had tried it once or twice. Only 1.4% of the sample population had consumed bison 3 to 5 times, and no one had consumed bison for more than 5 times in the past six months. Furthermore, 65.7% of the respondents had never consumed bison at home. These responses to prior bison meat experience were coded and used as interaction terms with the choice attributes during the estimation of the choice models.[7] However, likelihood-ratio tests indicated that none of the interactions were statistically significant.[8] This suggests that those consumers who had not previously experienced bison did not value the meat attributes in a significantly different way, compared to those consumers who had previously experienced bison. Although the final survey did not control explicitly for prior knowledge about bison, the focus group

research revealed that Alberta consumers were familiar with bison as a farmed animal, as well as aware of the lean meat property of bison. This was not too surprising, given the significance of bison farming in Alberta (Statistics Canada 2008).

Likelihood ratio-tests and Wald tests for non-linear restrictions were used to further refine the stated choice model 2. In both models 1 and 2, alternative-specific constants (ASC's) were included to allow for unobserved sources of utility associated with the beef, bison and the opt-out choice. The variables are described in Table 3. The estimation results for model 1 and model 2 are presented in Table 4.[9] On average, consumers opted out 8%, chose bison 17%, and chose their regular beef steak 75% of the time.

First we consider the attribute coefficients from the models. Price is statistically significant at the 1% level in both models, and the coefficient is negative as expected, suggesting that increasing prices decreases the utility of consumers. Further, we conclude from both models that, at the 5% level, the hypothesis that consumers are more likely to purchase a steak with a certified label which states that the steak was guaranteed produced without genetically modified organisms (as compared to a steak that was labeled without such information) is not rejected.

Model 2 shows responses to attribute-specific and choice-specific socio-economic characteristics. All models suggest that consumers prefer their regular beef steak to any

of the bison steaks offered. Households with children are, on average, more likely to be price sensitive than those without children, since the interaction term between price and children, KIDP, is negative, suggesting a decreased probability of choosing more of bison or beef steaks for households with one or more children.

The results suggest that education, gender and consumers' rural vs. urban origin are unlikely to influence consumers' decision-making in choosing bison steaks versus beef steaks. Using mean points of the age categories during the estimation, our results suggest that middle aged consumers and those who exercise regularly are more likely to choose bison than beef steaks (AGE1, EX1). However, consumers who regularly purchase organic produce (fruit, vegetables or meat) are less likely to purchase beef or bison steaks. This is not too surprising, since Canadian organic purchasers are more likely to be vegetarians (USDA 2000), compared to the average population.[10] No clear direction on fat preference is found between trimmable versus moderate levels of not trimmable fat. However high levels of not trimable fat are not preferred (Table 4). To test whether consumers value trimmable and not trimmable fat differently, an alternative model similar to model 2 was estimated. Model results not shown here indicate that consumers value trimmable fat slightly more than not trimmable fat. Overall results suggest consumers are indifferent between low and moderate levels of fat and may not be willing to trade improved health benefits for significantly reduced flavour associated with fat. These results for fat support the results of Hobbs et al. (2006), who find that the low fat attribute of bison meat alone is insignificant in affecting consumers' willingness-to-pay.

Farm origin traceability

Traceability is not statistically significant in model 1, but is significant in model 2 where interaction terms are introduced. The negative and statistically significant coefficient estimate for farm origin traceability in model 2 suggests that consumers are, on average, less likely to choose steaks with a certified label that provides a guarantee of farm origin traceability (model 2). However, the significant and positive interaction terms for education (10%) and children (1%) suggest that more educated consumers, and those with children value traceability more, compared to less educated consumers and those without children.[11]

