

THE IMPACT OF INFORMATION
ON WILLINGNESS-TO-PAY
FOR BISON

A Thesis Submitted to the College of Agriculture
in Partial Fulfillment of the Requirements
for the Degree of Master of Science
in the Department of Agricultural Economics
University of Saskatchewan
Saskatoon

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ABSTRACT

The bison industry has limited resources for increasing market share. Exploring how consumers react to information about bison and discovering what people know about bison is important to determine the most efficient way to increase market share and ensure the sustainability of the bison industry.

This thesis examines the impact of three different information treatments on willingness-to-pay for bison. The three treatments are a nutritional comparison chart of negatively-perceived nutrients, a bison taste testimonial from a chef and a statement concerning the absence of growth hormones and antibiotics in the processed bison product used in the research. The hypothesis tested is that nutritional information about bison would elicit the greatest increase in willingness-to-pay for the processed bison product.

A random n th-price auction was conducted in December 2002 in Guelph, Ontario with 57 participants to elicit willingness-to-pay values for the processed bison product. Participants' initial bids for the processed bison product were elicited without being given any information and a second round of bidding was conducted once participants had reviewed an information treatment. The mean difference in the bids between round two and round one are \$0.221 for the nutritional comparison treatment, \$0.210 for the taste testimonial treatment and \$0.185 for the natural aspects treatment. ANOVA results indicate no statistically significant difference between the mean difference in bids between the three treatments. Further analysis with a regression model using the difference in bids as the dependent variable, dummy variables representing treatment types and survey data for the other relevant

independent variables, shows that the coefficient for the nutritional comparison treatment is not significantly different from zero. Therefore, the hypothesis that nutritional information about bison would elicit the greatest increase in willingness-to-pay for the processed bison product has been rejected. The other independent variables examined in the regression are not significant.

This thesis does not clearly indicate which information treatment would be the most effective for the bison industry to utilize in a bison information campaign. However, each information treatment did increase the group mean willingness-to-pay so any information relevant to consumers about bison may be beneficial in increasing market share for bison products. Industry participants may need to work together to simultaneously increase awareness, distribution and consumption of bison products to ensure the sustainability of the bison industry.

ACKNOWLEDGEMENTS

I owe a debt of gratitude to the many groups and individuals who contributed their time and effort into assisting me with the completion of this thesis. First and foremost is my thesis supervisor, Dr. J.E. Hobbs, who spent countless hours directing me to the final goal of successful completion. Without her guidance this experience would not have nearly been as rewarding as it has been. I would like to thank my thesis committee members, Dr. W.A. Kerr and Dr. P.J. Shand, who assisted every page of the way and helped me to clarify different aspects within the thesis. To my external examiner, Wayne Robinson, who brought a new perspective to my research. Dr. Marshall Patterson and Nial Kuyek of the Saskatchewan Bison Association who provided insight into the bison industry and for funding the project through the Canada-Saskatchewan Agri-Food Innovation Fund. Sandra Pitts and the Compusense team in Guelph, Ontario for their professionalism and great facilities. Jag Dhanda, Paul Rogers and Ryan Sefton of the Specialty Livestock Value-Added Program for developing the processed bison products used in this research. Dan Prefontaine and Vince Neiser of the Saskatchewan Food Industry Development Centre for assisting in product development and for manufacturing the processed bison products. Finally, I thank my wife Lori for her unfaltering support in my endeavour of higher education, and my daughter Amelia, for whom I will continue to endeavour in all things great and small.

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1. INTRODUCTION

1.1 Background

The bison industry has finite marketing resources and these resources must be utilized as efficiently as possible to foster the industry's expansion. Over the last decade, bison consumption in North America has not kept up with the rapid pace of bison production. This disproportionate growth between production and consumption has caused an increase in bison meat inventories and a decrease in livestock values. Consumption of bison needs to increase to ensure the sustainability of the bison industry.

Information is the key to understanding what motivates the consumer to decide to purchase or not purchase bison products. This thesis will focus on different types of information about bison and examine changes in consumers' willingness-to-pay for a processed bison product once they are better informed about the product. The results of this thesis could potentially be used to help realign the bison industry's finite marketing resources behind a specific information type to increase demand for bison most efficiently. Continually focusing on the consumer and the information to which the consumer has access is the best way to ensure a successful bison industry in North America.

This thesis is part of the second phase of a four phase Bison Marketing Project being conducted on behalf of the Saskatchewan Bison Association by the

Specialized Livestock Marketing Research Group, Department of Agricultural Economics, University of Saskatchewan, the Specialty Livestock Value-Added Program, University of Saskatchewan and the Saskatchewan Food Industry Development Centre, Saskatoon. The second phase of the Bison Marketing Project has been developed using the results of the analysis of the first phase data as found in Hobbs and Sanderson (2002). Upon analyzing the initial data, two locations were selected and two value-added bison products were developed to continue the research in the second phase. The two locations were chosen based upon displayed willingness-to-pay for processed bison products in the laboratory experiment in the work done by Hobbs and Sanderson (2002) and the large target populations in the respective regions. Due to limited monetary and time resources this thesis focuses on one location and utilizes one processed bison product.

The processed bison product used was one that utilized certain portions of the bison carcass that are not currently being marketed successfully, had a high sales potential in the target market as identified from the initial results, and was in a form most conducive to the experiment treatments developed in this thesis. The consumer research was conducted in December 2002 in Guelph, Ontario, as the bison industry has identified Ontario as a potential target market.

This thesis is concerned with examining how information about bison impacts willingness-to-pay for a processed bison product. This will be done by examining willingness-to-pay elicited through an experimental auction when consumers are provided with specific information concerning bison, as identified in previous bison research, and presented in specific formats.

1.2 Problem Statement

Information is the key to marketing. Sanderson (2001) stated that, “Lack of information could be negatively influencing the consumers’ decision to purchase and consume bison meat products” (p.146). The key informational factors identified, by examining Hobbs and Sanderson (2002) and past bison research, that could influence purchasing behaviour are:

- 1) Search attributes – finding bison in the marketplace to purchase;
- 2) Credence attributes – no growth hormones; low in fat, cholesterol and calories; high in protein, iron and other essential nutrients; bison are ranch-raised and are not extinct or endangered;
- 3) Experience attributes – bison palatability: positive attributes of being tender, moist and flavourful.

It is also important to remember that the majority of consumers have not tried bison. Hobbs and Sanderson (2002) identified that 49% of all respondents in their study had never tried bison and in Ontario almost 70% of the respondents had not tried any bison products. Any information presented to consumers’ needs to overcome their lack of bison knowledge and inexperience with the product to persuade an initial purchase.

Therefore, the problem this thesis will explore is “What information about bison is most important in influencing willingness-to-pay for a processed bison product?”

1.3 Hypothesis

Willingness-to-pay is affected by the amount of product information that is available to the consumer (Lecocq *et al.*, 1999). Consumers with greater information, which is perceived to be positive, about a product will pay more for it than a consumer who is only partially informed. It is important to examine how willingness-to-pay is affected due to the type of information to which consumers have access. Consumers must be presented with relevant and credible information in an easy to understand format. The information is then relevant in eliciting a response from the consumer in the form of willingness-to-pay.

Currently, a primary concern in North America is the high percentage of overweight and obese people, both adults and children. It is a concern because of numerous health problems associated with obesity and the strain these health problems are adding to already limited healthcare resources. Government, social welfare groups, health care professionals and media attention has brought this problem to the forefront. This issue is causing a paradigm shift in the way people think about food. Similar to the link between the awareness of the negative effects of smoking cigarettes and the decline the tobacco market has faced domestically, consumers are becoming increasingly health conscious and it may be possible to differentiate bison on the basis of nutritional advantages over substitute meat products. Therefore, the hypothesis to be tested in this thesis is:

Ho: providing nutritional information about bison will elicit the greatest increase in willingness-to-pay for the processed bison product

1.4 Objectives

Developing industries, such as the bison industry, typically have limited resources for marketing initiatives. Therefore, the most important attributes need to be identified and researched so limited resources can potentially be utilized effectively.

The main objective of this thesis is to examine the hypothesis and how different information influences consumer willingness-to-pay for a processed bison product. How this information can be utilized by the industry to market bison products in general will also be discussed, as will further bison research opportunities.

1.5 Organization

This thesis is organized into five chapters: Introduction, Research Background and Literature Review, Theoretical Framework, Empirical Analysis and Summary. References and appendices are attached at the end.

The Introduction has presented the background for the thesis, the problem statement, hypothesis and objectives.

In the second chapter, Research Background and Literature Review, past bison research will be summarized, the economics literature pertaining to consumer information costs with respect to various product attributes and utility maximization will be summarized. Evidence on the effect of nutrition information and formats and the role of claims and spokespeople will be presented. A review of this research is important for several reasons. By examining previous bison research that directly

examined consumer attitudes, perceptions and preferences towards bison, replication of research can be avoided and knowledge increased about the bison consumer. The economics of consumer information costs is researched as it concerns search, credence and experience attributes and how consumers maximize utility. A review of research concerning nutritional information quantity, quality and format, as well as, a review of spokesperson and product claim research is presented. This research directly relates to conveying messages about bison to potential bison consumers.

Chapter 3, Theoretical Framework, contains a review of willingness-to-pay literature, including applications through experimental auctions. The chapter also discusses the random n th-price auction, introduces the three experiment treatments and develops the model to be used in this thesis. Experimental auctions have been used for nearly 40 years in economic research and are an effective tool in eliciting consumers' willingness-to-pay for goods with different attributes. The random n th-price auction is one variation, or improvement, of the experimental auctions introduced in the mid-1960s that are discussed in this thesis. The economic model is also outlined in Chapter 3.

Chapter 4, Empirical Analysis, presents the experiment and the empirical model upon which the analysis is based. All parts of the experiment are introduced and explained; this includes the experiment design, experiment organization and the experiment protocol. Socio-economic data concerning the experiment subjects and to be included as independent variables in the model is discussed and compared to Canadian averages. Data on participants' previous knowledge of certain broad aspects of bison to be used in the model is also reported. The research data is

presented and examined using regression analysis to test the hypothesis in the Introduction. Additional regressions are conducted for each experiment treatment to examine additional independent variables. Regression results are discussed, as are potential industry applications. Empirical results are then summarized.

The Summary, the last chapter of the thesis, discusses what was found in the thesis, potential problems of the research experiment and any further potential research that could be conducted concerning this topic.

2. RESEARCH BACKGROUND

2.1 Introduction

In this section of the thesis, previous bison marketing research is reviewed, with a particular focus on the Hobbs and Sanderson (2002) research for the Saskatchewan Bison Association Bison Marketing Project upon which this research builds. A literature review is also presented concerning consumer information costs with respect to search, credence and experience attributes; a review of consumer utility maximization; research conducted on nutritional information and format, and; a literature review of research on product claims and spokespeople. The information contained in this section was used to formulate the treatments used in the willingness-to-pay research experiment.

2.2 Bison Research

By reviewing the data concerning consumers' preferences and attitudes towards bison in Hobbs and Sanderson (2002), the information most important to potential bison consumers can be identified. The earlier project examined bison in three different ways. First, a taste panel was conducted with respondents to examine their acceptance of four different bison products. The bison products sampled included: bison patties, bison kabobs, bison stew and sliced bison deli roast. Participants tasted the products one at a time and filled out questionnaires

concerning taste/flavour, juiciness, tenderness, overall acceptability, stated willingness-to-pay in comparison to a similar beef product and asked where they would be most likely to purchase the particular product. Once all the products had been sampled, the respondents were asked to rank the four products. Second, participants completed a survey to discover their perceptions about bison and the bison industry.

Third, an experimental auction was performed to measure willingness-to-pay for different bison attributes such as production methods and fat content. Vickrey's second-price auction (Vickrey, 1961) was conducted to elicit willingness-to-pay for four different bison sandwiches relative to a beef sandwich. The four bison sandwiches were labeled as: bison sandwich, bison sandwich 60% lower in fat than the beef sandwich, bison sandwich produced without growth hormones and bison sandwich 60% lower in fat and produced without growth hormones. Each participant was given a comparable beef sandwich and they were asked to bid the difference in price they would pay to exchange their beef sandwich for one of the four aforementioned bison sandwiches. The auction consisted of ten rounds bidding on the sandwiches sequentially per round. After the bids were collected for a round but before the next round of bids could be made, the lab monitor would announce the second-highest bid as the market price. The market price is the endogenously determined price that particular sandwich would have sold for in that round if it was chosen as the binding round. Participants could then choose to either use or ignore this information. This continued until all the rounds were completed. Upon completion of the auction a four-sided die was used to determine which of the four

sandwiches would be awarded and a ten-sided die determined the binding round. This was all explained to the participants before the start of the auction so they all understood only one sandwich would be exchanged. A complete discussion of Vickrey second-price auctions is presented in Chapter 3 of this thesis.

From the consumer surveys, Hobbs and Sanderson (2002) found that nutritional content, fat and cholesterol were considered important by the majority of respondents in a meat purchase decision and 79% of respondents perceived bison as a healthy meat. After tasting the four value-added bison products, approximately 25% of the respondents perceived bison to taste “wild”, tough and dry. Another 25% of the respondents neither agreed nor disagreed when asked about their perceptions of these three attributes. When examining knowledge of bison production, 50% of the respondents either thought bison was an endangered species or did not know. The negative taste and the endangered species perceptions have potential implications for the marketing of bison products.

When the laboratory auction was conducted to determine respondents' willingness-to-pay, it was discovered that respondents were most willing-to-pay for the bison sandwich 60% lower in fat and produced without growth hormones. The range over the ten bidding rounds of willingness-to-pay for this particular bison sandwich over a similar beef product, averaged for the full sample, was \$0.63 - \$1.07. The Vickrey second-price auction experiment demonstrated that as participants were given more information concerning the bison sandwiches they increased their willingness-to-pay. The context of the information provided to consumers is important and the survey identified areas of consumer perception that

may need to be addressed to increase the market share of bison, particularly perceptions regarding palatability, nutritional aspects and bison production.

Similar findings concerning palatability, nutritional aspects and the endangered species issue were discovered in the thesis completed by Sanderson (2001). The thesis employed the use of conjoint analysis – a stated preference technique – although a taste test was not conducted. In addition to the conjoint analysis, respondents were asked how important certain attributes were in a meat product. The findings, in order of importance, were: flavour, tenderness, juiciness, availability, price, protein level, convenience, fat, and cholesterol. Some of the least important attributes were: special occasion meat, locally produced, organic, novelty and unique to North America. In addition, many respondents had a positive image of bison being indigenous to North America but a negative image of bison being an endangered species. Those who had never tried bison perceived the meat to be tough, “wild” tasting, dry and not particularly healthy. Sanderson (2001) suggested having positive articles published on bison products from culinary professionals who could provide testimonials about how good bison tasted. This suggestion will be explored in this thesis.

In another research study on bison, conducted by Torok *et al.* (1998), a taste panel was conducted in a restaurant to identify characteristics of potential bison consumers and to develop potential marketing strategies for restaurants. Participants for the study were asked to meet at an upscale Colorado restaurant for a taste test. At no time during the recruitment or introduction to the taste test were participants told what types of meat were being served (grass-finished bison, grain-finished

bison, beef and deer) or that they were part of a bison research study. The study had five surveys. Survey 1 collected demographic information, survey 2 involved a blind taste test and evaluation of the four meats, survey 3 was the same except the meats were identified, survey 4 collected information on participants' food and eating habits and survey 5 asked for the evaluation of various promotional materials.

The research discovered that potential bison consumers had the following characteristic dimensions: variety meat eaters (ate a wide variety of meats such as fish, pork, turkey, chicken, lamb, beef and game meats), enjoyed game meat (such as elk, deer, moose), were health conscious and would eat bison on special occasions. Two suggestions came out of this research for marketing bison products in restaurants. The first was to stress the health aspects of bison products and the second was to use a health conscious advertising spokesperson such as a famous fitness expert or professional athlete to promote bison products. These suggestions will be utilized in a slightly adapted form in this thesis.

