Consumers' Willingness-to-Pay for Retail Branded Beef Products with Bundled Attributes

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Abstract

With a declining share of the domestic meat market, some beef producers are becoming more attentive to opportunities for value-added products tailored to the desires of certain consumer segments. Using a survey of St. Louis and Kansas City, Missouri meat consumers, this study investigates perceptions of and willingness-to-pay for various value-added attributes that could be supplied as retail branded beef products. Factor analysis identifies two alternative attribute bundles as branding strategies based on perceived importance and complementarity of attributes. Nonparametric procedures provide conservative estimates of willingness-to-pay. Parametric methods identify types of consumers willing to pay significantly higher premiums.

Keywords: beef, branding, marketing, value-added, willingness-to-pay.

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The beef cattle industry has a substantial impact on the U.S. economy, contributing over $188 billion through direct and indirect activity (Otto and Lawrence 2001). Beef's share of domestic meat demand is declining and the U.S. beef herd continues to contract, as pork and poultry offer increasingly convenient, consistent, and less expensive products (Gillespie, Basarir, and Schupp, 2004; Plain 2010), leaving beef producers in search of ways to improve returns per head. European and U.S. consumers are becoming more concerned about how food is produced (Tonsor and Olynk 2010). A growing body of research addresses consumers' preferences and willingness-to-pay for branded foods produced under organic (Norwood and Lusk forthcoming), all natural (Springer, et al 2009), pasture-raised (Lusk, Fields, and Prevatt 2008; Xue, *et al*. 2009), environmentally friendly (Belcher, Germann, and Schmutz 2007), and/or humane conditions (Prickett, Norwood, and Lusk 2007; Tonsor, Olynk, and Wolf 2009; Tonsor and Olynk 2010).

This study investigates consumers' perceptions of and willingness-to-pay for various value-added attributes that could be supplied as retail branded beef products—U.S. produced, locally produced, organic, all natural, grass-fed/lean, nature friendly (habitat conserving), and low carbon footprint. An online survey of 406 Kansas City and St. Louis, Missouri consumers conducted in November, 2010, provides respondents' importance ratings for each attribute (1 = very unimportant through 4 = very important) and willingness-to-pay estimates for steaks with each attribute selected from predefined ranges. Factor analytic methods (Hair *et al*. 1995) are applied to respondents' importance ratings to explore which attributes may be bundled in branding endeavors. Since mean and median estimates of willingness-to-pay can vary dramatically (Haab and McConnell 1997), we employ the distribution-free Turnbull (1976)

estimator to derive a lower bound non-parametric estimate of mean willingness-to-pay, which should be more appealing to decision makers (Carson, Wilks, and Imber 1994; Haab and McConnell 1997; Lichtenberg and Zimmerman 1999; Giraud, Loomis, and Cooper 2001). The approach requires only that the distribution function to monotonically converges for higher bid prices. It does not impose additional assumptions on the distributional form, and it does not permit negative estimates of willingness-to-pay (Haab and McConnell 1997). A drawback of the approach is that the influence of demographics on willingness-to-pay cannot be ascertained, whereas such an analysis is feasible using parametric methods (Giraud, Loomis, and Cooper 2001). Hence, average values of the willingness-to-pay ranges selected by respondents are regressed on demographic variables in tobit and ordered probit procedures to provide insights into the target consumer segments for branded beef products.

The remainder of the paper is organized as follows. The next section discusses the empirical procedures employed and summarizes general findings of the empirical literature on willingness-to-pay estimates to motivate the current application of the distribution-free Turnbull (1976) estimate. Subsequently, a description and analysis of the consumer survey data is presented. The paper concludes with recommendations for branding strategies using bundled meat attributes, given the summarized results.

Empirical Procedures

Factor analytic methods (Hair *et al*. 1995), utilizing the common variance among respondents' importance ratings for meat attributes, are used to explore which attributes may be bundled in branding endeavors. Through exploratory factor analysis, relationships between relevant survey items are summarized as a smaller set of more parsimonious variables—eigenvectors, also called

factors (Thompson 2004). Several methods are available for extracting factors and rotating the solution to a simple structure, where each item loads substantially on only one factor and only negligibly on others (Bryant et al. 1995). Here, we employ the commonly used principal components factor analysis extraction method (Bryant et al. 1995) and Varimax rotation, which generally results in reasonably interpretable simple structure (Thompson 2004). Orthogonal solutions, such as those obtained by Varimax rotation, are more parsimonious than their oblique counterparts, since fewer parameters are estimated under orthogonal rotation (Thompson 2004). Factor analysis was conducted in SPSS.