Marginal WTP (MWTP) estimates for traceability for beef steak attributes versus bison steak attributes for model 1 were found by dividing the specific coefficient on the attribute by the price coefficient (Table 5). The marginal utility of money is the negative marginal utility of price. Therefore,

$$MWTP_j = -(1/\text{Marginal utility of money}) * \text{Marginal utility of } j\text{-th attribute} \quad (4)$$

as long as a steak attribute is measured in monetary units, utility contains only choice attributes, and the choice model is linear in the utility functions. MWTP results for model 2 were computed for each respondent based on the design variables, the relevant interaction terms and including demographic responses in the utility change. MWTP were calculated using the change in each individual's utility function and then averaging

the changes across the survey sample (Louviere, Hensher and Swait 2000). Consumers' MWTP is positive but small for a farm-origin traceability labeling scheme, suggesting that respondents are willing to pay a small price premium for this attribute. The mean MWTP for a bison or beef steak that carries a guarantee of farm origin traceability is $1.28 in model 1 and $2.91/kg in model 2.

In sum, except for households with one or more children, a simple traceability scheme still has some value to consumers, and households with no children have a negative MWTP for traceability. This is in line with previous studies on beef and pork meat, which have used methodological approaches other than choice experiments. European evidence from Verbeke, Ward and Avermaete (2002) suggests that compulsory beef label indicators of traceability, specifically the ability to track meat back to the animal of origin, the slaughterhouse and cutting unit, are the least important quality cues used by beef consumers in Belgium. In an experimental auction study on Canadian beef and pork meats, Hobbs et al. (2005) found a positive, albeit small, WTP for traceability in their beef experiments, while bundling traceability with quality assurance affects consumers' utility significantly. Similarly, the study of Verbeke and Ward (2006) on information cues on beef labels finds that traceability has little marketing potential in Europe, unless accompanied by trustworthy indications of quality.

GMO labeling

The impact of labeling beef and bison steaks as guaranteed produced without genetically modified organisms (non-GMO) is also tested. The statistically significant coefficient on non-GMO in both models (Table 4) suggests that consumers are more likely to purchase beef and bison steaks that are labeled in this way. The results suggest that Alberta consumers are concerned about the indirect consumption of genetically modified organisms, and this result is consistent with the findings of a European beef study by Roosen, Lusk and Fox (2003).

To obtain more differentiated evidence, non-GMO was interacted with households with children (KIDGMO), higher education (EDGMO), frequent purchasers of organic produce (ORGANGMO), income (INCGMO) and the alternative specific constant for beef (ANOGMOB). The negative coefficient estimate (Table 4) for ANOGMOB suggests that consumers are more likely to purchase bison steaks that are labeled non-GMO as compared to beef steaks. Steaks that are labeled as guaranteed produced without genetically modified organisms are more likely to be chosen by consumers who regularly purchase organic produce. Thus, there is consistent evidence for both beef and bison that consumers who are regular organic purchasers values non-GMO labeling distinctly different from other consumers. The interaction term with education (EDGMO) is significant at the 1% level with a negative sign. Higher educated consumers are thus less likely to choose beef or bison steaks labeled as guaranteed produced without

genetically modified organisms. This result contrasts with Veeman and Adamowicz (2004), who find that consumers with more years of education are more likely to choose foods that contain more information in terms of food labeling. However, there is evidence that consumers with more education are more aware of the underling processes of biotechnology (Hoban and Katic 1998). Thus, consumers with more education may perceive lower marginal benefits from explicit non-GMO labeling.

In a final step, results from models 1 and 2 are used to derive WTP measures for non-GMO labeling (Table 5). The mean WTP for a bison or beef steak that is labeled as guaranteed produced without GMOs is $5.03 and $10.05/kg for models 1 and 2, respectively. Based on the discussion above, our results suggest that non-GMO labeling has more value to consumers than farm origin traceability labeling.

