Assessing Consumer Willingness to Pay for Ground Bison Given Nutrition Information

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Abstract

According to the USDA National Nutrient Database for bison, the bison nutrient benefits include higher protein level, lower calories, lower fat, and lower cholesterol compared to various commercial meats, like skinless-chicken, beef, pork, lamb, and salmon. This study investigates how consumers evaluate fresh ground bison in terms of their willingness to pay. Results show that the variation of consumer knowledge on bison nutrition contributes to different levels of willingness to pay. Implications from this study suggest enhancing consumers' knowledge of bison products would increase the sale of bison products.

Keywords: bison, nutrition, WTP

JEL codes: Q13

Introduction

The relatively favorable nutrient benefits of bison products have attracted some nutrition-conscious consumers that have been made aware of these benefits, but the market price of bison products per pound has remained relatively higher than other premium commercial meats. According to the USDA National Nutrient Database for bison, bison nutrient benefits include higher protein level, lower calories, lower fat, and lower cholesterol in comparing with various commercial meats, like skinless-chicken, beef, pork, lamb, and salmon (figure 1). Besides these relatively favorable characteristics, the higher nutrient level on iron and vitamin B-12 compared to other commonly consumed meats have the potential to attract consumers who are used to paying attention to nutrition facts.

The bison industry is still fairly young and small scale compared with other commercial meat industries. Approximately 20,000 head of bison are slaughtered per year which is much small number if compared to about 125,000 cattle every day in the U.S. (USDA/FSIS, 2011). The majority of bison production is along the border between the West and Midwest region in the U.S. Bison are raised on the open range with non-antibiotics and non-growth hormones practices. Bison marketing outlets are limited, and most are bison farmers sell directly to consumers, restaurants, wholesale outlets, or cooperatives (Gegner, 2001). The National Bison Association (USDA/FSIS, 2011) estimates that the annual U.S. per capita bison consumption is about 0.07 pounds per person; a relatively small amount compared with other commercial meats. It is necessary to understand how likely consumers respond their perception and preference to bison.

This study focuses on consumers from the Ohio River Valley region, including Illinois, Indiana, Ohio, Kentucky, and Tennessee. Fresh ground bison was available in these markets and

observed in groceries with prices range between $8 and $10. Premium ground beef was sold at $6 during the research period in July, 2012. A total of 2,644 respondents from Ohio River Valley region were surveyed. The bison industry has tried to help offset their relatively higher prices with what they considered an active nutrition merchandising campaign. This study examines consumer awareness and perception of the bison nutrition information, and further investigates how consumers evaluate the benefits of bison nutrition in terms of their willingness to pay (WTP).

Consumers usually have positive WTP for the products if the nutrition information is provided to them (Jacoby, et al 1977). This study seeks to confirm the extent to which meat consumers are similarly influenced by bison nutrition information in their revealed WTP. We also examine whether different levels of nutrition knowledge create different WTP premiums for fresh ground bison.

Literature Review

Bison production was almost wiped out in the late 1880's, but the actual herd size in the U.S. today is estimated at about 220,000 bison in 2007 (National Bison Association 2012). The growing bison industry in North Dakota, for example, has been shown to contribute positively to the economy of the state (Sell, et al 2000). Marketing outlets for bison meat, however, are limited. Bison producers have several options selling directly to consumers, such as restaurants, wholesale outlets, cooperatives, or via internet (Gegner, 2001). Bison producers are subsequently under more pressure to develop marketing and merchandising plans for their own branding and bison products.

Compared to other commercial meats, the bison nutrition contains much advantageous health benefits to nutrition-conscious consumers, i.e. low calories, low fat, low cholesterol, but

high iron and vitamin B-12. However, nutrition labeling may not always serve an efficient and effective information provision to all consumers (Kiesel, et al, 2011). Over half of our surveyed respondents do not know anything regarding specific health benefits associated with bison products. Although the majority of consumers are willing to pay more if the nutrition information is provided to them (Jacoby, et al 1977; Loureiro, et al 2006), market consumer responses on high quality bison nutrition should be further identified.

Meat purchasing behavior can be highly related not only to socio-demographic characteristics of buyers but also to the product itself related to packaging, branding, and labeling. For example, higher educated female main meal planners tend to apply more different types of nutritional information (Nayga, 1996), and other socio-demographic characteristics, i.e. household size, race, employment status, urbanization, regions, age, and income, are also important factors to the nutritional information. Especially, consumer eating habits are highly related to nutrition information, and can be influenced and changed by nutritional labeling (Driskell, et al, 2008). Russo, et al (1986) found that listing different nutrition information (vitamins and minerals versus added sugar) may result in different product sales which are highly associated with consumer eating habits. Furthermore, nutrition-conscious consumers prefer to choose detailed nutrition labels compared with other condensed description of nutrition labels (Berning, et al, 2008). As a result, market consumers may alter their purchasing decision based on the contents of nutrition information.