Concerning the other reported characteristic dimensions, it was identified that women would not typically be game meat eaters but men were more inclined to consume game meat. Marketing bison as game meat however may not be beneficial when targeting a wide audience, especially since women are the primary shoppers. Identifying variety meat eaters as likely to accept bison is also not particularly informative. Variety meat eaters may simply be more health conscious and wish to eat a variety of meats to ensure proper nutrition. Consuming bison for a special occasion was also identified by Torok *et al.* (1998) as a dimension to be used in marketing bison to potential consumers. This is an interesting observation but is not

within the scope of this thesis to examine, as special occasions are difficult to replicate experimentally.

Therefore, the information most important to consumers concerning bison, as identified by previous bison marketing research, is palatability, nutritional aspects, production methods and the negative endangered species image. This thesis will examine these issues. The next section will examine product attributes, food quality indicators and transaction costs.

2.3 Product Quality Attributes and Transaction Costs

Consumers gather, interpret and act upon information available to them to maximize their expected utility in regards to their preferences. In the preceding section, previous bison research was examined, important information for consumers concerning specific bison attributes has been identified and this information can be provided to consumers to affect purchasing decisions. However, information is not costless and credibility needs to be established for each attribute. Establishing credibility for some attributes is easier than for others. Product attributes fall into three information categories: search, experience and credence.

Credibility for search attributes is established immediately, as these are the attributes consumers use in identifying a product before purchasing. This may include product colour and packaging. Attributes consumers identify while consuming the product are called experience attributes. Experience attributes may include taste, tenderness and product convenience. Credibility for experience attributes will be established during consumption so firms must be sure claims are

accurate, or lose customers. Credence attributes are unidentifiable before, during and after purchasing and consuming the product. Credence attributes may include nutritional or hormone-free claims. Claims related to credence attributes generally need to be made by a reputable firm or have reputable third party assurances to be considered credible by consumers. All three of these attributes signify quality to the consumer.

Caswell *et al.* (2002) developed a unified quality framework utilizing the three intrinsic quality attributes identified above. A slightly modified Food Quality Framework is presented in Figure 2.1.

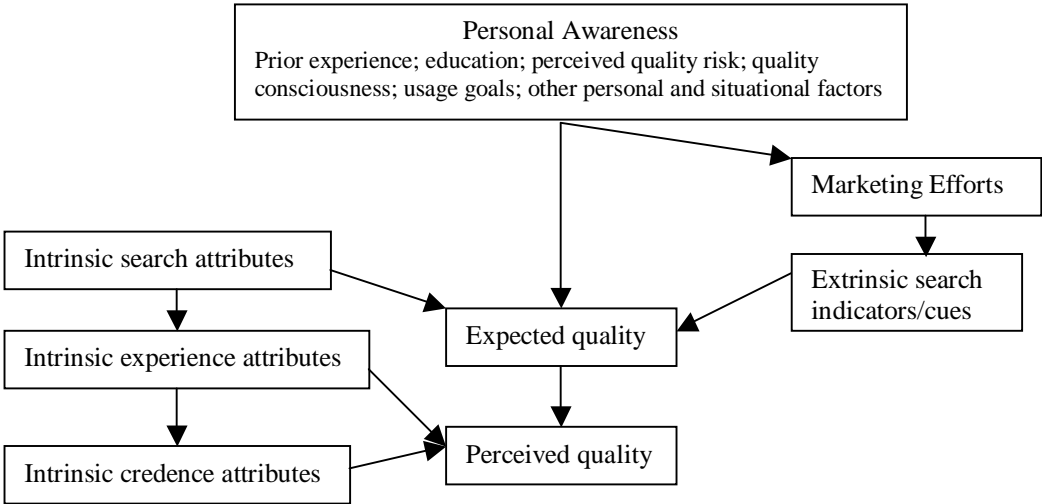


Figure 2.1 – Food Quality Framework (as adapted from p.55 of Caswell *et al.* (2002))

This model represents the quality perception process for consumers. It is assumed that every product has an array of intrinsic quality attributes, search, experience and credence, which exist in a buyer’s information environment. However, each buyer may classify the information as a different intrinsic quality attribute depending on the benefit and cost the buyer faces in gathering the information and using it in a purchase decision. In addition to the intrinsic quality

attributes, products have extrinsic indicators/cues to facilitate purchase decisions. Intrinsic search attributes and extrinsic indicators/cues can influence quality expectations. Extrinsic indicators/cues also influence expected quality and are especially important for credence attributes. By using a credible system (i.e. third-party verification) to verify information provided to consumers, intrinsic credence attributes could be used as a marketing tool in the form of extrinsic indicators/cues. Possible intrinsic attributes and extrinsic quality indicators/cues for a processed bison product are listed in Figure 2.2.

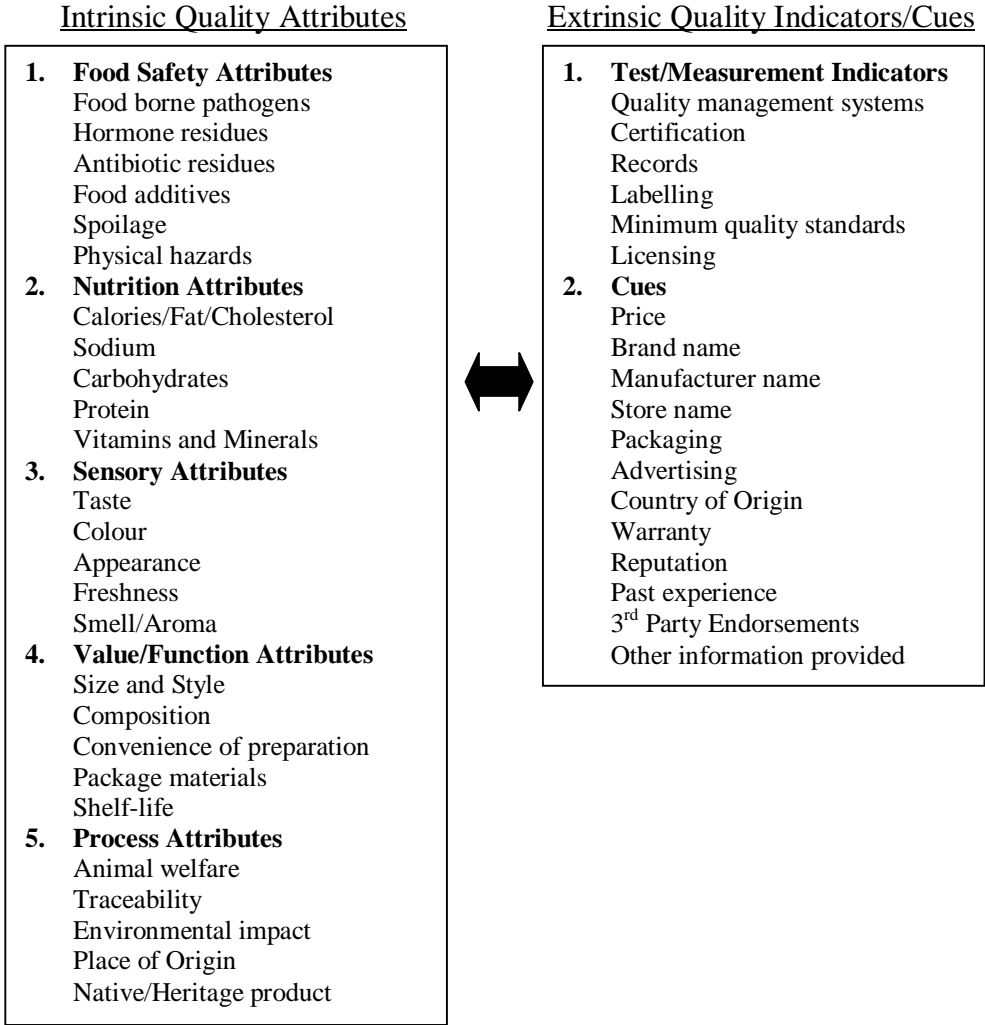


Figure 2.2 – Intrinsic/Extrinsic Attributes (as adapted from p.57 of Caswell *et al.* (2002))

These lists are not divided into search, experience and credence attributes for several reasons. Different attributes fall into different categories for different buyers depending upon the cost to them of gathering, interpreting and/or analyzing information about product quality. Technology may also change the classification of different attributes, as can information provided by marketers if it reduces transaction costs for consumers and is credible. Later in this chapter the credibility of intrinsic quality attributes presented in different information formats to act as extrinsic indicators/cues will be discussed. This discussion will be utilized in formulating the experiment treatments for this thesis where the intrinsic attributes of nutrient data and palatability will be used as extrinsic indicators/cues to elicit willingness-to-pay. Converting these intrinsic credence and experience attributes into credible extrinsic indicators/cues reduces transaction costs for consumers.

Transaction costs are the costs of carrying out an exchange (Hobbs, 1996) and can be divided into three main classifications of: information, negotiation and monitoring costs. Consumers incur information costs before an actual exchange is made. Information costs include searching for the desired product, obtaining information about the product and price discovery. Negotiation costs arise from physically carrying out the exchange between the buyer and seller. Monitoring costs arise once the exchange is agreed upon to ensure both parties receive what was negotiated for. The information cost classification is the only one of concern in this thesis and information can be further divided into the product attributes previously mentioned: search, experience and credence attributes. This is the link between the Food Quality Framework, intrinsic indicators transformed to extrinsic

indicators/cues, and transaction costs. Transaction costs can be reduced for consumers by providing information affecting preferences for the product and that information must be credible. Improving information about important product attributes reduces transaction costs for consumers, increases utility and entices more product purchases and/or higher prices. Thus, this thesis is examining willingness-to-pay for a processed bison product when consumers are provided with specific information that is targeted at decreasing their information/search costs and enhancing their utility in consuming the product. Consumer utility maximization will be presented next.

2.4 Utility Maximization

Consumers derive utility from purchasing and consuming goods. Consumers choose foods in order to obtain greater expected utility. Part of that utility is derived from using food to maintain or improve health (Caswell and Mojduszka, 1996). Another part of that utility is derived from the pleasurable experience of consuming palatable food. This thesis will examine both of these components with the willingness-to-pay that results from maximizing utility with respect to the presented information. If consumers are willing to pay more for a processed bison product when presented with specific information about bison, then they must be deriving some additional utility from purchasing the bison as opposed to not purchasing it as measured by willingness-to-pay. The higher the willingness-to-pay, the more expected utility the consumer is deriving from the bison due to the information presented to them. For example, the utility of consuming one unit of food,

considering it is a small expenditure, could be represented as $U_f = U_i + U_o - p_f$. Where U_i is the utility derived from characteristics unique to this particular food product. This could be information about nutrition, taste, product treatment, ingredients or a multitude of other factors making the product unique. U_o is utility from unspecified characteristics of food that are equal between perceived substitutes and p_f is the price of one unit of food. If the information about bison increases U_i , by an amount greater than or equal to the change in p_f , then the utility from consuming one unit of bison is greater than or equal to consuming a substitute product. So if $\Delta U_i \geq \Delta p_f$, then $U_{\text{bison}} \geq U_{\text{substitute}}$. This utility theory can also be applied to the research experiment in this thesis. If the information presented about the processed bison product increases the utility of consuming the product, participants will place a higher value on the same product. Also, greater utility translates into greater willingness-to-pay, which is more demand.

Research conducted on the amount, quality and presentation of nutritional data will be discussed next and will be utilized in forming one of the experiment treatments to be used in this thesis.

2.5 Nutrition Data & Format

In order to persuade consumers to make an initial purchase of bison they will require information about the product that will maximize their utility and make them willing to pay. The important information for consumers concerning bison has been discussed in the introduction and explored in the bison literature review section. Past research about consumer choice, information load (quantity), quality and format

will now be discussed from the marketing and consumer psychology literature. The research discussed here shows that a consumer's confidence in their decision is directly affected by the quantity, quality and format of information provided to them (Keller and Staelin, 1987). The more confident a consumer is in their choice, the more likely they are to purchase the product. The application of this research on information and format to this thesis will also be explored.

Consumers make choices in order to accomplish goals. Four of the most important goals for consumer decision-making are:

- (a) maximizing the accuracy of the choice;
- (b) minimizing the cognitive effort required to make the choice;
- (c) minimizing the experience of negative emotion when making the choice,
and;
- (d) maximizing the ease of justifying the decision (Bettman *et al.*, 1998).

To facilitate the ease of making a choice about a new product purchase, consumers generally acquire information from product packaging at the point of purchase and consult friends, while salespeople and advertising are the least consulted forms of information for new product purchases (Berning and Jacoby, 1974). These findings demonstrate that consumers want information about new products to be readily available, as on the packaging, and want the information to be trustworthy and easy to understand so they consult friends.

Reducing the cost to consumers of searching for and processing new product information is vital in persuading initial sales. In Hobbs and Sanderson (2002), it was identified that the main reason consumers had not purchased bison was because

it was not available where they normally purchase groceries. The search cost was too high for them to acquire bison at another location. This is largely a supply chain problem. Once bison is available more readily in the restaurant or grocery store, consumers must be able to easily acquire information about the new product. Consumers need information on which to base their decisions but the effort they put into finding and understanding the information is a cost and they are working under bounded rationality (Bettman and Zins, 1979). Bounded rationality essentially means limited cognitive ability, as all humans are not able to process all information available to them (Hobbs, 1996).

Research on information load has demonstrated that consumers prefer more information but it does not always bring about a change in understanding or purchase behaviour. Muller (1984) found that varying the information load on nutrition signs in a supermarket (signs were hung in the aisles) over a two-week period produced no systematic shifts in purchase behavior. Scammon (1977) examined information load on two food products. The amount and format of information was varied and subjects were asked to identify the nutritionally superior brand – not the preferred brand. There was no evidence of an increase in the selection of the most nutritious brand resulting from increases in attribute information. Information has two components and each has a different effect (Keller and Staelin, 1987). As the information load increases there is diminishing marginal effectiveness, keeping information quality fixed. Decision effectiveness increases as the quality of information is increased, keeping information load fixed. Therefore,

decision effectiveness is adversely affected by increasing the quantity of information and fostered by increasing quality.

Jacoby *et al.* (1977) studied nutritional information on packaging of a few specific products and found that most consumers neither acquire nor comprehend nutrition information when arriving at food purchase decisions. However, since this research was conducted there have been continuing government sponsored media campaigns concerning nutrition and health. Since the early 1980s, North American governments have taken a much more active role in linking diet with health and have focused on educating the public on the importance of a balanced diet (Chern *et al.*, 1995). Scammon (1977) concluded in his paper that an education campaign could educate people on the value of good nutrition as a food selection criterion and demonstrated that information format did influence consumer decision-making when they had been educated.

Research since the 1980s has demonstrated that nutrition information sells products and displaying this information in the most useful format for purchase decisions is important for product sales (Geiger *et al.*, 1991). Results on research of the cereal market by Ippolito and Mathios (1990) indicated that consumers changed behaviour once informed of the health benefits of fibre cereal consumption. Unnevehr *et al.* (1999) also stated that research shows consumer demand shifts in response to new information about the health benefits of existing foods and that willingness-to-pay is a crucial determinant of the incentives for product innovation using emerging health information. This research demonstrates that consumers were not educated about nutrition content of foods in the 1970s and were not concerned

with examining the nutrition labels. Once an education campaign started in the 1980s consumers have become more aware of nutrition and more capable of understanding nutrition labels so it has been used as an effective marketing tool.

Different information formats can make some forms of processing easier, requiring less effort than others (Bettman *et al.*, 1998). Results of the Ford *et al.* (1996) investigation showed health claims and nutrition information influence beliefs about product healthfulness. However, health claims and nutrition information influenced the consumer independently of one another. Health claims projected the image that the product may be healthy but the information on the nutrition label had to confirm the claim and two types of information had to be considered by the consumer. In 1977, Bettman and Kakkar determined that information must not only be available to consumers but also processable. The format in which information is presented determines to a great extent the way information is acquired and used. The key phrase in their paper was, “processability depends on format.” They also stated that the type of product advantage was important. Given an attribute advantage the marketer should structure information to encourage examining the product by attribute (comparative advertising). Or, given an “image” advantage, examining the product by brand or product type is preferred.