Conclusions

This study uses an attribute-based repeated choice-experiment to analyze Alberta consumers' marginal willingness-to-pay for beef and bison labeling attributes. The study was undertaken in November 2005, thus allowing sufficient time for consumers to evaluate their preferences for red meat following the discovery of BSE cases of Canadian origin in 2003. The results suggest that consumers value a guarantee for farm origin traceability distinctly different compared to a guarantee that steaks were produced

without genetically modified organisms (GMOs). Traceability labeling has only a significant and positive effect on consumers' choice probabilities in the case of households with one or more children. The overall results on traceability suggest that there has been no change from previous beef studies by Verbeke and Van Kenhove (2002), Hobbs et al. (2005) and Verbeke and Ward (2006), all of which employed different methodological approaches than the present paper. A possible explanation for our finding that a simple traceability assurance scheme has minimal value to consumers is that consumers may not be fully aware of the potential benefits of improving traceability.

The results also suggest that labeling steaks "guaranteed produced without GMO" significantly increases choice probabilities in the cases of both beef and bison steaks. Further, more educated consumers were found to be less likely to choose beef or bison steaks labeled as guaranteed produced without GMO. This finding is somewhat expected, since previous studies suggest that more educated consumers are more aware of the underlying processes of biotechnology (Hoban and Katic 1998).

Consumers who purchase organic produce regularly are less likely to purchase bison or beef steaks. This was expected, since organic consumers are more likely to be vegetarians, compared to the average population. Further, regular purchasers of organic produce highly value steaks that were labeled as guaranteed produced without GMO. Although such GMO labeling significantly increases choice probabilities for beef and

bison steaks, the results suggest that consumers are more likely to choose bison steaks that are labeled as guaranteed produced without GMO, as compared to beef steaks.

The results provide more evidence for heterogeneity among consumers' marginal willingness-to-pay, since households with one or more children were found to be more likely to decrease their consumption of beef or bison steaks when faced with a price rise, as compared to any other household type in the sample. Similar to the U.S. study by Torok et al. (1998), there is tentative evidence for a distinct consumer group of healthy meat eaters that could be key bison meat eaters, since the results suggest that middle aged consumers and those who exercise regularly are more likely to choose bison than beef steaks. Marketing efforts for bison meat could therefore be targeted specifically towards those consumer groups. The results also suggest that consumers are not willing to trade-off potential health benefits for taste, by reducing their fat consumption associated with steak consumption.

While this study used choice experiments to explore potential market segmentation and the targeting of labeling information to specific consumer groups, it has several limitations. Our focus on two credence attributes has partially answered which labeling strategies are valued most by particular consumer groups. However, we are unable to reveal to what extent such labeling provides benefits by improving consumers' decision making (Teisl and Caswell 2003). Also, our study did not analyze why consumers are likely to attach a positive value to steaks that were guaranteed produced without

genetically modified organisms. Teisl et al. (2002), for example, have shown that consumers value GMO labels due to uncertainties about environmental impacts and long-term health effects.

Further, the methodological approach did not explore consumer involvement as a motivational force and an explanatory factor for information search and information processing (Verbeke 2005a). Consumer differences in information processing were not assessed (Teisl and Roe 1998). Although consumers were not differentiated according to their subjective knowledge of bison attributes, we controlled for prior experience with bison meat and found that it had not a statistically significant impact on consumers' valuation of our design variables. Nevertheless, since Sanderson et al. 2001 have provided evidence for misperceptions about bison (being an endangered species), and as a recent study on functional foods suggests that subjective knowledge can significantly impact on consumers' choice probabilities (Verbeke 2005b), there is scope for more work on bison meat as it relates to prior knowledge and risk perceptions.

Endnotes

[1] Similar results were obtained by Verbeke and Ward (2006) for European beef.

[2] Canada does not require genetically modified foods (GMF) to be labeled unless the GMF are significantly different from the conventional food product, or the GMF presents a health concern (CFIA, 2006).

[3] Alternative-specific constants are included to estimate the impact of unobserved and unmeasured characteristics of the alternatives in the choice experiments (Louviere *et al*. 2000).

[4] Both evidence from visits of several retail outlets in Alberta during July of 2005 and evidence from Oliver-Lyons (1998) suggests that consumption of frozen bison meat is significant.