The decision of bison purchasing entails various reasons and attribute dimensions, and the labeling of bison products can convey information that may not help consumers on purchasing decision (Caswell and Padberg, 1992), it is important to understand how consumers make the bison purchasing decision and what information they refer on their choices. Particularly,

nonusers of nutrition labels tend to be the ones who do not have enough nutrition knowledge (Klopp and MacDonald, 1981), so this type of consumers may not know about the benefit of bison nutrition information. In addition, the market price of bison is much higher compared with other commercial meats. Since the perception of the product quality may differ across customers, who would command a premium of WTP if they perceive high quality of products (McCluskey and Loureiro, 2003), it is necessary to understand whether bison consumers would command a premium if they perceive the bison quality compared with other premium quality commercial meats.

Data and Empirical Models

Meat consumers were surveyed from five states, i.e., Illinois (21%), Indiana (22%), Ohio (22%), Kentucky (16%), and Tennessee (17%). The survey was conducted through an existing consumer panel maintained by Zoomerang.com, an affiliate of MarketTools, Inc., and the primary data were collected during mid-September, 2012. Respondents were asked to classify themselves to the extent to which they knew about specific health benefits associated with bison products. Further, the surveyed respondents were randomly distributed into two different groups: one test group being showing nutrition comparison information (figure 1) and reference price for fresh ground bison and premium ground beef; and the other control group only showed the reference price for fresh ground bison and premium ground beef. The payment card method was used to elicit WTP.

The empirical models of this study focus on consumers' WTP for one pound of fresh ground bison. Premium ground beef, selected as a reference product most consumers would recognize, was sold at about $6.00 per pound. Consumers were provided WTP choice ranges from "$4.00" to "more than $10.00." The WTP for fresh ground bison is listed in the survey as: 1:

I do not wish to buy this product; 2: \$4.00; 3: \$4.50; 4: \$5.00; up to 15: more than \$10.00, so censored-type estimators, i.e., tobit and interval censored models, were applied to statistically analyze the results. The comparison of estimates from both models allows us to compare the differences of respondents' true WTP obtained from each estimator. The identical assumption of both models is normality, and the tobit model further assumes homoscedasticity. Tests for normality and homoscedasticity are performed.

Tobit is a censored normal regression model ($y^* = x'\beta + e$). Individuals may not want to consumer fresh ground bison, so they would indicate a zero for WTP. The tobit estimation is censored from below at zero ($y = \begin{cases} y^*, & if\ y^* > 0 \\ 0, & if\ y^* \le 0 \end{cases}$). However, consumers can choose their WTP more than \$10.00, so the tobit estimation is also censored from above at more than \$10.00 ($y = \begin{cases} y^*, & if\ y^* < U \\ U, & if\ y^* \ge U \end{cases}$), where U is the upper bound, more than \$10.00). In addition, it is reasonable to assume that respondents may have certain amount of WTP that is not provided in the list. Consumers' true value of WTP can lie on any point that is between the given WTPs. For instance, if consumer's WTP is \$6.75, this respondent may choose \$6.50 instead of \$7.00. The interval range of WTP for this category is \$6.50─\$6.99. Therefore, the interval boundaries (α's) are known and the true WTP will lie in regions $(-\infty, \alpha_1]$, $(\alpha_1, \alpha_2]$, ..., (α_J, ∞).

The empirical specification for tobit model is:

(1) $$WTP_{tobit} = y^*_{tobit} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_{17} X_{17} + \varepsilon$$

where WTP_{tobit} is consumers' WTP for fresh ground bison by using the tobit model. In addition, the empirical specification for interval censored regression is:

(2) $$WTP_{interval} = y^*_{interval} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_{17} X_{17} + \varepsilon$$

where $WTP_{interval}$ is consumers' WTP by using the interval regression model. The *WTPs* for fresh ground bison (variable y^*_{tobit} and $y^*_{interval}$) are individually accounted for 17 independent variables including given the bison nutrition information, knowledge of bison nutrition, socio-demographic variables, and regional characteristic variables.

The variable *Given nutrition info* shows that 49% of respondents were given bison nutrition information. In addition, we include the interaction terms for nutrition information and knowledge of bison nutrition, i.e. *Given info*Know bison nutrition* and *Given info*Know bison nutrition*. The premise here is that the information effect is likely to be different when measured across group with varying degrees of pre-existing nutrition knowledge. The socio-demographic variables include *Age*, *Male*, *Have kids under age 6 at home*, *Education*, *White*, and *Income*. The regional characteristic variables enclose *City* and *Suburb* to compare with rural, such as small town, countryside (but not a farm), and farm. Four states, i.e. *Illinois*, *Indiana*, *Ohio*, and *Kentucky*, are included to compare with *Tennessee*. The definitions and summary statistics of these variables are presented in table 1.