A study conducted by Almanza and Hsieh (1995) indicated that attractiveness, ease of use and clear presentation of nutrition information are important factors in consumers’ preference among nutrition labelling formats. Consumers are least likely to use nutrition information if it is not attractive or easy

to use or provide the desired information. Geiger *et al.* (1991) found consumers significantly preferred nutrition information stated in absolute numbers and percentages in a bar graph format. Consumers also preferred nutrition information rearranged in an order that grouped nutrients that should be consumed in adequate amounts on the top, calories in the middle and nutrients that should be consumed in lesser amounts on the bottom of the label. Respondents in the study indicated that they frequently read the label to avoid negatively-perceived nutrients such as calories, sodium, cholesterol, sugar and fat. However, the rearranged order described above was most preferred and the authors reported consumers found that format easier to read due to the breaks between the information and wanted to have the label divided between the perceived positive and negative nutrients.

Many consumers are concerned with negatively-perceived nutrients and strive to avoid or reduce consumption of various attributes, including calories, cholesterol, sodium, sugar and various chemical additives. However, basing a brand purchase decision on nutrition information is difficult because consumers must collect, comprehend and compute the information, which results in a high search cost. An information format to reduce search costs is a comparison of nutrition information between competing brands in a single list. There are low perceived benefits of positively-perceived nutrients and consumers can take multivitamins or other food supplements to compensate for any dietary deficiencies. Negatively-perceived nutrients may be more likely to cause a change in purchase patterns since consumers attempt to avoid them (Russo *et al.*, 1986). Decreasing processing effort will always be an important strategy for making information provision programs

more successful. The format features that have the greatest impact are those that reduce the effort of processing information – namely summary indicators and percentages (Levy *et al.*, 1996). Study results of Byrd-Bredbenner (1994) indicated that:

- 1) formats presenting data in the form of both absolute measures and percentage standard can substantially enhance the ability of the consumer to locate, manipulate and compare label data, and;
- 2) adding benchmarks (i.e. daily reference values) to formats utilizing absolute measures can enhance consumers' abilities to interpret label information accurately and make appropriate dietary management decisions.

The nutrition label is an important educational tool for conveying information that consumers can use to make informed food choices that promote optimal health (Byrd-Bredbenner, 1994).

Consumers utilize more nutrition information when it is presented in an easily processed form. Information detailing the consequences of not getting a certain nutrient in enough quantity is one easily processed form. As “consequence information” becomes more emotionally charged and specific in its instructions, consumers are more motivated and able to process information, elaborate upon it to a greater extent and make better decisions. Consequence information communicates the relationship between product-level attributes and consumer consequences.

Consequences are defined as any result accruing to the consumer from their behaviour. Consumers find the consequence associated with negatively-perceived nutrients (fat, cholesterol, calories) more relevant than those nutrients judged more

positively (protein, vitamins, minerals) (Moorman, 1990). Messages act to emotionally motivate consumers and then the consumer can be given a way to minimize the hazard communicated to them. Nutrition disclosures containing negative consequence information that is motivational and that offers remedies to overcome or avoid the consequence should increase consumers' need for information about the relevant attribute. The result of discovering more information to avoid negative consequences is higher decision quality. Disclosures that are less motivational and specific in guidance result in decisions that are of a lower quality. Moorman (1990) concluded that, "Nutrition disclosures containing reference information and consequence information evoke higher information comprehension and higher decision quality than do disclosures not containing both types of information" (p. 368).

To convey reference and consequence information quickly and easily to consumers, a statement is sometimes used on product packaging or in advertising. A discussion of research conducted on statement and claim sources is presented below and will be used as one of the experiment treatments in this thesis.

2.6 Statement Source

Media and government attention, directed to the links between diet and health in general, have made consumers more conscious about the foods they eat (Chern *et al.*, 1995). Over the past 35 years consumers have become more conscious about the relationship between fitness, diet and health. There is

widespread acceptance that regular exercise and proper nutrition are essential to good health (Bennett and McCrohan, 1993).

To capitalize on the free promotion from the media and the government on healthy eating, food companies have used product endorsements from impartial third parties to promote their products with healthy attributes. Research has shown that product endorsements from impartial third parties have a high degree of credibility when they exhibit both “expertness” and “trustworthiness”, they are more effective in persuading consumers to use the approved product (Bennett and McCrohan, 1993). An example of an impartial third party is the government.

Although consumers tend to believe government-mandated information on food labels (Mazis and Raymond, 1997), some companies have used celebrity figures to promote their products. Ads with claims featuring celebrity figures produce more favourable ad evaluation ratings and product image, but not believability of the ad or the likelihood of purchasing (Atkin and Block, 1983) but claims made by experts in their field are generally believable and do increase the likelihood of purchasing (Frieden, 1984).

It has been shown that nutrition information on food packaging is often difficult for consumers to understand (Rayner *et al.*, 2001). Using advertising endorsements or claims on packaging can be used to create positive product attitudes. Claims are assertions about product features and/or performance consequences presumed to be beneficial to members of the target audience (i.e. Two Tums a day can prevent osteoporosis.). However, stating product claims provides no guarantee that people will believe those claims and any claims on packaging must

adhere to strict government regulations in Canada. Canada introduced new labelling regulations in January 2003 (Medicinal Food News, 2003). These new guidelines expand upon the previous guidelines on the types of health claims allowed.

Advertisers must work within these new regulations and to encourage consumers' acceptance of claims, advertisers may provide arguments as rationale for the claim. The simplest form of argument is an assertion of factual evidence such as a nutrition fact (i.e. Tums is packed with calcium.). Arguments are offered to ensure consumers believe claims. Warrants can be used to give the argument structure. Warrants are statements of general knowledge that explain the relationship between an asserted claim and its supporting evidence (i.e. Calcium aids in healthy bone development.). However, the regulations do not allow for statements that make therapeutic claims (i.e. Tums is one of the best lifelong defences against the pain of brittle bones and a stooped back that come from osteoporosis.).

Affective tagging is an effective way to transform consumers' beliefs about claimed product features and consequences into benefit beliefs (e.g. declarative tag – "That's a good feature" or a rhetorical tag – "Isn't that a good feature?"). Affective tags are end-of-argument sentences that state the desirability of the feature to:

- 1) transform consumer product beliefs about product attributes into benefit beliefs, and;
- 2) direct consumers to form product attitudes.

Rhetorical tagging may adversely affect consumers' evaluation of product claim desirability if it is perceived to be highly pressuring or presumptuous, as the tag

disrupts the consumers' ability to process the tag to recognize the product claim is beneficial, so declarative tags are generally used (Munch *et al.*, 1993).

Research has suggested that consumers are generally skeptical of advertising claims but Kellogg's All-Bran, which featured messages about the benefits of a high-fibre, low-fat diet in reducing the risk of some types of cancer, gained a 47% market share in the U.S. in 24 weeks (Mazis and Raymond, 1997). An explanation of this large increase in market share may be that the message motivated or emotionally activated consumers and provided them with a way to minimize the risk of cancer. If this explanation is accurate, Kellogg's increase in market share demonstrates how nutrition disclosures containing negative consequence information, that is attention grabbing and that offers remedies for overcoming the negative consequences, motivates consumers to make a purchasing decision. The point is that consumers respond to negative information and declarative statements, of which both will be used in this thesis. In other research, instead of motivating a consumer with negative information, product endorsements from health research organizations have been utilized as part of positive health promotion campaigns.

Rayner *et al.* (2001) studied health-related food endorsement programs that identify individual food products as healthy or healthier choices with an on-pack symbol. These programs are becoming popular because, as Rayner *et al.* (2001) reported, a study of consumer understanding of nutrition labelling found that "when asked to read figures from a nutrition label, or make comparisons of nutrient levels between two labels, almost a third of respondents were unable to answer each time" (p. 24). Therefore, operators of food endorsement programs argue that they help

people make healthier food choices and also impact product development by encouraging food manufacturers to alter the nutritional composition of their foods in beneficial ways (Tobin *et al.*, 1992). Rayner *et al.* (2001) discovered that when consumers in their study were doing their everyday shopping there was limited use of endorsements. When the researchers asked the same consumers a week later to shop healthily there still was a limited use of endorsements. Consumers who did use the endorsements looked for evidence to support the endorsement rather than putting all their faith into the endorsement, as it was just another piece of information to be gathered and interpreted. Rayner *et al.* (2001) concluded that the nutrition panel on the product label was the most used source of information in making healthy purchase decisions.

The implications for this thesis concerning statement source is that nutrition information is important, and motivating a consumer with negative information is expected to elicit positive purchase behaviour. In addition, the nutrition information must come from a credible third-party source such as a government organization. Using an endorsement from a health research organization and promoting the positive aspects of any particular product may not be as effective as stated in the research outlined in this chapter. Also, any statements made about other aspects of bison must be from a credible and reliable third-party source that consumers trust and view as a possible expert.

2.7 Summary and Conclusions

Past bison research was examined to determine the primary factors of concern to consumers when making a bison purchase. Of those identified, this thesis will focus upon the nutritional aspects, palatability and bison production methods, particularly the absence of growth hormones and sub-therapeutic antibiotics. These factors can be classified as intrinsic indicators of food quality and further classified as a credence attribute (nutritional and production aspects) and an experience attribute (taste). If these factors can be converted to extrinsic indicators/cues consumers can reduce their cost of gathering purchase information and marketers can potentially gain market share. How these intrinsic quality indicators can be converted into efficient and credible extrinsic indicators/cues has also been examined through a literature review in this section.

For the nutritional information factor there is considerable research demonstrating that consumers focus upon the negative attributes of food, particularly fat, calories and cholesterol. Also, Russo *et al.* (1986) reported that negative nutrients may be more compelling to cause a change in purchase patterns, which the bison industry requires for long-term growth. Information load is also important. Keller and Staelin (1987) reported diminishing marginal effectiveness of participant decisions concerning food products as information load increased. They concluded that easily processed formats are generally the most effective as did Bettman and Kakkar (1977), Almanza and Hsieh (1995) and Bettman *et al.* (1998). Format is also important for ease of processing the information. One information format identified by Russo *et al.* (1986) to reduce search costs is a comparison of nutrition

information between competing brands in a single list. Bison competes with other protein sources such as beef, chicken and pork for a share of the consumer dollar, so a comparison with these products would assist consumers in assessing the nutritional quality of bison. To compare the products a bar graph may be most effective because Geiger *et al.* (1991) found consumers significantly preferred nutrition information stated in a bar graph format. The first experiment treatment will be created with this information in mind.

The second experiment treatment will focus on the palatability of bison, drawing on the literature review on statement source. Consumers are more conscious about the foods they eat (Chern *et al.*, 1995) but the food must still taste good. Conveying the taste of a product without actually giving consumers a chance to experience it is the focus for this experiment treatment. In the literature review it was found that product endorsements from impartial third parties have a high degree of credibility, when they exhibit both “expertness” and “trustworthiness”, they are effective in persuading consumers to use the approved product (Bennett and McCrohan, 1993). Research concerning celebrity figures promoting products found that believability of the ad or the likelihood of purchasing did not increase (Atkin and Block, 1983) but claims made by experts in their field are generally believable and do increase the likelihood of purchasing (Frieden, 1984). To be effective the endorsement must also cause consumers to form product attitudes (Munch *et al.*, 1993). However, some research suggests that food endorsement programs that identify foods as healthier choices are not effective in causing consumers to form product attitudes or to even create demand for products with endorsements (Rayner

et al., 2001) so this type of information format will not be utilized in this thesis. The findings concerning endorsement statements will be used to create a statement about the palatability of bison and the statement will be endorsed by an accredited professional chef to create the second experiment treatment.

The third treatment will focus solely upon bison production methods. A statement will be created to inform the reader that the processed bison product being viewed was produced from bison not given growth hormones or fed any sub-therapeutic^{2.1} antibiotics. A source to backup the statement will not be provided, although participants may attribute an implicit source as the University of Saskatchewan since representatives from the University of Saskatchewan will be conducting the experiment. The statement is accurate since the source of the bison meat used to produce the processed bison products was the North American Bison Cooperative (NABC). NABC ensures all the bison it processes are hormone and antibiotic free in two ways. First, members of this cooperative must annually supply an affidavit signed by themselves and witnessed by their veterinarian that the bison shipped to NABC have never received growth hormones or sub-therapeutic antibiotics. Second, a blood sample is taken from every bison processed at NABC to be analyzed at an independent lab to ensure the bison are free of artificial growth hormones and antibiotics. Along with the blood sample, muscle tissue, organ and urine samples are randomly taken by a United States Department of Agriculture veterinarian for residue testing. This is done to meet European Union (EU) shipment specifications and is conducted on every animal. EU shipments are also

^{2.1} Antibiotics provided to healthy animals as a preventative measure against disease.

subject to random residue testing. This information will not be provided to the participants but they will be asked in a concluding survey if they believed the information given to them.

3. THEORETICAL FRAMEWORK

3.1 Introduction

This section of the thesis will discuss willingness-to-pay studies, review the use of experimental auctions to measure willingness-to-pay, present the random n th-price auction used in this thesis, introduce the regression model and discuss how the results are subsequently analyzed.

3.2 Willingness-to-Pay

It is important to know a consumer's true^{3.1} willingness-to-pay (WTP) for a market good in order to estimate demand and in designing optimal pricing schedules. Researchers can measure WTP for existing goods by gathering market data on quantity demanded at different prices and use the data to estimate price elasticities. This method cannot be utilized when examining the market for bison products because bison is not a widely sold commodity and data is not readily available. Data is not readily available because there are few bison sellers in the industry and pricing information is kept confidential. It would also be particularly difficult to evaluate the impact information has on consumers' WTP for bison as the information is completely absent. Therefore, some type of research experiment is required. Researchers have estimated WTP for non-market goods and new goods by

^{3.1} The actual value or worth to the consumer.

eliciting revealed preferences with controlled market transactions or by eliciting stated preferences with methodologies such as conjoint analysis or contingent valuation. However, there are problems with both of these methods.

Controlling prices to elicit revealed preferences in a controlled market setting may not discover consumers' true WTP. This method is conducted with the cooperation of a retailer who allows researchers to change the prices and information about the good they are researching right in the retailers store and then record data on actual purchases. However, the data will only reveal the buyer's WTP is at least as high as the controlled price and a non-buyer's WTP is lower than the price, thus, the true WTP is unknown (Werthenbroch and Skiera, 2002). Not knowing the true WTP prevents marketers from extracting maximum consumer surplus.

Eliciting stated preferences with conjoint analysis or contingent valuation is also problematic (Werthenbroch and Skiera, 2002). Conjoint analysis is a procedure where choice alternatives are presented between products or services as defined by sets of attributes and participants are given a predefined set of choices by the researcher. Conjoint analysis allows the researcher to examine the trade-offs that people may make when purchasing a product. The contingent valuation method involves directly asking people, in a survey, how much they would be willing to pay for specific products or services. It is called contingent valuation because people are asked to state their WTP based, or contingent, on a specific hypothetical scenario and description of the product or service. The contingent valuation method is a stated preference method because it asks people to directly state their values, rather than inferring values from actual choices, as do the revealed preference methods.

The main problem with conjoint analysis and contingent valuation is that there is no incentive for the consumer to reveal their true WTP because the responses are hypothetical. In other words, these methods raise the question of their validity because they are non-observed choices (Combris *et al.*, 2002). Observed choices include market data and the elicited responses in the controlled market settings as outlined earlier.

Trying to discover WTP in a laboratory setting using contingent valuation or conjoint analysis poses two additional problems. First, respondents may inflate WTP to please the researcher, this is known as the Classic Hawthorne effect. Respondents react to the setting they are in and want to feel like they are contributing. Second, if subjects believe that their responses will be used to set long-term market prices, they have an incentive to report a WTP that is less than their true WTP for the product. If they believe that their responses will determine the introduction of a desirable new product, they may feel it is in their best interests to report a WTP that is greater than their true WTP (Wertenbroch and Skiera, 2002). It is important to take these problems into consideration when designing an experimental protocol to elicit WTP as will be done in this thesis.

Applying both approaches of the market transaction and the laboratory survey methods to elicit consumers' true WTP results in the most useful data for both researchers and marketers. Experimental economics is an alternative to the hypothetical approaches by providing subjects with real choices. Experimental auctions, for example, are an efficient way to present people with non-hypothetical choices where they are compelled to reveal their true preferences and the value they

put on new goods (Combris *et al.*, 2002) because the auction can be designed so the individual may have to actually pay his/her bid price for the new good.