[5] Hobbs et al. (2006) also use a verbal description of percentage fat, to compare bison and beef fat level differences.

[6] Following the standard assumption that each choice set is an independent decision task (independence of choice sets: Hensher *et al*. (2005)), each consumer completed four choice sets, thereby reducing the number of decision makers required to be sampled. With information on true population proportions the exact minimum number of decision makers required could be obtained (for a variety of desired levels of accuracy of the estimated probabilities) by applying equation 6.1. in Hensher et al. (2005, p.185). However, in the absence of this information, and while assuming independence of choice sets, Hensher *et al*.'s (2005) rule of thumb was followed: "*With the collection of RP [revealed preference] choice data, the guiding rule of thumb is simple. Experience suggests that the best strategy for sampling is CBS [choice based sampling] with minimum sampling sizes of 50 decision makers choosing each alternative*." (p.194). Considering this rule of thumb, we believe that our sample size is sufficiently large.

[7] These questions included: "How often have you eaten bison in a sit-down restaurant over the past six months?"; "How often have you eaten bison meat over the past six months at home?"; "For which of the following events have you purchased bison, to eat at home?"; "If you have consumed bison before, please indicate where you first tried it, outside of a sit-down restaurant (including at home and in a fast-food restaurant), or in a sit-down restaurant?"; "Where do you usually get bison meat from?".

[8] Evidence for significant interaction variables implies that the utility derived from one attribute depends on the level of the second attribute.

[9] Limdep 3.0 and NLogit 3.0.1 were used for all estimations.

[10] It should be emphasized that when the professional marketing company recruited respondents, vegetarianism was an exclusion criteria for participation. Nevertheless, we still conjecture that purchasers of organic produce are more likely to be vegetarians, thus less likely to purchase significant quantities of red meat.

[11] Since TR is negative and KIDTR is positive, we tested for the joint effects of both parameters, using a likelihood-ratio test. The results suggest that the unrestricted model including TR and KIDTR is superior to the restricted one (Log likelihood: -499.3380; chi sq for 2DF: 5.99 (0.05); Pseudo-R^2 .16359). We can probably rule out that consumers misunderstood the concept of "farm origin traceability", since such misunderstandings did not emerge during the focus groups. The negative traceability coefficient in model 2 may reflect other effects that are not being accounted for by the variables included in the estimation.

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Table 1: Nutrient composition of selected meats and fish (per 100 grams of cooked lean meat/fish)

SPECIES	FAT (GRAMS)	CALORIES (Kcal)	CHOLESTEROL (MG)	IRON (MG)
Bison	2.42	143	82	3.42
Beef	8.09	201	86	2.99
Pork	9.66	212	86	1.10
Chicken	2.00	158	86	0.60
Salmon	12.35	206	63	0.34

Source: Health Canada (2007)

Table 2: Summary statistics of demographic and socio-economic variables of survey respondents

Description	Mean	N
Female	54%	206
Locale[1] Rural	39%	205
Non-Smoker	72%	206
Exercise regularly	54%	206
Married	53%	196
Education: University degree or higher[2]	27%	206
Median Income Range	$50,000-69,999	206
Median Age	40-49 years	206
Households With One Or More Children At Home	42%	206
Households that purchase organic produce (fruit, vegetables or meat) regularly[3]	38%	210

[1] Respondents were asked whether they would consider their roots to be rural or urban. This does not correspond to the locale of current residency.

[2] The categories were: Elementary, High School, College, University, Graduate School.

[3] Where "regular" is coded as "three to five times or more over the past four weeks".