Empirical Results

The empirical results of tobit and interval censored models are exhibited in the table 2. The LR (χ^2) and Wald (χ^2) tests indicate that tobit and interval regression models are significantly different from zero, respectively. The normality assumption holds, and a robust estimator was applied for possible heteroskedasticity in the tobit and interval censored models. Our results exhibit how individuals may treat and react towards fresh ground bison through their WTP. Most estimated parameters of both models have very consistent outcomes, but the variable *Have kids under age 6 at home* reveals significant differences at the 10% level in the interval censored

model instead of in the tobit model. This result suggests that respondents who have kids under age 6 at home would likely pay less for fresh ground bison.

The outcomes of average marginal effects represent actual dollar differences of consumers' WTP premium for fresh ground bison. Respondents who were given bison nutrition information would like to pay about $0.43─$0.48 more for fresh ground bison compared to those who were not given nutrition information. Consumer knowledge of bison nutrition is self-recognized as "*Don't know the bison nutrition*," "*Assume bison nutrition same as beef*," and "*Know about the bison nutrition*." The majority of surveyed respondents are not sure about bison nutrition: over 60% of consumers don't know about the benefits of bison nutrition, approximately 20% of consumers assume that the benefits of bison nutrition just like beef, and about 20% of consumers know about the bison nutrition benefits. In terms of WTP for ground bison, respondents who know bison nutrition are willing to pay more about $2.68─$2.81 as compared with respondents who don't know bison nutrition at all. Respondents who assume that the bison nutrition just same as beef are willing to pay more about $1.70─$1.84 as compared with those who don't know bison nutrition. As a result, consumers' knowledge of bison nutrition can be positively related to higher WTP.

The variable *Given info*Know bison nutrition* explain an indirect effect among respondents who already know bison nutrition and were given a nutrition information. The result of the variable *Given info*Know bison nutrition* reveals that if respondents who already know bison nutrition and were given a nutrition information, they would like to pay less about $0.66─$0.74 per pound for fresh ground bison in compared to those who don't know bison nutrition and were given a nutrition information. This confirms that nutrition merchandising

programs are going to be most impactful among those who don't know the benefits of bison nutrition.

Younger male respondents with higher education and high income are more likely have positive WTP for fresh ground bison. If individuals are younger by one year, they have an additional $0.04 in actual WTP for fresh ground bison. Male individuals are willing to pay more about $0.57─$0.63 than female consumers. Education also has a positive effect. Each year of education contributes an additional $0.10 in WTP for fresh ground bison. Respondents have slight income sensitivity. Each additional $10,000 in annual household income suggests an additional $0.04─$0.05 in actual WTP for fresh ground bison. Although regional residence factors do not suggest significant differences (*City* and *Suburb)*, respondents from Illinois are willing to pay about $0.40 more than those who are from Tennessee.

In sum, the bison nutrition information is quite important to bison industry. Consumers in this study show positive responses to bison nutrition, particularly among the majority of consumers who still don't know the benefits of bison nutrition. Younger male consumers with higher education and high income and families without kids under age 6 also reveal strong interests in bison products.

Discussion and Conclusion

Although the bison industry is still fairly young compared to other commercial meat industries in the U.S., our empirical findings suggest that bison products have enormous opportunities to promote nutrition and better target potential consumers. Consumers are willing to pay more if they know the specific benefits of bison nutrition and if they don't know the bison nutrition but were given the nutrition information. Consumers are willing to pay less if they don't know the specific benefits of bison nutrition and were not given the bison nutrition. Therefore, promoting

and enhancing consumers' knowledge of specific benefits of bison nutrition can potentially increase bison products' market sales.

Our empirical results show that younger males, consumers with higher education and income and families without kids under age 6 at home would have higher WTP for fresh ground bison. Consumer location within the Ohio River Valley region does reveal slight differences. In particular, Illinois individuals would have higher WTP than Tennessee consumers, but geography seems to otherwise have little impact.

The access to bison products is relative limited comparing with other meats because of the scale of bison production and the premature of market distribution. This study presents several groups of potential consumers who have higher interests on ground bison around these five states. Especially, there are still fair amount of consumers who don't know about the bison nutrient benefits. The contribution of this study can help bison marketers to target the potential markets and consumers. The nutrition merchandising campaign and product education targeting those consumers who don't know the bison nutrient benefits will be appropriate during this stage.