Experimental auctions have been preferred to survey methods to elicit hypothetical WTP because it has been found that WTP using survey methods has often overstated real WTP, implying that responses in hypothetical survey circumstances may not be accurate estimates of the responses in real circumstances (Blackburn *et al.*, 1994; Swallow, 1994; Fox *et al.*, 1998; Krieger and Hoehn, 1999;).

3.3 Experimental Auctions

As a way to learn more about potential consumer choice, an experimental auction mechanism can be used to induce individuals to reveal private information contained in their preferences for new goods and services. Experimental auction methods are designed to isolate and control the market setting to address specific questions on how people value new and/or controversial food products (Shogren *et al.*, 2002). Two auction mechanisms will be examined here; Vickrey's second-price auction (Vickrey, 1961) and the Becker-DeGroot-Marschak mechanism (Becker *et al.*, 1964).

Experimenters have typically used Vickrey's second-price, sealed-bid auction to reveal demand (Shogren *et al.*, 1994; Hayes *et al.*, 1995; Melton *et al.*, 1996; Lecocq *et al.*, 1999; List and Shogren, 1999; Shogren *et al.*, 1999). The popularity of Vickrey's second-price auction is largely due to the mechanism being demand revealing in theory, its relative simplicity to explain and the presence of an endogenous market-clearing price.

The standard version of this auction works as follows. Participants record their bid and submit it to a monitor. Bids are then ranked from highest to lowest and the highest bidder pays the second highest price. In repeated bid versions, the process is replicated a given number of times (usually ten or twenty) and after each round the second-highest price (market clearing price) is announced. The information from a posted market price assists bidders in learning about the market mechanism and the market-clearing price (List and Shogren, 1999). The binding trial is determined at the end of all the rounds by a random draw. A random draw is used to control for bid reductions caused by price discrimination. In the absence of a random draw participants who value the good most highly would make the first purchases and then disengage themselves from the bidding process because their perceived utility needs are satisfied. The remaining participants would bid less because as products are purchased they would all move down their demand curve. Alternatively, by using a random draw participants should bid sincerely in every round because only one transaction will be made (Shogren *et al.*, 1994). It usually takes several rounds before subjects realize that revealing their true preference is the best strategy (Melton *et al.*, 1996), which is the reason for the repeated bid version.

Vickrey's auction provides an incentive to reveal one's true preference because the auction separates value from market price and there is no gain from strategic bidding. If the award is given to the highest bidder on the basis of the price set by the second highest bidder then the optimal strategy for each bidder (assuming the absence of collusion among bidders) will be to make bids equal to the full value of the article to the bidder. The full value of the article to the bidder is the highest

amount they would pay to be on the margin of indifference as to obtaining the award or not. Bidding less than this full value would only diminish the chances of winning at what would have been a utility enhancing price. Bidding more than the full value would increase the chances of winning and also the chances of paying more than the bidder valued the award (Vickrey, 1961). Therefore, a person who bids less than his true value risks foregoing a utility enhancing purchase, whereas someone who overbids risks making less than maximum utility by paying too much for the good (Shogren *et al.*, 1994; Hayes *et al.*, 1995; Shogren *et al.*, 1999). Therefore, the bidder's optimal strategy is independent of other bidders (Shogren *et al.*, 1994; Lecocq *et al.*, 1999).

Problems with Vickrey's second-price auction include the fact that the demand curve is not accurately revealed for the good by all participants and individuals whose value for the experimental good is far below or above the market-clearing price frequently bid insincerely. With these results it is impossible to measure the demand curve for the good. Vickrey's auction fails to engage all bidders and is not demand revealing because it does not engage low-value bidders who think they will never lose by insincere bidding. Insincere bidding can be sustained if the behaviour is undetected and goes unpunished by the institutional structure of the auction mechanism (Huffman *et al.*, 2001). The chance also exists that the Classic Hawthorne effect may be present – asking people to bid for new products makes them feel useful, so they inflate bids to please the monitor by matching perceived expectations of good bidding behaviour (Shogren *et al.*, 1999). The competitive atmosphere of an auction in a laboratory setting where the second

highest price is paid may also cause inflated bids (Combris *et al.*, 2002) as a person's private value may become affiliated with the reported market price in repeated bidding (List and Shogren, 1999).

The Becker-DeGroot-Marschak (BDM) mechanism combines incentive compatibility with WTP elicitation to assess consumers true WTP. In this way, the BDM is similar to Vickrey's second-price auction (Rutstrom, 1998).

The BDM is designed to be incentive compatible, realistic, transparent to respondents and operationally efficient (Combris *et al.*, 2002). The BDM mechanism has been used to elicit minimum seller prices as well as maximum buyer prices in research since 1961 when it was first introduced (Huffman *et al.*, 2001). In the BDM mechanism, subjects have a dominant strategy to reveal their WTP truthfully. The principle is the same as that of the perfect market or Vickrey's second-price auction; the subject cannot influence the purchase price (Bohm *et al.*, 1997). The BDM enables researchers to determine individual consumers' WTP in relevant purchase situations and eliminates competitiveness because each subject has the opportunity to purchase the good. In the original BDM procedure, the utility of lotteries was measured by eliciting minimum selling prices for gambles by determining actual transaction prices randomly (Becker *et al.*, 1964). The distribution of BDM transaction prices is exogenous to respondents' WTP, just as with Vickrey's auction, which ensures incentive compatibility (Combris *et al.*, 2002; Wertenbroch and Skiera, 2002).

The typical BDM to elicit buyer prices works as follows: consumers are told that they have a chance to buy a product without spending more money on the

purchase than they want to. They are told that the buying price p for the product is not yet determined and will be determined randomly. They are then asked to offer a price s for the product, which should equal the highest price they are willing to pay for the product. Then the price p of the product is randomly determined from a pre-specified distribution (which is unknown to respondents). If the drawn price p is less than or equal to their offer s , they are required to buy the product at price p . If p exceeds their offer, they are not allowed to buy the product. Consumers' dominant strategy is to offer their true WTP, because for any distribution of buying prices:

- 1) understating one's true WTP ($s < \text{WTP}$) reduces the chance of a utility maximizing purchase (where the forgone gain is $\text{WTP} - p > 0$ for all $s < p < \text{WTP}$), without increasing the actual gain if the consumer must buy (if $p \leq s$), because understating cannot affect the buying price p , and;
- 2) overstating one's true WTP ($\text{WTP} < s$) increases the chance of achieving less than maximum utility (where the incurred loss is $\text{WTP} - p < 0$ for all $\text{WTP} < p \leq s$) (Wertenbroch and Skiera, 2002).

It is important that the prespecified distribution of prices for the product is not revealed to the respondents. Stating an upper and lower bound for the BDM may contaminate the incentive-compatibility properties of the BDM mechanism if the bounds are unrealistic. Studies conducted with stated unrealistic bounds have found that subjects attempt to misrepresent their WTP in order to gain from the transaction by gambling. Bohm *et al.* (1997) show that when the upper bound is inflated above the price any real buyer would pay, the subjects' selling prices are clearly inflated relative to when the upper bound is closer to an expected real maximum buyer price,

even though the BDM mechanism is theoretically incentive compatible in both instances. Bohm *et al.* (1997) also reported that for a commodity where the upper bound is not known because of the newness of the product, it would make sense to keep the upper and lower bound unspecified. It should be stated that the bounds are set to not exceed what any real buyer is believed to be willing to pay (Bohm *et al.*, 1997).

Combining elements of the Vickrey's second-price and the BDM auction mechanisms creates the random n th-price auction presented below.

3.4 Random n th-Price Auction

The random n th-price auction is designed to engage otherwise disengaged off-the-margin bidders and thereby reveal a greater section of the demand curve and reduce the effects of competition (Huffman *et al.*, 2001). Disengaged off-the-margin bidders are bidders whose value for a good is far below or above a market-clearing price and who frequently bid insincerely. The random n th-price auction combines the elements of two classic demand-revealing mechanisms as previously described: Vickrey's second-price auction and the BDM random price mechanism.

The key characteristic of the random n th-price auction is a random but endogenously determined market-clearing price. Randomness is used to give all participants a positive probability of being a purchaser of the auctioned good, thereby engages all bidders, and to reduce any incentive for bidders to fixate on a stable market-clearing price. The endogenous price guarantees that the market-clearing price retains some relation to bidders' private values. Each bidder should

bid sincerely because they cannot use a random market-clearing price as a marker and they all should be engaged because everyone has a chance to buy a unit of the good (Huffman *et al.*, 2001).

The random n th-price auction works as follows. Each of the k bidders submits a bid for one unit of a good; then each of the bids is ranked from highest to lowest. The auction monitor then selects a random number – the n in the n th-price auction, which is drawn from a uniform distribution between 2 and k ; and then the monitor sells one unit of the good to each of the $(n-1)$ highest bidders at the n th-price. For instance, if the monitor randomly selects $n=5$, the four highest bidders each purchase one unit of the good priced at the fifth-highest bid. Bidders who have low or moderate valuations now have a nontrivial chance to buy the good because the price is determined randomly. This auction increases the odds that insincere bidding will lead to a loss and engages each bidder to bid sincerely (Huffman *et al.*, 2001).

3.5 Experiment Treatments

The three information treatment categories this thesis will examine include a nutritional information comparison treatment, a taste testimonial treatment and a natural aspects treatment. Each treatment has been created as discussed in Chapter 2 and is presented here as Figures 3.1 through 3.3.

3.5.1 Nutritional Comparison Treatment

Information concerning nutritional information and formats was used to formulate this experiment treatment. Information about bison nutritional attributes, as reported in Sanderson (2001) and Hobbs and Sanderson (2002), was also used.

Previous research has found that consumers concentrate on specific nutrients they wish to avoid such as fat, cholesterol and calories (Russo *et al.*, 1986; Moorman, 1990; Geiger *et al.*, 1991). Other research demonstrated that consumers are more able to compare product information when it is together in a single format (Levy *et al.*, 1996) and that consumers found nutrition labels with bar graphs easiest to read (Geiger *et al.*, 1991). The nutritional comparison chart used for the treatment was:

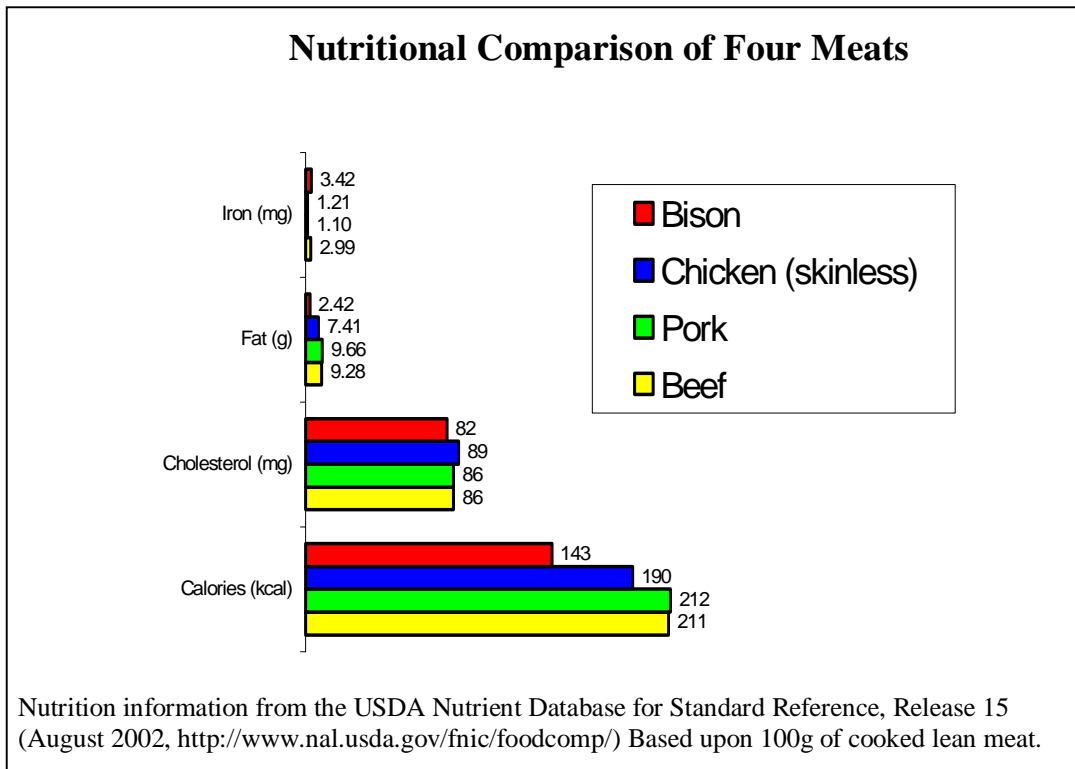


Figure 3.1 – Nutritional Comparison Treatment

3.5.2 Taste Testimonial Treatment

The literature review indicated that a spokesperson might help in selling new products, as long as that person is credible. Torok *et al.* (1998) specifically stated that, “Advertising spokespeople could include health conscious figures such as famous fitness experts or professional athletes” (p.47). Since it has been discovered that consumers are concerned with bison tasting “wild”, being tough and dry, a culinary expert may be used to promote the taste of bison. Many consumers have also compared bison to beef in taste tests (Sanderson, 2001) and the comparison has been used on bison industry promotional brochures (North American Bison Cooperative, 2001). The statement used was:

Bison is delicious due to its tender, non-greasy taste that's richer and sweeter than beef.

Chef Peter Phillips

Chef Peter Phillips is a former member of Culinary Team Canada who owns and operates a restaurant/catering business in Saskatoon.

(Statement devised from North American Bison Cooperative, 2001 and permission received from Chef Peter Phillips to be the culinary expert)

Figure 3.2 – Taste Testimonial Treatment

3.5.3 Natural Aspects Treatment

Participants were given a statement of information concerning the fact that the bison used to manufacture the processed bison product were produced without the use of growth hormones and that sub-therapeutic antibiotics were not part of their feed ration. This treatment was used as natural production methods was one of the three primary factors of concern when it comes to purchasing bison as identified by examining previous bison research. The information about the processed bison product provided to the participants is verifiable as the source of the bison meat was NABC and NABC supports the statement. The unattributed statement used for the natural aspects treatment was:

Growth hormones and sub-therapeutic antibiotics were not used in the production of the bison used to manufacture this product.

Figure 3.3 – Natural Aspects Treatment

3.6 Model

Consumers derive utility from purchasing and consuming goods. If consumers are willing to pay for a processed bison product when presented with specific information about bison, then they must be deriving some expected utility from consuming the processed bison product as measured by WTP. The higher the WTP the more expected utility the consumer is deriving from the processed bison product due to the information presented to them. WTP will be measured with the random n th-price auction and results will be examined with regression analysis. A simple model is presented here:

$$P_i^{\text{pre-info}} = \alpha_1^{\text{pre-info}} + \beta_2^{\text{pre-info}} \chi_i + \mu_i^{\text{pre-info}} \quad (3.1)$$

$$P_i^{\text{info}} = \alpha_1^{\text{info}} + \beta_2^{\text{info}} \chi_i + \mu_i^{\text{info}} \quad (3.2)$$

Equation (3.1) is the regression equation for the processed bison product before being given information about bison and equation (3.2) is the regression equation for the processed bison product when respondents have received their experiment treatment of either; nutritional comparison treatment, taste testimonial treatment or natural aspects treatment. P_i is the bid price for a processed bison product by participant i , α_1 is an intercept term, χ_i is a vector of demographic, bison knowledge and lifestyle characteristics, β_2 is the associated vector of coefficients and μ_i is the random error term.