Table 3: Description and names of variables used in the choice models

Variable Name	Variable description
ALT1	alternative specific constant for beef (choice 1)
ALT2	alternative specific constant for bison (choice 2)
ALT3	alternative specific constant for opt-out (choice 3)
PRICE[1]	price (in Canadian Dollars)/kg
TR	farm origin traceability: 1 = yes, 0 = no
NOGMO	certified label "without GMO": 1 = yes, 0 = no
FAT1	dummy-coded fat level 1, trimmable
FAT2	dummy-coded fat level 2, 1-5% visible (not trimmable)
FAT3	dummy-coded fat level 3, 6-15%visible (not trimmable)
FAT4	dummy-coded fat level 4, 16-50% (not trimmable)
EDU	education: university or grad school = 1, otherwise = 0
INCOME	mean point of the income categories
AGE	mean point of age categories
EX	exercise regularly = 1 otherwise = 0
RED	consumers who consider themselves red meat eaters = 1, otherwise=0
KID	at least one child = 1, otherwise = 0
ORGANIC	regular organic food buyers = 1, otherwise = 0
Interaction terms used in final model	
AGE1	AGE × ALT1
$AGE1^2$	AGE^2 × ALT1
AGE3	AGE × ALT3
$AGE3^2$	AGE^2 × ALT3
ANOGMOB	NOGMO x ALT1
EDGMO	EDU × NOGMO
EDTR	EDU × TR
EX1	EX × ALT1
EX3	EX × ALT3
INCGMO	INCOME × NOGMO
INCOME1	INCOME x ALT1
INCOME3	INCOME x ALT3
INCTR	INCOME × TR

INCTR1	INCOME1 x TR
KIDGMO	KID × NOGMO
KIDP	KID × PRICE
KIDTR	KID × TR
ORGANGMO	ORGANIC × NOGMO
ORGANIC1	ORGANIC × ALT1
ORGANIC3	ORGANIC × ALT3
ORGANTR	ORGANIC × TR
RED1	RED x ALT1
RED3	RED x ALT 3

[1] The prices were as following: $13.99, $15.99, $22.99, $28.99 per kg.

Table 4: Parameter estimates for the choice models

Variable	*Coefficient (standard errors)*	
	Model 1	**Model 2**
ALT1	0.860*** (0.129)	3.812*** (1.078)
ALT3	-1.848***(0.330)	-0.686 (1.562)
PRICE	-0.076*** (0.092)	-0.076*** (0.011)
TR	0.097 (0.146)	-1.328** (0.580)
NOGMO	0.382** (0.150)	2.187*** (0.661)
FAT1	0.700*** (0.245)	0.917*** (0.271)
FAT2	0.618** (0.243)	0.672** (0.274)
FAT3	0.710*** (0.256)	0.782*** (0.288)
Interaction terms		
AGE1		-0.125** (0.051)
AGE1^2		0.001** (0.000)
AGE3		0.025 (0.073)
AGE3^2		-6.83E-05 (0.000)
ANOGMOB		-0.683** (0.345)
EDGMO		-0.706*** (0.189)
EDTR		0.312* (0.172)
EX1		-0.490** (0.226)
EX3		-1.146*** (0.332)
INCGMO		1.15E-05 (6.45E-06)
INCOME1		7.32E-06 (5.48E-06)
INCOME3		-1.09E-05 (7.86E-06)
INCTR		6.94E-06 (6.44E-06)
INCTR1		-6.49E-06 (5.65e-06)
KIDGMO		-0.135 (0.326)
KIDP		-0.027** (0.014)
KIDTR		0.969*** (0.319)
ORGANGMO		0.764** (0.351)
ORGANIC1		-0.147 (0.269)
ORGANIC3		0.598 (0.416)
ORGANTR		0.295 (0.335)
RED1		0.402 (0.254)
RED3		-0.921*** (0.347)
Log likelihood	-556.7602	-493.0715
Pseudo-R^2	.08145	.17408
Number of observations	840	840