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Table 1. Definitions and Sample Statistics of Variables (N = 2,644)

Variables	Description of Variables	Mean	Std. Dev.	Min.	Max.
WTP	The mid-point premium for each chosen WTP	3.52	3.18	0	10.5
Given nutrition info	Binary variable=1 if respondent was given bison nutrition information	0.49	0.50	0	1
Don't know bison nutrition	Binary variable=1 if respondent indicates that he/she don't know bison nutrition at all	0.61	0.48	0	1
Assume same as beef nutrition	Binary variable=1 if respondent assumes that bison nutrition is same as beef nutrition	0.17	0.38	0	1
Know bison nutrition	Binary variable=1 if respondent knows the specific health benefits of bison nutrition	0.20	0.40	0	1
*Given info*Same as Beef*	Binary variable=1 if respondent, who is also given bison nutrition information, assumes that bison nutrition is same as beef nutrition	0.08	0.28	0	1
*Given info*Know bison nutrition*	Binary variable=1 if respondent, who is also given bison nutrition information, knows the specific health benefits of bison nutrition	0.10	0.30	0	1
Age	Continuous variable; years of age	52.81	13.84	15	82
Male	Binary variable=1 if respondent is male, 0 otherwise	0.40	0.49	0	1
Have kids under age 6 at home	Binary variable=1 if respondent has kid aged under 6 years old at home	0.17	0.37	0	1
Education	Continuous variable: years of education	14.30	2.12	9	18
White	Binary variable=1 if respondent's race is white, 0 otherwise	0.92	0.26	0	1
Income	Continuous variable; total yearly household income before tax ($1,000)	60.12	41.14	7.5	237.5
City	Binary variable=1 if respondent is from city, 0 otherwise	0.20	0.40	0	1
Suburb	Binary variable=1 if respondent is from suburb, 0 otherwise	0.41	0.49	0	1
Rural	Binary variable=1 if respondent is from rural, 0 otherwise	0.38	0.48	0	1
IL	Binary variable=1 if respondent is from Illinois, 0 otherwise	0.21	0.41	0	1
IN	Binary variable=1 if respondent is from Indiana, 0 otherwise	0.22	0.41	0	1
KY	Binary variable=1 if respondent is from Kentucky, 0 otherwise	0.16	0.36	0	1
OH	Binary variable=1 if respondent is from Ohio, 0 otherwise	0.22	0.41	0	1
TN	Binary variable=1 if respondent is from Tennessee, 0 otherwise	0.17	0.37	0	1

Table 2. The Empirical Results of the Tobit and Interval Censored Models for Fresh Ground Bison

Estimator Dependent Variable: WTP	Tobit Coefficients	Marginal Effects After Tobit	Interval censored Coefficients	Marginal Effects After Interval
Given nutrition info	0.782***	0.482***	0.712***	0.431***
Assume same as beef nutrition	2.992***	1.846***	2.815***	1.702***
Know bison nutrition	4.556***	2.811***	4.437***	2.682***
*Given info*Same as beef*	-0.655	-0.404	-0.564	-0.341
*Given info*Know bison nutrition*	-1.203***	-0.742***	-1.105***	-0.668***
Age	-0.076***	-0.046***	-0.075***	-0.045***
Male	1.028***	0.634***	0.958***	0.579***
Have kids under age 6 at home	-0.360	-0.222	-0.433*	-0.261*
Education	0.164***	0.101***	0.177***	0.107***
Income	0.007***	0.004***	0.009***	0.005***
White	0.023	0.014	0.028	0.017
City	0.077	0.047	0.155	0.094
Suburb	-0.103	-0.063	-0.030	-0.018
IL	0.656**	0.405**	0.665**	0.402**
IN	0.069	0.042	0.134	0.081
KY	0.438	0.270	0.508	0.307
OH	0.387	0.238	0.405	0.245
Constant	1.020		0.375	
Number of observation	2,644		2,644	
Log Likelihood	-5,397		-5,711	
Sigma	4.480***		4.329***	
LR (χ^2)	532.920			
Pseudo R^2	0.047			
Wald (χ^2)			713,080	

Note: Asterisks indicate levels of significance: * = 0.10, ** = 0.05, and *** = 0.01.

NUTRITIONAL COMPARISON Per 100 GRAM SERVING – COOKED MEAT					
SPECIES	FAT GRAMS	CALORIES KCAL	CHOLESTEROL MG	IRON MG	VITAMIN B-12 MCG
Bison:	**2.42**	**143**	**82**	**3.42**	**2.86**
Beef (choice):	10.15	219	86	2.99	2.65
Beef (Select):	8.09	201	86	2.99	2.64
Pork:	9.66	212	86	1.1	0.75
Chicken (Skinless):	7.41	190	89	1.21	0.33
Sockeye Salmon:	10.97	216	87	0.55	5.80

Figure 1: Nutritional comparison for various meats.
Source: http://jacksonrecord.com/viewarticle.aspx?smid=1437&aid=1432