To obtain a regression equation for bid price difference between the bids for the processed bison product without information and the processed bison product with information, equations (3.1) and (3.2) can be rearranged as adapted from Huffman *et al.* (2001):

$$P_i^{\text{info}} - P_i^{\text{pre-info}} = \alpha_1^{\text{info}} - \alpha_1^{\text{pre-info}} + (\beta_2^{\text{info}} - \beta_2^{\text{pre-info}})\chi_i + \mu_i^{\text{info}} - \mu_i^{\text{pre-info}} \quad (3.3)$$

$$P_i^* = \alpha_1^* + \beta_2^* \chi_i + \mu_i^* \quad (3.4)$$

The dependent variable is the difference in the bid prices ($P_i^* = P_i^{\text{info}} - P_i^{\text{pre-info}}$). By using the difference in bid prices as the dependent variable consumers' tastes are held constant for each participant (Rousu *et al.*, 2002). The independent variables (χ_i) include demographic, knowledge and lifestyle characteristics. An example of a demographic characteristic is gender as a qualitative variable taking a value of 1 if a person is female and 0 otherwise. Additional qualitative variables, more commonly referred to as dummy variables, must be added to equation (3.4) to represent the experiment treatments in order to determine their influence on the dependent variable. The regression equation shall be:

$$P_i^* = \alpha_1^* + \beta_2 D_{1i} + \beta_3 D_{2i} + \beta_4^* \chi_i + \mu_i^* \quad (3.5)$$

Where D_{1i} represents the dummy variable for those participants who received the nutritional comparison treatment and D_{2i} represents the dummy variable for those participants who received the taste testimonial treatment. In order to avoid the dummy variable trap, the situation of perfect multicollinearity, a third dummy variable representing the third experiment treatment, natural aspects, is not introduced (Gujarati, p.504 1995). Estimation using ordinary least squares regression would not be possible if perfect multicollinearity existed (Gujarati, p.504 1995) because the estimates would be biased. The qualitative variable of experiment treatments has three categories so only two categories are introduced into the equation as dummy variables.

A series of regressions can now be introduced to analyze the bid results for the random n th-price auctions. β_1^* and β_4^* are estimates of differences for coefficients in equations (3.1) and (3.2). Again, the dependent variable is the individual differences in bids between the processed bison product with no information and the processed bison product with information about bison. The information treatments about bison, presented in the previous section of this chapter, include the nutritional comparison treatment, the taste testimonial treatment and the natural aspects treatment. The result of the regression analysis will determine which, if any, of the information treatments about bison caused a significant change in WTP from the other treatments and if any demographic information can assist in explaining the difference.

3.7 Summary

The random n th-price auction will be utilized to elicit WTP for the processed bison product in this experiment. This method is superior to conjoint analysis, contingent valuation, Vickrey auctions and the BDM mechanism for several reasons. First of all, the procedure engages participants in an actual transaction, unlike conjoint analysis and contingent valuation. Furthermore, it engages all the participants to bid sincerely due to the randomness of awarding transactions and the positive probability that each participant may be required to make a transaction. This is unlike the Vickrey auction and the BDM experimental procedure where only one person engages in or has the potential to engage in a transaction at a time.

A simple regression model will be used to analyze the data gathered from the random n th-price auction. The model will determine which type of information elicits a significant change in WTP over the other information types or if there is no significant change.

4. EMPIRICAL ANALYSIS

4.1 Introduction

Participants recruited for this study completed the random n th-price auction experiment and then participated in a separate sensory evaluation of the bison products. To conduct the random n th-price research, three experiment treatments were developed for use in this study. The first treatment was nutrition data, in a format compiled from previous research as being most useful and efficient to process for consumers. The second treatment was a testimonial from a culinary expert concerning the taste of bison. A culinary expert was used because previous research indicated that an expert on the particular subject was the most trusted source for information. The third treatment was a statement about the “natural” production methods used to raise the bison for the particular product being used in the research. By measuring WTP with the random n th-price auction in each treatment it is possible to make inferences about whether the different information affects WTP for the processed bison product. These inferences can be made by using regression equation 3.5. A complete model and analysis is presented in section 4.4.3 of this chapter. The results of regression analysis may also assist in determining where bison marketers and associations can concentrate limited resources.

4.2 Experiment Design

4.2.1 Experiment Organization

The research for this study was conducted in December 2002 in Guelph, Ontario with the assistance of a private consumer research company and with the approval of the University of Saskatchewan Behavioural Research Ethics Board, reference number BSC# 2001-231. The company's meeting room was used to conduct the random *n*th-price auction and, once completed, the sensory evaluation facility was used for the sensory evaluation of the bison products.

Subjects were eligible to participate in the experiment if they had purchased a prepared meat product within 30 days prior to the experiment. A demographic breakdown of the sample is provided in section 4.3.1. There were 57 participants over a two-day period, in 6 separate groups. Each group consisted of 10 people except the last group, which only had 7 participants. Two groups, one on each day, received the same experiment treatment and were categorized together as to which treatment they received. The order in which groups were given the treatment information varied between the two days. On day one the order was nutritional comparison treatment, natural aspects treatment and the taste testimonial treatment. On day two the order was altered to natural aspects treatment, taste testimonial treatment and the nutrition information comparison treatment. The order was altered between the days in an attempt to keep the groups as uniform as possible because people with differing demographic characteristics may be available at different times during a typical day.

After completing the random n th-price research the participants moved into the sensory evaluation room for the second portion of the research. Here subjects were asked to provide feedback on four different bison product samples and their packaging. Those results will not be presented as part of this thesis as the evaluations were conducted after the experimental auction. Once the sensory evaluations were completed, participants were then asked to complete a survey, which gathered data on experience with and knowledge of bison, lifestyle choices and demographic information.

4.2.2 Experiment Procedure

The experiment procedure is outlined in Figure 4.1. Immediately following Figure 4.1 is a detailed explanation of each stage in the experiment.

Step 1

Participants complete and sign a consent form, receive payment, are assigned ID numbers and given written instructions concerning the auction.

Step 2

Verbal explanation of the random n th-price auction is given, along with an example.

Step 3

Practice round is conducted with a chocolate bar.

Step 4

Participants are given information about chocolate.

Step 5

Second practice round is conducted with the same chocolate bar.

Step 6

Binding round is determined by flip of coin and binding n th-price is determined with multi-sided die. Transaction for chocolate bar is completed.

Step 7

Participants bid on a processed bison product. No information about bison has been received at this point of the experiment.

Step 8

Participants are given one of the three experiment treatments: Nutrition Information, Taste Testimonial or Natural Aspects.

Step 9

Participants bid on the processed bison product a second time.

Step 10

Participants are asked about any change in their bison purchase intentions after receiving the information using a five-point Likert scale.

Step 11

Binding round is determined by flip of coin and binding n th-price is determined with multi-sided die. Winning participants are notified.

Step 12

Participants complete sensory evaluations of four bison products and packaging.

Step 13

Participants complete a post-experiment survey and “winning” participants receive package of bison after payment.

Figure 4.1 - Outline of Experiment Procedure

Step 1 - Before the experiment starts

Consistent with the University of Saskatchewan Ethics in Behavioural Research Procedures, participants were required to read an approved consent form and give their consent to participate in the bison research experiment. Participants received an ID number, which was used to track data and allowed for anonymity. Written instructions were also distributed (see APPENDIX A).

Step 2 – Experiment Instructions

A moderator gave experiment participants verbal instructions on how the experiment would be conducted in addition to written instructions already distributed. Participants were notified that the monetary exchange for goods would take place at the end of the experiment for time saving purposes. They were also told that this portion of the research would take approximately 30 minutes and after that they would continue with sensory evaluations of some products. As part of the instructions an example was given using chocolate bars and then was practiced.

Step 3 – Practice Rounds

There were two practice rounds of bidding on a Cadbury Caramilk chocolate bar as in Huffman *et al.* (2001) and Melton *et al.* (1996) to ensure participants had a grasp of how the auction would work. Usually, participants require several rounds of bidding before realizing that revealing their true preference is the best strategy (Melton *et al.*, 1996). Participants had a chance to view the chocolate bar as it was carried around the room. They were then asked to write down their WTP for the

chocolate bar. All bids were private information. Bids were collected before the second round was conducted.

Step 4 – Practice Information Treatment

Participants were given the following statement about chocolate after the first round of bidding was completed.

“It is the presence of polyphenols that make chocolate a candidate as a functional food. Polyphenols, or flavonoids, have been researched for decades, mostly because of their antioxidant characteristics (Borchers et al., 2000). Besides in chocolate, flavonoids are also found in red wine and in green tea. The consumption of flavonoids, including those found in chocolate, have been associated with reducing the risk of heart disease, having potentially beneficial effects on inflammatory processes and being cancer-protective agents (Borchers et al., 2000).”

The previous excerpt was taken from Natural Health Products Technology Cluster on the web at <http://www.uoguelph.ca/nhptc/Jessica1.html> on November 5, 2002.

Borchers, A., Keen, C., Hannum, S., Gershwin, M. 2000. Cocoa and chocolate: composition, bioavailability, and health implications. *Journal of Medicinal Food*, 3(2):77-105.

Figure 4.2 – Practice Round Treatment

Step 5 – Second Practice Round

After having read the information, the participants bid on the same chocolate bar in a second round of practice bidding. Participants once again viewed the chocolate bar as it was carried around the room before bidding. They wrote down their individual bids privately on a piece of paper, which were then collected.

Step 6 – Practice Round Transaction

Upon completion of both rounds of practice bidding the binding round was determined by flipping a coin. Once the round was determined the prices from that round were written on a board sequentially, beginning with the highest price. If more than one participant bid the same value, that value was classified as a unique bid and the unique bids were ranked from 1 to r , where r is the number of unique bids.

The binding n th-price was then determined by rolling a multi-sided die. The number of unique bids was used to determine which multi-sided die to use. There were six-sided, eight-sided and ten-sided die available. If the number of unique bids was an uneven number the multi-sided die with one greater number was used. Participants were told that if the number rolled were not one of the unique bids there would be another roll of the die. Once the binding n th-price was revealed, also known as the cut-off price, the participant(s) with a bid higher than this price were required to purchase a chocolate bar but only had to pay the revealed n th-price. The transaction took place at this point to reinforce the fact that actual money was going to be used to purchase a product in this experiment and it reinforced the incentive for people to bid their true value.

Step 7 – First Experimental Bidding Round

Having completed the practice rounds, the same procedure was used for the processed bison product. Participants were then shown the processed bison product. The processed bison product used in this experiment was a 450g package of

Seasoned Bison Strips. This product was packaged in clear plastic, the variously sized strips weighed 10g each on average and were immersed in a marinade. The product was shown in a fresh state, not frozen and no label was viewable on the package. Participants were told they were bidding on the package of Seasoned Bison Strips and that the package weighed 450g or approximately one pound. Participants were not told what flavour the marinade was to prevent flavour bias. They were told that, as in the practice rounds, there would be more than one round of bidding for the product. Participants were also told the binding round and *n*th-price would be determined randomly once all the rounds were completed. Bids were taken on the processed bison product before any additional information was given to the participants. Bids were collected, sorted highest to lowest and held as private information until both rounds had been completed. There was no sale of product at the end of this step.

Step 8 – Experiment Treatments

Participants were then exposed to one of the three experiment treatments presented in section 3.5, either:

Group A – Nutritional Comparison Treatment

Group B – Taste Testimonial Treatment

Group C – Natural Aspects Treatment

Participants in each group were given some time to read and understand the information provided to them. Once participants had been given time to evaluate the information a second round of bidding commenced.

Step 9 – Second Experimental Bidding Round

Participants were asked to bid for the processed bison a second time. Everyone wrote down an individual bid for the processed bison product. As before, all individual bids were private information and at this stage the participants did not have any information on bids from the first round. The bids were collected and sorted from highest to lowest.

Step 10 – Determination of Binding n th-Price

Upon completion of both rounds of bidding for the processed bison product, the binding round was determined by flipping a coin. The prices from that round were then written on the board at the front of the room in sequential order starting with the highest bid. The number of unique bids was then determined and shown on the board. To determine the binding n th-price a multi-sided die was rolled to determine the n th cut-off or binding price. This was conducted in the same manner as the chocolate bar practice rounds. Once the binding n th-price was revealed the participant(s) who bid above this cut-off price were required to purchase a package of the bison product but only had to pay the revealed and binding n th-price. Participants paid for and received their products at the conclusion of the sensory evaluations.

The round chosen as binding, the random n per r unique prices, the n th or binding purchase price paid and the number of purchasers are presented in Table 4.1.

Table 4.1 – Purchase Results for Each Separate Group

Day	Treatment Type	Binding Round	random <i>n/r</i> unique prices	<i>n</i> th-price paid	Purchasers/ Participants
1	Nutritional	1	6/8	\$2.99	6/10
1	Testimonial	2	5/7	\$3.00	6/10
1	Natural	1	5/6	\$1.50	5/10
2	Testimonial	2	6/7	\$2.50	6/10
2	Natural	2	9/10	\$2.00	8/10
2	Nutritional	2	5/5	\$0.50	6/7

When choosing a binding round, the second round was chosen as binding for four of the six groups, the random *n*th-price paid was typically one of the lower values bid and the majority, 64.9%, of participants were required to purchase a package of Seasoned Bison Strips.

Step 11 – Purchase Intention

Participants were asked about any change in their bison purchase intentions after receiving the information using a five-point Likert scale. The following question was posed:

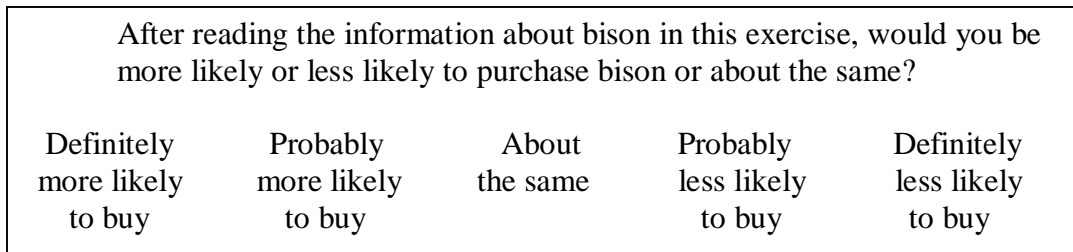


Figure 4.3 – Likert Scale for Purchase Intentions

The resulting distribution of stated purchase intentions is shown in Table 4.2. Forty-nine percent of participants stated no change in the likelihood they would purchase bison, an equal percentage of respondents stated that the information received in the exercise increased their likelihood of purchasing bison and one

respondent, or 2% of participants, reported being probably less likely to buy bison after receiving the information treatment.

Table 4.2 – Distribution of Stated Purchase Intentions

Purchase Intention Category	Percentage of Participants
Definitely more likely to buy	12%
Probably more likely to buy	37%
About the same	49%
Probably less likely to buy	2%
Definitely less likely to buy	0%

Although nearly 50% of participants stated they would be more likely to buy bison after receiving the information treatment, the true measure of the impact of the information on willingness-to-pay for bison will come during the regression analysis portion of the research. Additional comments were also requested of the participants immediately following this question.

Step 12 –Sensory Evaluations

Participants moved to the sensory lab to evaluate four different bison products and packaging. The four products evaluated were a Bison Garlic Coil (fully cooked sausage product), Ginger Teriyaki Seasoned Bison Strips, Mesquite BBQ Seasoned Bison Strips and Roasted Garlic Seasoned Bison Strips. This portion of the experiment took the participants an additional 40 minutes.

Step 13 – Survey

At the end of the sensory evaluations participants completed a survey (see APPENDIX B). The survey was designed to assess the attitudes of the participants

towards bison, collect demographic information, examine the effectiveness of the experiment and collect information about previous experience with bison products. The demographic information collected for each participant, included: age, gender, education, ethnic background, number of people in the household, and annual gross household income.

4.3 Survey Results

Information for the survey completed after the sensory evaluation provides data for the independent variables in the regression analysis, as discussed below. Other factors pertinent to future product development and marketing strategies for the bison industry will be presented in section 4.6.

4.3.1 Demographic Variables

The important demographic variables to be used in the regression analysis are presented and the information is compared with Canadian demographic information from Statistics Canada. The demographic variables identified as important for the regression analysis includes gender, age, education and gross household income. In this study the majority of participants were female (61%), were in the 30-39 and 40-49 years of age categories (69%), had a college level or higher education (60%) and lived in households that made more than \$60,000 per year (73%). The following tables and figures depict the group in each individual category. The gender variable will be presented first.

GENDER

Table 4.3 – Gender Type of Participants (n=57)

Gender	Percentage of Participants	Canada*
Female	61%	50.5%
Male	39%	49.5%

*Source: Statistics Canada, CANSIM II, table 051-0001.
<http://www.statcan.ca/english/Pgdb/demo31a.htm>,
February 6, 2003.