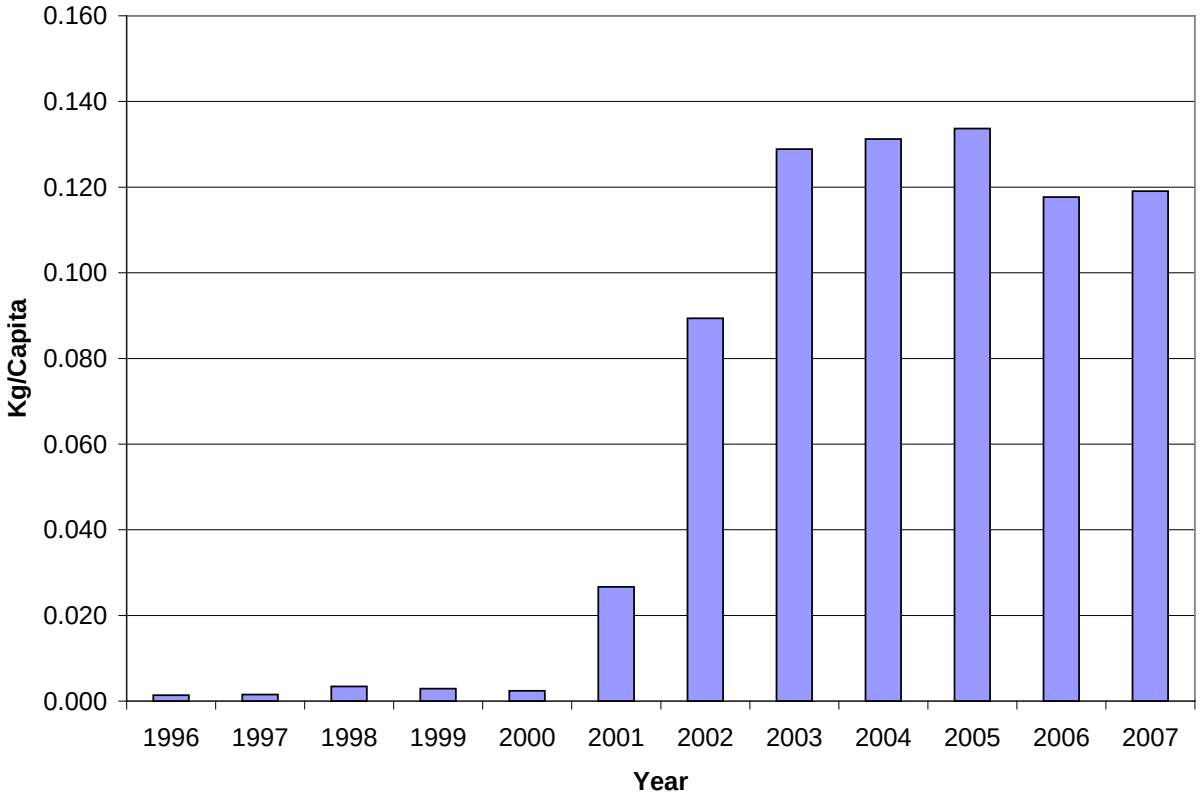
*, **, *** significant at the 10%, 5% and 1% significance level, respectively.

Table 5: Marginal willingness-to-pay measures for farm origin traceability and non-GMO labeling[1]

Labeling Attribute	Model 1	Model 2
MWTP-Farm Origin Traceability $/kg	$1.28	$2.91
MWTP-No GMO labeling $/kg	$5.03	$10.04

[1] Model 1: MWTP measures are computed using equation 4. Model 2: MWTP results are computed for each individual based on the design variables, the relevant interaction terms and including demographic responses in the utility change. The individual WTP measures are then averaged across the sample.