Upon analyzing the survey results for this research it was discovered that more females were recruited than males. When compared with Statistics Canada data in Table 4.1 there is a difference of more than 10% for each gender. This is not cause for concern given the focus of this study. A U.S. study by Katsaras *et al.* (2001) reported that 83% of grocery shoppers are females. Therefore, with 61% of the research participants being female the results may be more realistic than a group matching Canadian population demographics where only 50% are female.

AGE

Table 4.4 – Age Category of Participants (n=57)

Age Category	Percentage of Participants	Canada*
Under 20	2%	25.2%
20-29 years	19%	13.6%
30-39 years	32%	15.5%
40-49 years	37%	16.4%
50-59 years	7%	12.4%
Over 60	5%	17.0%

*Source: Statistics Canada, CANSIM II, table 051-0001.
<http://www.statcan.ca/english/Pgdb/demo10a.htm>,
February 6, 2003.

Participants under 18 years of age were not recruited for this study, which explains the difference in the Under 20 segment. Otherwise, the participants are a reasonably good representation of the Canadian population, with the exception that older consumers (over 60) are underrepresented.

HIGHEST LEVEL OF EDUCATION ATTAINED

Table 4.5 – Highest Level of Education Achieved by Participants (n=57)

Education Attained	Percentage of Participants	Canada*
Less than Grade 9	0%	12.8%
Grade 9 to 13	12%	23.9%
High School Graduate	25%	23.1%
Technical School	4%	10.5%
College Diploma	28%	16.4%
Bachelor's Degree	19%	10.1%
Master's Degree	9%	2.2%
Doctorate Degree	4%	0.9%

*Source: Statistics Canada, 1996 Census *Nation* tables.
<http://www.statcan.ca/english/Pgdb/educ41a.htm>,
 February 6, 2003.

The high percentage of participants with high levels of education may be due to the research being conducted in Guelph, which is a university town. The consumer database from which the respondents were drawn may tend to have a higher proportion of people with high levels of education than is found in the general population.

ANNUAL GROSS (BEFORE TAX) HOUSEHOLD INCOME

Table 4.6 – Annual Gross Household Income of Participants (n=57)

Annual Gross Household Income	Percentage of Participants	Canada*
Under \$20,000	5%	20.0%
\$20,000-39,000	16%	25.4%
\$40,000-59,000	16%	19.6%
\$60,000-79,000	23%	14.0%
\$80,000-99,000	19%	9.2%
\$100,000-119,000	12%	6.2% \$100-125,000
\$120,000-139,000	7%	2.5% \$125-150,000
\$140,000-169,000	0%	3.2% Over \$150,000
\$170,000-199,000	2%	
Over \$200,000	0%	

*Source: Statistics Canada, CANSIM II, table 202-0403 and Catalogue no. 75-202-XIE.
<http://www.statcan.ca/english/Pgdb/famil05a.htm>,
 February 6, 2003.

The participants in this sample were higher wage earners than typical Canadians, which may be due to the sample being more educated than average Canadians. However, having a sample of families with higher incomes may be appropriate for this study, as they are part of the target market for the seasoned bison strips.

A demographic comparison of the treatment groups is presented in Table 4.7.

Table 4.7 – Treatment Group Demographics

Treatment Type	n	Gender		Age Group (Mean)	Education Category (Mean)	Annual Gross Household Income Range (Mean)
		Male	Female			
Nutrition	17	47.1%	52.9%	3.41	4.88	3.65
Testimonial	20	30.0%	70.0%	3.10	4.20	4.15
Natural	20	40.0%	60.0%	3.85	4.70	4.45

Categories and Values

Value	Age	Education	Household Size	Annual Gross Household Income
1	Under 20	Less than Grade 9	1	Under \$20,000
2	20-29 years	Grade 9 to Grade 13	2	\$20,000-39,000
3	30-39 years	High School Graduate	3	\$40,000-59,000
4	40-49 years	Technical School	4	\$60,000-79,000
5	50-59 years	College Diploma	5	\$80,000-99,000
6	Over 60	Bachelor's Degree	6 or more	\$100,000-119,000
7		Master's Degree		\$120,000-139,000
8		Doctorate Degree		\$140,000-169,000
9				\$170,000-199,000
10				Over \$200,000

The treatment groups were similar in most respects. The main difference being the gender mix between the nutrition group and the other two groups where females were the dominating gender. Also, this thesis is examining the impact of information treatment on the difference in WTP while holding demographic variables constant. Therefore, it is less important to have a representative sample of the Canadian population than if the thesis was attempting to identify the effect of different demographic variables on the difference in WTP.

4.3.2 Bison Knowledge

Two bison knowledge questions that would be useful as explanatory independent variables include information about previous bison consumption and knowledge of the non-endangered status of bison in North America. Previous experience with eating bison will be presented first.

Participants were asked about their experience with eating bison, “Have you ever tasted bison before? (not including today)” and the possible answers to select from were never, once or twice, 3 to 5 times, over 5 times or eat bison regularly. The majority of responses indicated that participants had never tried bison before. Figure 4.4 illustrates the responses with a pie chart. Nearly 67% of the participants in this thesis research had never tried bison before and less than 10% had tasted it more than twice.

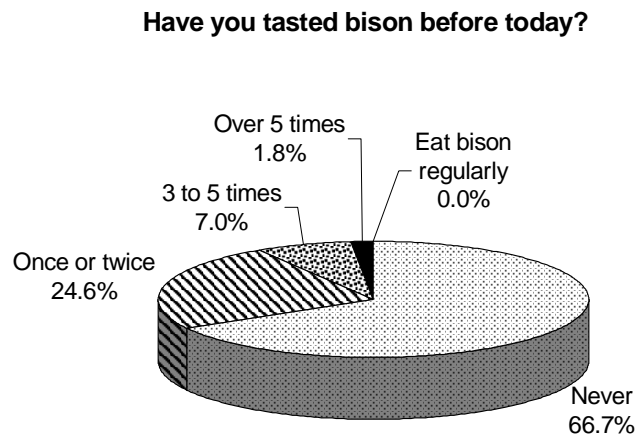


Figure 4.4 - Have you ever tasted bison before? (not including today) (n=57)

To assess if participants were aware of the increase in the number of bison being raised on ranches in North America, they were asked, “To what extent do you agree or disagree with this statement – “Bison are an endangered species”.” Participants could agree, disagree or answer that they did not know. Fifty-one percent of respondents did not know, 22.8% agreed with the statement and 26.3% disagreed, correctly, that bison are not an endangered species. The current estimate of the bison population is over 350,000 animals in both private and public herds around the world (BisonCentral, 2003).

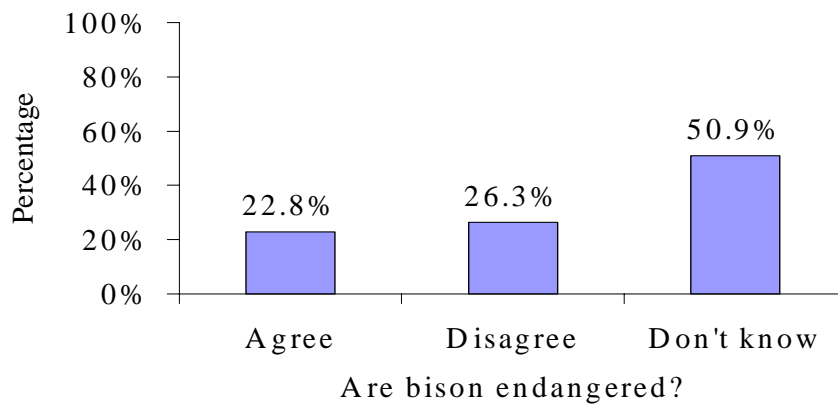


Figure 4.5 - To what extent do you agree or disagree with this statement – “Bison are an endangered species”. (n=57)

4.4 WTP Results

First, the basic WTP data will be described, as this is the dependent variable. Second, the independent variables to be used in the regression model will be discussed. The regression model and results using these independent variables will then be presented. Regression models will also be presented for each information treatment to examine the explanatory power of other independent variables more closely related to that particular type of information.

4.4.1 Basic WTP Data

Table 4.8 describes the willingness-to-pay bids for each treatment group. The number of participants in a particular treatment is represented by n, Bison1 represents the first average bid from participants before any information is provided, Bison2 is the second average bid from participants after receiving their specified treatment and Difference is the difference between participants mean Bison2 and mean Bison1 bids specified as: $\text{Difference} = \text{Bison2} - \text{Bison1}$. Standard deviation, median, minimum and maximum bids are also presented.

Table 4.8 – WTP Data by Treatment Type (\$)

Treatment Type	Round	n	Mean	S.D.	Median	Min	Max
Nutritional Comparison	Bison1	17	2.981	2.215	2.99	0.50	9.98
	Bison2	17	3.201	2.325	2.89	0.50	9.98
	Difference	17	0.221	0.482	0.00	-1.00	1.00
Taste Testimonial	Bison1	20	2.238	1.611	2.00	0.00	5.99
	Bison2	20	2.448	1.617	2.13	0.00	5.99
	Difference	20	0.210	0.484	0.00	-1.00	1.00
Natural Aspects	Bison1	20	3.217	1.436	3.00	0.60	6.95
	Bison2	20	3.402	1.436	3.25	0.70	6.95
	Difference	20	0.185	0.341	0.00	-0.25	1.00

An initial statistical test, analysis of variance or ANOVA, can be conducted to determine if the difference in bids between the information treatments is significant. This test of equality examines the relationship between measurements of the mean and the variance of each group to determine if the difference between them is significant. The results of this test are displayed in Table 4.9.

Table 4.9 - Test for Equality of Means Between Information Treatments
Difference in Bids

Method	df	Value	Probability
ANOVA F-statistic	(2, 54)	0.032790	0.9678

Analysis of Variance			
Source of Variation	df	Sum of Sq.	Mean Sq.
Between	2	0.012609	0.006305
Within	54	10.38299	0.192278
Total	56	10.39560	0.185636

Category Statistics				
Variable	Count	Mean	Std. Dev.	Std. Err. of Mean
NUTRITION	17	0.220588	0.482150	0.116938
TASTE	20	0.210000	0.484116	0.108252
NATURAL	20	0.185000	0.341090	0.076270
All	57	0.204386	0.430855	0.057068

The ANOVA F-statistic shows a probability value of 0.9678. This means that there is no significant difference in the means of the difference in bids between the three information treatments. The probability value is nearly 1, which implies that the means between information treatments difference in bids are basically identical. However, the nutritional comparison treatment does have the largest mean

difference value of the three treatments. This weakly supports the hypothesis that nutritional information will cause the greatest increase in WTP for consumers. However, further analysis using a regression model with the addition of relevant independent variables will be used to determine if there is any significant difference in WTP between the three information treatment types, thereby testing the hypothesis.

4.4.2 Independent Variables

The independent variables discussed earlier and that will be used in the regression model include gender (GENDER), age (AGE), highest level of education attained (EDUCATION), annual gross (before tax) income (INCOME), have you ever tasted bison before? (EATBISON) and do you think bison are endangered? (ENDANGERED). These six variables are expected to be the most relevant in explaining the difference in the WTP values. Table 4.10 displays each variable name, description, assigned values and the á priori expected sign of the coefficient. The distribution of responses was presented in section 4.3.

Table 4.10 – Independent Variables for Regression Model

Variable Name	Description	Assigned Values	Expected Sign
GENDER	Gender	1=Female 0=Male	?
AGE	Age	1=Under 20 2=20-29 3=30-39 4=40-49 5=50-59 6=Over 60	+

Table 4.10 continued – Independent Variables for Regression Model

Variable Name	Description	Assigned Values	Expected Sign
EDUCATION	Highest Level of Education Attained	1=Less than Grade 9 2=Grade 9 to 13 3=High School Graduate 4=Technical School 5=College Diploma 6=Bachelor’s Degree 7=Master’s Degree 8=Doctorate	+
INCOME	Annual Gross (Before Tax) Household Income	1=Under \$20,000 2=\$20,000-39,000 3=\$40,000-59,000 4=\$60,000-79,000 5=\$80,000-99,000 6=\$100,000-119,000 7=\$120,000-139,000 8=\$140,000-169,000 9=\$170,000-199,000 10=Over \$200,000	?
EATBISON	Have you ever tasted bison before? (not including today)	1=Never tried bison 0=Tried bison before	?
ENDANGERED	Are bison an endangered species?	1=Agree/Don’t Know 0=Disagree	+
NUTRITION	Nutritional Comparison Treatment	1=Received 0=Did Not Receive	+
TASTE	Taste Testimonial Treatment	1=Received 0=Did Not Receive	?

For the variable GENDER there is no á priori sign expectation for bidding differences between the sexes; AGE was expected to be positive as the information provided is expected to appeal to older people concerned more with nutrition, taste and eating “natural” foods; EDUCATION was also expected to be positive because participants with more education were expected to have a greater knowledge of the importance of good nutrition and the potential harmful effects of hormones and antibiotic residues in food products; there was no theoretical expectation on how individuals with different INCOME levels would react to the information; there

were no strong *á priori* expectations for the variable EATBISON sign either because it would be difficult to assess how previous bison eating experiences would influence the effect of information on WTP; and ENDANGERED was expected to be positive because positive information about bison may counteract any negative attributes from people who think bison are endangered or do not know.

The regression model was fitted with two dummy variables to test the impact of the information treatments on WTP. Dummy variables are defined for the nutritional comparison treatment (NUTRITION) and the taste testimonial treatment (TASTE) where 1 represents participants who received the particular treatment and 0 means they did not receive the treatment. The natural aspects treatment is the omitted dummy variable to avoid the dummy variable trap as explained in section 3.6. NUTRITION has an expected positive sign because the hypothesis stated that this particular information type would increase the bid more than the other information types. There is no expected sign for TASTE because it was uncertain if this treatment would have a greater effect than the natural aspects treatment.

4.4.3 Regression Results for Significance of Information Treatment Type

The regression model presented in section 3.6 is presented here with the above variables. The independent variables used to explain the difference in WTP include the two dummy variables, NUTRITION and TASTE, the demographic variables, GENDER, AGE, EDUCATION and INCOME, and the general bison knowledge variables, EATBISON and ENDANGERED. The full model is represented by equation 4.1.

$$\text{BISON2} - \text{BISON1} = \alpha_1 + \beta_2 \text{NUTRITON} + \beta_3 \text{TASTE} + \beta_4 \text{GENDER} + \beta_5 \text{AGE} + \beta_6 \text{EDUCATION} + \beta_7 \text{INCOME} + \beta_8 \text{EATBISON} + \beta_9 \text{ENDANGERED} \quad (4.1)$$

Table 4.11 displays the regression results output for the model using the Ordinary Least Squares method in EViews Version 3.1.

Table 4.11 – Regression Model Results

Dependent Variable: BISON2-BISON1

Method: Least Squares

Included observations: 57

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.172089	0.343197	-0.501429	0.6184
NUTRITION	0.028832	0.149298	0.193120	0.8477
TASTE	0.017150	0.150903	0.113650	0.9100
GENDER	0.118949	0.123804	0.960788	0.3415
AGE	0.064985	0.057552	1.129159	0.2644
EDUCATION	0.032149	0.035699	0.900575	0.3723
INCOME	-0.047579	0.034786	-1.367762	0.1778
EATBISON	-0.047559	0.126968	-0.374575	0.7096
ENDANGERED	0.195489	0.140987	1.386573	0.1720
R-squared	0.108870	Mean dependent var		0.204386
Adjusted R-squared	-0.039651	S.D. dependent var		0.430855
S.E. of regression	0.439314	Akaike info criterion		1.336733
Sum squared resid	9.263830	Schwarz criterion		1.659320
Log likelihood	-29.09689	F-statistic		0.733028
Durbin-Watson stat	1.991335	Prob(F-statistic)		0.661840

The first variable to examine in these results is the dummy variable NUTRITION to reject or not reject the hypothesis that providing nutritional information about bison would elicit the greatest increase in willingness-to-pay for the processed bison product. In this regression model the NUTRITION coefficient is not significant. Therefore, the hypothesis is rejected. The nutritional comparison treatment did not significantly increase WTP when compared to the other treatments but the coefficient is positive as expected a priori. Other independent variables in the model had little explanatory power.

The coefficient for GENDER was not significant but was positive as women generally had a greater increase in WTP than men. This may be due to the fact that as women often make household food purchasing decisions, they normally look for the type of information that was provided in the treatments when making purchasing decisions. AGE was positive as expected *á priori* because older people were expected to have increased utility from consuming products with the attributes described in the information treatments but was not significant. EDUCATION was positive as expected *á priori* because those with higher education attainment possibly had a greater knowledge base about eating a healthy diet and the potential harmful health effects of consuming food products produced with artificial growth hormones and sub-therapeutic antibiotics, however, the coefficient was not significant. There were no expectations for INCOME *á priori* and the coefficient resulted in being negative. This negative value may mean that high-income people are not swayed by the information types presented to them as much as low-income people but no real conclusion can be made as the coefficient was not significant. The independent variable EATBISON was negative and was not significant. There was no *á priori* expectation for EATBISON but a negative value may mean that participants were uncertain of what the product would taste like since 67% of them had never tried bison before and were unwilling to pay for an unknown commodity. ENDANGERED was a positive coefficient as expected *á priori* because participants were expected to have less doubt about the endangered status of bison with more information but it also was not statistically significant.

4.4.4 Regression Results for WTP within a Treatment Group

Regression analysis was also conducted on WTP within each of the three treatment groups using additional variables. These regressions were conducted to determine if there were any other factors that may explain responsiveness to a particular type of information. Only the newly introduced variables will be discussed here and will be added to the original model to conduct the regression analysis. The variables that may have influenced WTP in the nutritional comparison treatment are presented first along with a regression model and the regression results.

Three independent variables will be introduced in the model to analyze WTP difference in the nutritional comparison treatment. These independent variables provide information about lifestyle habits such as exercise and eating habits because participants concerned with health may have higher WTP for bison when provided with a nutritional comparison chart of four meats that includes bison. Particularly if the nutritional information presented to them is persuasive, as the literature review indicated. Participants may also have prior knowledge of the general nutritional characteristics of bison and that knowledge may have influenced WTP. Data on these three variables was collected in the survey. The three independent variables, the response distribution and the expected signs of the coefficients are presented in Table 4.12.

Table 4.12 – Nutritional Comparison Treatment Variables (n=17)

Variable Name	Description	Assigned Values	Response Distribution	Expected Sign
NUTRITIONAL	Before today, how much did you know about the nutritional characteristics of bison meat?	1=Familiar 0=Unfamiliar	41% 59%	?
EXERCISE	On average, how many days per week do you engage in a planned exercise program?	1=Exercise program 0=No exercise program	82% 18%	+
HEALTH	Do you have any health-related problems that would motivate you to purchase lean meat products?	1=Yes 0=No	12% 88%	+

There are no *á priori* expectations for the sign of the coefficient for NUTRITIONAL because there is uncertainty as to what aspects of and how in-depth participants' knowledge is of bison meat nutritional characteristics. EXERCISE is expected to have a positive coefficient *á priori* because it is expected that people with a regular exercise program would be more interested in consuming a meat product with superior positive nutritional characteristics. The independent variable HEALTH is also expected to have a positive coefficient. It is anticipated that people with health-related reasons for choosing lean meat products would react favourably to the nutritional comparison treatment and have a greater increase in WTP.

A regression model can be introduced to examine the explanatory effects of these variables on changes to WTP in the nutritional comparison treatment. The model is:

$$\text{BISON2} - \text{BISON1} = \alpha_1 + \beta_2 \text{GENDER} + \beta_3 \text{AGE} + \beta_4 \text{EDUCATION} + \beta_5 \text{INCOME} + \beta_6 \text{EATBISON} + \beta_7 \text{ENDANGERED} + \beta_8 \text{NUTRITIONAL} + \beta_9 \text{HEALTH} + \beta_{10} \text{EXERCISE} \quad (4.2)$$

The regression results are as follows:

Table 4.13 – Nutritional Comparison Treatment Regression Results

Dependent Variable: BISON2-BISON1

Method: Least Squares

Included observations: 17

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.161175	1.176873	-0.986661	0.3567
GENDER	-0.077823	0.481255	-0.161708	0.8761
AGE	0.107037	0.190475	0.561950	0.5917
EDUCATION	-0.013580	0.149974	-0.090551	0.9304
INCOME	-0.029181	0.092313	-0.316106	0.7611
EATBISON	1.036473	0.822369	1.260350	0.2479
ENDANGERED	-0.002841	0.428589	-0.006630	0.9949
NUTRITIONAL	0.797124	0.757870	1.051795	0.3278
HEALTH	0.528941	0.684466	0.772778	0.4649
EXERCISE	0.242575	0.420286	0.577166	0.5819
R-squared	0.385053	Mean dependent var		0.220588
Adjusted R-squared	-0.405592	S.D. dependent var		0.482150
S.E. of regression	0.571626	Akaike info criterion		2.008502
Sum squared resid	2.287290	Schwarz criterion		2.498628
Log likelihood	-7.072269	F-statistic		0.487011
Durbin-Watson stat	1.769755	Prob(F-statistic)		0.844426

The independent variables, HEALTH and EXERCISE, introduced in this model for the nutritional comparison treatment were not significant but were positive as expected á priori. People in this group who actively participate in an exercise program, had a greater increase in WTP than those with no exercise program, after receiving the nutritional information. Also as expected, the participants eating lean meat due to health problems had an increase in WTP once exposed to the nutritional information. The NUTRITIONAL variable did not have an expected sign á priori but the coefficient was also positive. The information presented to the group may have reinforced the nutritional aspects some participants reported being familiar with as they increased their WTP more than those unfamiliar with the nutritional characteristics of bison although the coefficient is not statistically significant.

For the taste testimonial treatment there were no new independent variables to introduce for analysis but a regression could be conducted with model 4.1 to determine what effect prior bison eating experience may have in this particular treatment. Table 4.14 provides information about the EATBISON variable.

Table 4.14 – Taste Testimonial Treatment Variable (n=20)

Variable Name	Description	Assigned Values	Response Distribution	Expected Sign
EATBISON	Have you ever tasted bison before? (not including today)	1=Never tried bison 0=Tried bison before	70% 30%	?

The response distribution of the participants in this group was similar to the overall results of 67% having never tried bison before. There are no *a priori* expectations for the sign of the coefficient. The regression results for model 4.1 using data from the taste testimonial treatment group are presented in Table 4.15.

Table 4.15 – Taste Testimonial Treatment Regression Results

Dependent Variable: BISON2-BISON1

Method: Least Squares

Included observations: 20

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.030047	0.861485	0.034879	0.9727
GENDER	-0.121467	0.318728	-0.381099	0.7093
AGE	0.195272	0.174958	1.116106	0.2846
EDUCATION	0.061485	0.092550	0.664345	0.5181
INCOME	-0.067076	0.086664	-0.773982	0.4528
EATBISON	-0.061443	0.292107	-0.210343	0.8367
ENDANGERED	-0.308027	0.430908	-0.714833	0.4874
R-squared	0.158094	Mean dependent var		0.210000
Adjusted R-squared	-0.230479	S.D. dependent var		0.484116
S.E. of regression	0.537015	Akaike info criterion		1.863636
Sum squared resid	3.749009	Schwarz criterion		2.212143
Log likelihood	-11.63636	F-statistic		0.406858
Durbin-Watson stat	1.573385	Prob(F-statistic)		0.861581

EATBISON has a negative coefficient in this regression just as it had in the original regression model. This reinforces the belief that those who have never tried bison before are wary of purchasing it for the first time and perhaps the information treatments may not be persuasive enough.

For the natural aspects treatment there are two new independent variables to introduce. These variables, their descriptions, assigned values, response distribution and expected signs are displayed in Table 4.16.

Table 4.16 – Natural Aspects Treatment Variables (n=20)

Variable Name	Description	Assigned Values	Response Distribution	Expected Sign
ORGANIC	Have you ever purchased certified organic or “natural” meat products?	1=Regularly/ several times 0=No/once or twice	30% 70%	+
HORMONES	Before today, how much did you know about the use of growth hormones and antibiotics in the production of bison?	1=Familiar 0=Not familiar	5% 95%	?

When examining the ORGANIC variable to be used in the model *á priori* expectations are for a positive coefficient, positive because participants who regularly or frequently purchase organic products are expected to have a higher WTP for food when certain characteristics consistent with organic products are displayed. Some of these characteristics of organic products, hormone and antibiotic free for example, are included in the natural aspects treatment. There were no *á priori* expectations for the HORMONES variable because few participants reported being familiar with bison production practices and it was not clear if the information they had was positive, negative or accurate.

A regression model can be introduced to examine the explanatory effects of these variables on changes to WTP in the natural aspects treatment. The model is:

$$\begin{aligned} \text{BISON2} - \text{BISON1} = & \alpha_1 + \beta_2 \text{GENDER} + \beta_3 \text{AGE} + \beta_4 \text{EDUCATION} + \beta_5 \text{INCOME} \\ & + \beta_6 \text{EATBISON} + \beta_7 \text{ENDANGERED} + \beta_8 \text{ORGANIC} + \\ & \beta_9 \text{HORMONES} \end{aligned} \quad (4.3)$$

The regression results are presented in Table 4.17.

Table 4.17 – Natural Aspects Treatment Regression Results

Dependent Variable: BISON2-BISON1

Method: Least Squares

Included observations: 20

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.349994	0.530790	0.659383	0.5232
GENDER	0.117545	0.185634	0.633208	0.5395
AGE	0.030023	0.068354	0.439234	0.6690
INCOME	-0.045932	0.042394	-1.083471	0.3018
EDUCATION	-0.016508	0.053738	-0.307202	0.7644
EATBISON	-0.278066	0.187321	-1.484435	0.1658
ENDANGERED	0.211250	0.187726	1.125311	0.2844
ORGANIC	-0.052285	0.191842	-0.272540	0.7903
HORMONES	-0.043296	0.420659	-0.102923	0.9199
R-squared	0.372924	Mean dependent var		0.185000
Adjusted R-squared	-0.083132	S.D. dependent var		0.341090
S.E. of regression	0.354984	Akaike info criterion		1.068677
Sum squared resid	1.386152	Schwarz criterion		1.516756
Log likelihood	-1.686766	F-statistic		0.817715
Durbin-Watson stat	3.092842	Prob(F-statistic)		0.603098

Both of the independent variables, ORGANIC and HORMONES, are not significant and have negative coefficients. ORGANIC has the wrong expected sign so perhaps the unknown aspects of bison, taste and nutritional characteristics, outweighed the fact that the product had no growth hormones or antibiotics associated with it. Also, perhaps the natural aspects treatment was not as credible as the other two treatments which had statement sources written beneath them,

although 100% of the participants reported believing the statement when asked in the survey.

4.5 Discussion

Before discussing the results it may be useful to examine the believability of the random n th-price auction purchase requirement and the information treatments. Seventy-nine percent of the participants said that they believed they would have to purchase the bison product and many commented that they expected a purchase would be required due to the exchange of money for the chocolate bar example. This believability helped to ensure participants would report their true WTP. Participants were also asked in the survey if they believed the information they were given in their group. Ninety-six and a half percent of the participants believed their information treatment about bison. Only two participants in the taste testimonial treatment did not believe the statement but they provided no reason as to why. The believability of the information treatments was important because if participants felt the information was not true there would be no motivation to change WTP. The answers to these two questions provide credibility to the experiment design and confidence in the data collected.

The regression model results in Table 4.11 have led to rejecting the hypothesis that providing nutritional information about bison will elicit the greatest increase in WTP for the processed bison product. In further analysis of the regression results, no other independent variable had a significant influence on the difference in WTP.

Regression analysis was also conducted on each information treatment separately to examine additional variables. None of the variables examined were found to be significant. The most interesting results came from the regression of the nutritional comparison treatment. The newly introduced variables were all positive as expected *á priori* and EATBISON was also positive in this regression. EATBISON is negative in all other regression results. Perhaps the nutritional comparison treatment had more impact on those participants who had never tried bison before than the other two treatments where EATBISON remained negative as in the original regression results. This would need further analysis before a conclusion could be made.

Before conducting the experiment it was known that there was a possibility of a zero bid being received in the first, second or both rounds of the random n th-price auction and that zero bids may not be truly demand revealing on the bottom portion of the demand curve (Rousu *et al.*, 2002). Upon examining the data from the random n th-price auction it was discovered that some participants had indeed bid zero. Three participants bid zero in both rounds and one participant bid zero in the first round. Participants were not given the opportunity to bid any value below zero and were told to simply bid their true value for the product being shown to them. The scenario of bidding a negative value was not discussed with participants before the auction. If participants were given this option there may have been an incentive to strategically bid values below zero in the hopes of being paid to take the processed bison product home. However, since negative bids were not discussed, a zero bid may not be accurately reflecting the participant's true WTP if the product

yielded disutility for the participant. This may suggest censoring in the dependent variable, however, it was not felt to be a significant problem.

Participants bidding zero in both rounds for the bison product provide no information about their bison demand. Therefore, since the dependent variable is the difference in the two bids and information impact is being examined, the double zero bids should not have any significant influence. A participant bidding positively in one of the rounds and zero in the other does not provide a true difference in bids because the zero may not be revealing the participant's true WTP. In the experiment presented in this thesis one participant bid zero in the first round and positive in the second round. Therefore, the information treatment did have an effect on the participant and it can be assumed that the zero bid in the first round was the participant's true WTP because of the positive second round bid. To determine whether the censoring of the dependent variable was a concern, regression equation 4.1 was used again on the same data but excluding the zero bids and is presented in APPENDIX C. The results are similar to those presented in Table 4.11 for all independent variables except for the sign on TASTE and the intercept. This is due to all four zero bidding participants being in the TASTE group. No independent variables are significant in this scenario. Therefore, censoring may be affecting the regression coefficients in the original results but not in any significant way.

4.6 Application

Results from analysis of variance and regression analysis have shown that there is no significant difference between the information treatments. The

hypothesis that the nutritional comparison treatment would have the greatest impact on WTP was rejected. Therefore, this thesis has not clearly shown which information treatment would be the most effective for the bison industry to utilize in a bison information campaign. However, this thesis has shown with the raw WTP data that every information treatment did increase the group mean WTP for the processed bison product: \$0.221 for the nutritional comparison treatment, \$0.210 for the taste testimonial treatment and \$0.185 for the natural aspects treatment. Any information given to participants increased WTP and this may be due to the limited knowledge they had of bison. The survey results showed that 67% had not tried bison before, 77% thought bison were or did not know if bison were endangered, 59% were not familiar with the nutritional characteristics of bison meat and 95% were unfamiliar with bison production practices. As stated in section 1.2, the key to marketing is information and it has been shown that the information presented to the research participants about bison did increase WTP for the processed bison product but not at significant levels using the experiment outlined here.

Since consumers know so little about bison, almost any type of information about bison would be beneficial in increasing awareness about bison products. The primary priority for the bison industry could be to increase the awareness of bison being ranch-raised all over North America and promote the fact that bison are not an endangered species. Then, persuading people to taste bison by using information such as the treatments in this thesis could be a secondary priority for the bison industry. The information to use would be determined by the target audience. For example, if bison is promoted to fitness minded people it may be best to focus on the

nutritional characteristics. If promotions are being done in conjunction with a health food store it may be wise to highlight bison production practices that include the absence of growth hormones and antibiotics. In culinary events taste may reign supreme.

The problem is not that people are getting misleading information about bison; they are simply not getting any information about bison. That may be why WTP increased in all information treatments but was not significantly different for any specific treatment.

4.7 Summary

Three experiment treatments were developed to conduct the random *n*th-price research in this study. The three treatments developed were the nutritional comparison treatment, the taste testimonial treatment and the natural aspects treatment. WTP was measured before and after participants received one of these treatments. The WTP values were then used in a regression analysis to determine the impact between information types given to the participants.

Regression analysis determined that the hypothesis be rejected as the nutritional comparison treatment did not significantly increase WTP when compared to the other treatments. However, the information did increase WTP more than the other two information types as expected but not significantly. Other independent variables in the model did not have any explanatory power.

Regressions were also done for each information treatment separately to determine if independent variables specific to certain treatments had any explanatory power. These regressions did not reveal any independent variables of significance.