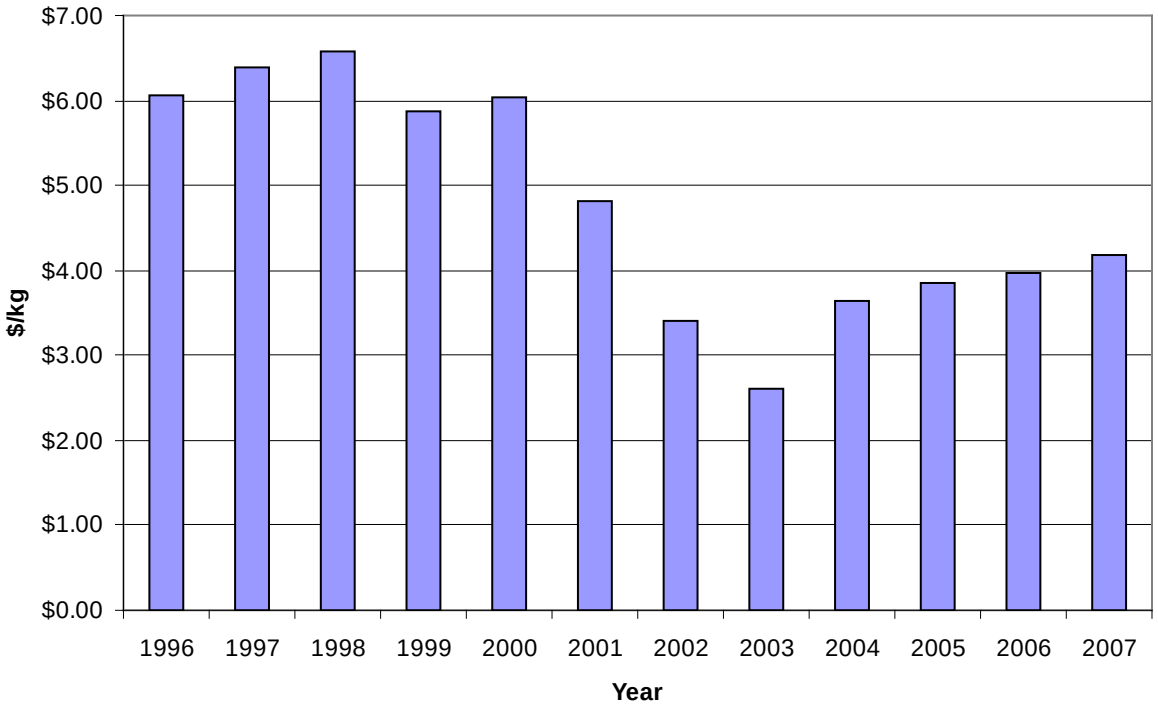
Figure 1: Canadian Bison Per Capita Disappearance (available for consumption*)



Source: AAFC (2008).

* Statistics Canada defines "consumption" as bison meat available per capita adjusted for losses, and "disappearance" as bison meat available per capita *not* adjusted for losses. Therefore, disappearance is defined as the product available for consumption, while consumption is an estimate of the product actually consumed by the population (CMC 2008).

Figure 2: Canadian market Bison prices (hot hanging weights, average price $/kg)



Source: Canadian Bison Association (CBA 2008)

Figure 3: Specifications of regular beef steak purchase attributes and levels

Features	**Level of feature**			
Price per kg	☐ $13.99/ kg	☐ $15.99/ kg	☐ $22.99/ kg	☐ $28.99/ kg
Fat	☐ trimmable	☐ 1-5% visible (not trimmable)	☐ 6-15% visible (not trimmable)	☐ 16-50% visible (not trimmable)
Guarantee of farm origin traceability	☐ yes		☐ no	
Guaranteed produced without genetically modified organisms (GMO)	☐ yes		☐ no	

Figure 4: An example choice set from the choice experiment

Product features	**Choice A** *Your regular beef steak purchase (as in Question XY)*	**Choice B** *Bison steak*	**Choice C** *Neither my regular beef steak nor the bison steak*
Fat:	*(as selected in Question XY)*	6-15% visible fat (not trimmable)	
Certified label gives guarantee of farm origin traceability:	*(as selected in Question XY)*	Yes	
Certified label states: *"Guaranteed produced without genetically modified organisms (GMO)"*	*(as selected in Question XY)*	No	
Price:	*(as selected in Question XY)*	$15.99/kg	
I would choose:	☐Choice A	☐Choice B	☐Choice C