The survey results indicated that consumers have very little information or experience with bison. This is the major hurdle facing the industry and only by providing that information and providing products which appeal to consumers will demand increase for bison products. Emphasis could be placed on increasing the awareness of the non-endangerment status of bison and then information about bison, such as presented in this thesis, can be targeted to specific segments of the population that may find the information most beneficial. This information would need to be provided in conjunction with an increase in the availability of bison as availability was identified in Hobbs and Sanderson (2001) as the primary reason people had not purchased bison before.

5. SUMMARY

5.1 Introduction

The bison industry currently has limited market share and limited resources. To increase profitable sales most efficiently, the bison industry could explore how consumers react to information about bison and find out what people know about bison.

This thesis focused on examining how consumers' WTP changed in response to different information treatments. Three important aspects about bison were identified by examining past bison research and a literature review assisted in developing three experiment treatments for examination. The three treatments attempted to use intrinsic credence attributes (nutritional characteristics and production methods), and an intrinsic experience attribute (taste), as marketing tools in the form of extrinsic indicators. In order to elicit reliable WTP values the indicators needed to be credible and the literature review examined research on credibility issues. By converting these intrinsic credence and experience attributes into credible extrinsic indicators, transaction costs were reduced for consumers. This was important because if the extrinsic indicators were not credible, consumers would want to gather information for verification and this would be costly. Gathering information would diminish the consumers' utility, WTP and therefore, demand for the processed bison product.

To elicit WTP, a random n th-price auction procedure was developed after examining market information, revealed preference, stated preference and several experimental auction options as detailed in sections 3.2 and 3.3. The random n th-price auction was conducted in December 2002 in Guelph, Ontario with 57 participants using the experiment design as outlined in section 4.2. A summary of the thesis findings is presented below.

5.2 Thesis Findings

The hypothesis, that nutritional information about bison would elicit the greatest increase in willingness-to-pay for the processed bison product, has been rejected. The hypothesis was rejected because the regression results in Table 4.11 indicated that the NUTRITION coefficient was not significant. Therefore, the nutritional comparison treatment did not significantly increase WTP when compared to the other treatments. However, the coefficient was positive as expected *á priori* and the information did increase WTP.

The independent variables examined in the regression were GENDER, AGE, INCOME, EDUCATION, EATBISON and ENDANGERED. None of these independent variables were found to be significant.

Additional regression analysis was conducted for each treatment group separately to examine the influence of additional independent variables specific to the particular treatment. The addition of these variables to the regression model did not result in revealing any variables of significance. One interesting result in this portion of the analysis was a positive coefficient for the EATBISON variable in the

nutritional comparison treatment regression results. All other regression results displayed a negative EATBISON coefficient. This may be additional evidence of the nutritional comparison treatment being more persuasive than the other two treatments, although significant evidence was not provided in this research.

When examining participants' knowledge of bison it was revealed that little was known. Sixty-seven percent of participants had never tried bison before, seventy-four percent thought bison were endangered or did not know, seventy-five percent were not familiar with bison nutritional characteristics and ninety-five percent were not familiar with the use of growth hormones and antibiotics in the production of bison. There may be an opportunity here for the bison industry to shape consumer perception of bison products.

It is known that consumers gather, interpret and act upon information available to them to maximize their utility in regards to preferences. The bison industry can organize and distribute information about bison to consumers that would increase their food consumption utility by choosing bison. The information could encourage consumers to search for bison products and by disseminating this information to consumers the bison industry would be decreasing their transaction costs. Transaction costs are the costs to carry out an exchange (Hobbs, 1996) and credible information reduces the search portion of transaction costs. When transaction costs are reduced, utility, purchases and/or prices increase. This is required to ensure a sustainable bison industry. In the process of preparing this information, it may be useful for the bison industry to review the Food Quality

Framework developed by Caswell *et al.* (2002), as presented in section 2.3, to understand how consumers quality perception process may affect bison purchases.

Intrinsic quality attributes about bison can be used as extrinsic quality indicators to influence purchase intentions. This can be done as long as the extrinsic quality indicators are credible and pertinent to the targeted consumer segment. Providing this information will reduce the information cost of a transaction and thereby increase utility of bison consumption. To ensure credibility of the information it may be useful to review the relevant literature, as presented in sections 2.5 and 2.6. Consumers must easily understand information for it to be credible. Secondly, an impartial third party source that exhibits both “trustworthiness” and “expertness” should endorse the product (Bennett and McCrohan, 1993). The government is an impartial third party source that consumers view as credible. The nutritional comparison treatment utilized the United States Department of Agriculture (USDA) as the impartial third party for credibility. One hundred percent of the participants in that treatment group responded that they believed the information provided to them and many commented that they believed the information because it came from the USDA.

5.3 Limitations of Thesis

As in all experimental research there were many limitations to this thesis. Having only enough resources to conduct research in one location with fifty-seven people resulted in a limited quantity of data to work with. Limited data did not allow for broad statements to be made of the results or for comparing results

between locations. Conducting the research in other locations of Ontario would have allowed for results with greater precision and for examining any potential regional differences within Ontario.

The random n th-price auction may also have resulted in conservative WTP values. Research conducted by Lusk *et al.* (2002) has found that random n th-price auctions yield lower valuations than BDM, English and Vickrey's second-price auctions, but only significantly when subjects were endowed with a product that they could exchange by bidding on another product. The subjects in this experiment were not endowed with a product to exchange for the processed bison product. When subjects in the Lusk *et al.* (2002) study were not endowed there, no statistically significant difference in the valuations between the experimental auction types was found. However, there were economic differences and the random n th-price auction did yield the lowest values. Therefore, the results in the thesis may have varied if an alternative experimental auction choice had been made and the WTP values found in this experiment may have been conservative.

5.4 Further Research

Additional research that could be conducted on the WTP topic could include a retail test trial in the target markets. This thesis was part of the second phase of a four phase Bison Marketing Project and the third phase is a test trial using the processed bison products described in Step 12 of section 4.2.2. A retail test trial does not allow the entire demand curve to be estimated for each bison product but quantity demanded at given prices can be discovered. It would also be interesting to

interview shoppers as they are exiting the store to discover their motivation to purchase or not to purchase one of the processed bison products. This would provide additional insight for developing relevant information for consumers.

Another aspect of marketing retail products is the in-store taste test. Many companies utilize taste tests to introduce new products and it would be interesting to examine WTP changes before and after a bison taste test. This would best be done in an actual retail setting so consumers would not have to be paid to participate and researchers could also examine what information, if any, would be required to convince a consumer to try bison.

Another potential research area would be to investigate the experimental auction mechanism. The research conducted for this thesis could be replicated by utilizing a different experimental auction mechanism, such as the BDM, to examine how the results differ.

5.5 Conclusion

Although the hypothesis has been rejected there is plenty of useable information contained in this thesis to further the goals of the bison industry in increasing market share. Understanding the basic motivations of consumers to maximize utility, knowing the quality perception process consumers go through and knowing what makes information credible to consumers will assist in developing information about bison to ensure a sustainable industry. Further research on this topic will add to the bison knowledge base and future marketing initiatives by the bison industry could potentially be more effective.

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APPENDICES

APPENDIX A – BIDDING INSTRUCTIONS

Welcome!

Thank you for choosing to participate in our consumer research. Here is a packet of information that you will need during the bidding exercise, which we will conduct first. Two products will be used in the bidding experiment. First a chocolate bar and then a meat product.

Please read the instruction sheet as the exercise moves along but do not look ahead until we reach the right point in the exercise. The monitor will tell you when to turn the sheet. Feel free to go back and examine any instructions if you need to once we are past that point.

Please follow the instructions carefully and do not talk to any other participants.

All information obtained today will be used only for group comparisons. No information on any individual will be divulged for any reason.

While we wait for the entire panel to arrive, please review the next page only to familiarize yourself with how this particular bidding exercise will operate.

Detailed instructions of how the bidding exercise works will be explained to you by the monitor before we begin.

Explanation of Bidding Exercise

We are going to hold a bidding exercise today. In a minute we will be asking you to write down your bid for the product on a bid slip. This is private information, please do not show your bids to another participant.

There are four steps in this exercise.

1. View the product
Before we ask you to bid on a product, we will carry the product around the room and allow you to view it so you know what product you will be bidding on.
2. Write down your bid for the product
After the product is viewed, you can write down how much you would pay for this product on your bid slip.
3. Random choosing of the payment price
Once everyone has bid and the bids have been collected, we will write up the bids from highest to lowest. Then we will randomly pick one of these bids by rolling a multi-sided die where 1 represents the highest bid, 2 the second highest and so forth. This will be called the “payment price”.
(We will go through an example of this)
4. Determining who pays the payment price and receives the product
The payment price is the “cutoff”. Everyone who bid **higher** than the payment price will be obligated to purchase the product and will **pay** the payment price. Everyone who bid at or below the payment price will not have the opportunity to purchase the product.
(We will go through an example of this)

NOTE: In this bidding exercise it is in your best interest to bid your true value for the product. In other words, think about how much **you** would pay for this product and write down that amount down on your bid slip. Remember, if you bid less than your true value for the product, you may be giving up an opportunity to purchase the product. Likewise, if you bid more than you are truly willing to pay you may end up having to pay more than you wanted to for the product. So it is in your best interests to write down your true value for the product, i.e. how much you would really be willing to pay for it.

STOP!

Please wait until you are asked to turn the sheet.

Practice Rounds

Explanation of the Practice Rounds

There will be two rounds of bidding in the practice rounds. We are about to begin the first practice round. Only one of the two practice rounds will be binding. That is, only one of the two practice rounds will be chosen as the round where people will be obligated to purchase a product (i.e. only one round will count). Since you do not know which round will be chosen, it is in your best interest to bid your true value for the product in both practice rounds. The round that is binding will be chosen by a coin toss and will be determined after the second practice round.

Steps of the Practice Rounds

1. Take a look at the chocolate bar being shown around the room.
2. Place your bid for the chocolate bar on the **YELLOW** piece of paper.
3. Bids will be collected.

STOP!

Please wait until you are asked to turn the sheet.

Please read the following statement.

“It is the presence of polyphenols that make chocolate a candidate as a functional food. Polyphenols, or flavonoids, have been researched for decades, mostly because of their antioxidant characteristics (Borchers et al., 2000). Besides in chocolate, flavonoids are also found in red wine and in green tea. The consumption of flavonoids, including those found in chocolate, have been associated with reducing the risk of heart disease, having potentially beneficial effects on inflammatory processes and being cancer-protective agents (Borchers et al., 2000).”

The previous excerpt was taken from Natural Health Products Technology Cluster on the web at <http://www.uoguelph.ca/nhptc/Jessical.html> on November 5, 2002.

Borchers, A., Keen, C., Hannum, S., Gershwin, M. Cocoa and chocolate: composition, bioavailability, and health implications. *J Medicinal Food* 2000; 3(2):77-105.

We will now bid on the chocolate bar a second time.

4. Take a look at the chocolate bar being shown around the room.
5. Place your bid for the chocolate bar on the **GREEN** piece of paper.
6. Bids will be collected.
7. The binding round will be determined by a coin toss – heads for round one, tails for round two.
8. The payment price will be determined randomly by rolling a die.
9. All participants with bids higher than the payment price will purchase the product. The price they pay will be the payment price.

STOP!

Please wait until you are asked to turn the sheet.

Seasoned Bison Strips

Again, there will be 2 rounds of bidding, but only one of the two rounds will be chosen as binding by a coin toss.

Steps of the Seasoned Bison Strips Bidding Rounds

1. Take a look at the package of seasoned bison strips being shown around the room.
2. Place your bid for the seasoned bison strips on the **BLUE** piece of paper.
3. Bids will be collected.

STOP!

Please wait until you are asked to turn the sheet.

We will now bid on the seasoned bison strips a second time.

4. Take a look at the seasoned bison strips being shown around the room.
5. Place your bid for the seasoned bison strips on the **RED** piece of paper.
6. Bids will be collected.
7. The binding round will be determined by a coin toss – heads for round one, tails for round two.
8. The payment price will be determined randomly by rolling a die.
9. All participants with bids higher than the payment price will purchase the product. The price they pay will be the payment price.

End of bidding exercise

APPENDIX B – SURVEY QUESTIONS

Department of Agricultural Economics
University of Saskatchewan

Please answer all questions below. The information will be treated in the strictest of confidence, you will not be asked to identify yourself on the survey.

Please check only one box for each question.

1. Have you ever tasted bison before?(not including today)

- Never
- Once or twice
- 3 to 5 times
- Over 5 times
- Eat bison regularly

2. On average, how many days per week do you engage in a planned exercise program?

- 3 or more days per week
- Less than 3 days per week
- No regular program

3. On average, how many **evening meals** are prepared in your home per week?

- 5 or more meals
- 2 to 4 meals
- Less than 2 meals

4. How much time is usually spent preparing and cooking an evening meal?

- More than 1 hour
- ½ to 1 hour
- Less than ½ hour

5. Have you ever purchased certified organic or “natural” meat products?

- Never Once or twice Several times Regularly

6. Do you have any health-related problems that would motivate you to purchase lean meat products? Yes No

7. In the bidding exercise, did you believe that the successful bidders would really have to purchase a package of bison stir-fry?
 Yes No

8. Why or why not?

9. Was the information provided about bison during the bidding exercise believable? Yes No

10. Why or why not?

11. To what extent do you agree or disagree with this statement – “Bison are an endangered species”.
 Agree Disagree Don't Know

12. Before today, how much did you know about the nutritional characteristics of bison meat?
 Very Familiar Somewhat Familiar Not Familiar

13. Before today, how much did you know about the use of growth hormones and antibiotics in the production of bison?
 Very Familiar Somewhat Familiar Not Familiar

Answers to the following questions help us determine broad trends. The information will be kept strictly confidential and only used in aggregate, not on the individual level.

14. Gender Male Female

15. Age Under 20 40-49 years
 20-29 years 50-59 years
 30-39 years Over 60

16. Education Less than Grade 9 College Diploma
 Grade 9 to 13 Bachelor's Degree
 High School Graduate Master's Degree
 Technical School Doctorate

17. Ethnic Background

<input type="checkbox"/> British Isles	<input type="checkbox"/> Asian
<input type="checkbox"/> French	<input type="checkbox"/> Arab
<input type="checkbox"/> European	<input type="checkbox"/> African
<input type="checkbox"/> Canadian	<input type="checkbox"/> Central/South American
<input type="checkbox"/> First Nation	<input type="checkbox"/> Other
<input type="checkbox"/> Caribbean	

18. Household Size 1 4
 2 5
 3 6 or more

19. Annual Gross (before tax) Household Income

<input type="checkbox"/>	Under \$20,000	<input type="checkbox"/>	\$100,000-119,000
<input type="checkbox"/>	\$20,000-39,000	<input type="checkbox"/>	\$120,000-139,000
<input type="checkbox"/>	\$40,000-59,000	<input type="checkbox"/>	\$139,000-169,000
<input type="checkbox"/>	\$60,000-79,000	<input type="checkbox"/>	\$170,000-199,000
<input type="checkbox"/>	\$80,000-99,000	<input type="checkbox"/>	Over \$200,000

20. Do you have any additional comment (optional)

Thank you for participating.

APPENDIX C – REGRESSION RESULTS EXCLUDING ZERO BIDS

Dependent Variable: BISON2-BISON1

Method: Least Squares

Included observations: 53

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.167179	0.387270	-0.431685	0.6681
NUTRITION	0.057894	0.175425	0.330022	0.7429
TASTE	-0.005617	0.144772	-0.038799	0.9692
GENDER	0.116033	0.128060	0.906082	0.3698
AGE	0.060002	0.060264	0.995648	0.3249
EDUCATION	0.024193	0.038207	0.633206	0.5299
INCOME	-0.038847	0.036860	-1.053891	0.2977
EATBISON	-0.024044	0.154735	-0.155390	0.8772
ENDANGERED	0.192610	0.144423	1.333654	0.1892
R-squared	0.089419	Mean dependent var		0.200943
Adjusted R-squared	-0.076141	S.D. dependent var		0.430488
S.E. of regression	0.446577	Akaike info criterion		1.379109
Sum squared resid	8.774948	Schwarz criterion		1.713687
Log likelihood	-27.54638	F-statistic		0.540103
Durbin-Watson stat	2.081042	Prob(F-statistic)		0.819800