Surveys and experiments commonly are used to derive non-market contingent valuations of willingness-to-pay, which may be computed by parametric or non-parametric means (c.f., Haab and McConnell 1997). In general, the literature supports using simple and flexible approaches, given the cognitive burden of more complex approaches on respondents (Lusk and Norwood 2005) and that uncertainty often exists regarding the true form of the utility function (Lusk and Norwood 2009) and the willingness-to-pay distribution (Haab and McConnell 1997). Lusk and Norwood (2005; 2009) examine several commonly used experimental designs and find that none generated biased valuation estimates, suggesting that more involved procedures may not be worth the cost in terms of ease of survey administration. Haab and McConnell (1997) demonstrate that parametric models are sensitive to the assumed distribution and that these approaches can yield counterintuitive negative mean willingness-to-pay estimates.

A description of the process used to arrive at the distribution-free Turnbull (1976) estimator for the current study follows from work of Haab and McConnell (1997).[1] Here, we suppress individual-specific coefficients for simplicity. Assume each respondent is offered M bid prices (or price ranges) represented by s_j ($j = 1, 2, \ldots, M$) and N_j and Y_j refer to the number

of no and yes responses to s_j, respectively. For $j > k$, $s_j > s_k$ and $s_0 = 0$. The probability that an individual's willingness-to-pay (W) is in the interval S_{j-1} to S_j can be specified as:

$p_j = P(s_{j-1} < W \leq s_j)$ for $j = 1, \ldots, M+1$.

A consumer (respondent) is allowed to choose between each of the j intervals, and the buyer chooses an interval s_j where $s_{M+1} = \infty$ for above the maximum interval provided. Thus, the cumulative density function, F_j, can be specified as:

$F_j = P(W \leq s_j)$ for $j = 1, \ldots, M+1$, and $F_{M+1} = 1$.

Thus, the cumulative and probability density functions can be computed from a set of respondents' 0 or 1 responses using the following steps:

a. $F_j = N_j/(N_j + Y_j)$, N_j and Y_j refer to the number of no and yes responses, respectively, for the willingness-to-pay interval s_j,
b. Compare F_j to F_{j+1}
    1. If $F_j > F_{j+1}$, continue to c) or
    2. If $F_{j+1} > F_j$, aggregate so that $F_j = F_j + F_{j+1}$ and repeat until $F_j > F_{j+1}$,
c. Continue, until the cumulative density function is a monotonically increasing function, and
d. Compute probability density function as the difference between the cumulative density functions between the relevant ranges

Using the minimum values of the willingness-to-pay intervals offered, compute the expected lower bound (l.b.) willingness-to-pay as:

$$E(\text{l.b. willingness-to-pay}) = 0 \cdot p(0 \leq W < s_1) + s_1 \cdot p(s_1 \leq W < s_2) + \ldots s_M \cdot p(s_M \leq W < s_{M+1}).$$

For the current analysis, the cumulative density function, probability density function, and expected value of the lower bound willingness-to-pay are computed in Microsoft Excel® 2007.

Finally, a tobit regression analysis is performed to investigate factors contributing to respondent's willingness-to-pay for various meat attributes. For each meat attribute considered, the underlying model is

$$y^* = X\beta + u, \tag{1}$$

where X is a matrix of explanatory variables, β is a vector of coefficients, u is a vector of normally distributed error terms, and y^* is a continuous latent variable of the form

$$\begin{aligned} y &= Y_{Low} \text{ if } y^* \leq Y_{Low} \\ y &= y^* \text{ if } Y_{Low} < y^* < Y_{High} \\ y &= Y_{High} \text{ if } y^* \geq Y_{High}. \end{aligned} \tag{2}$$

For the current application, Y_{High} = \$16 and Y_{Low} = \$9 are maximum and minimum steak prices per pound for a set of predefined ranges from which survey respondents selected the category best representing their willingness-to-pay for the attribute. The model is that of a censored dependent variable due to observations occurring at the limits. Models are estimated in STATA.

Empirical Analysis

Summary statistics for respondent demographics and purchasing patterns are presented in Table 1. Age varied between 21 and 65 with a mean of 44. Seventy-two percent of respondents were female. Household income varied between \$12,500 and \$150,000 with a mean of \$78,000, suggesting that at least a portion of the sample represents a relatively affluent population. About a third of respondents currently purchase all-natural, grass-fed/lean, or locally produced beef, and around two thirds purchase U.S. produced beef. Only 20% purchase organic beef. Sixty-two percent make beef purchases based on health considerations, while 22% support local producers. Notably, less than 10% purchase beef for environmental or animal welfare reasons, suggesting that these traits may have to be combined with other attributes to support a brand.

This finding is consistent with Tonsor and Olynk's (2010) finding that animal welfare media has no impact on beef demand and little impact for pork and poultry demand.

Though, on average, there is only a moderate likelihood that respondents will seek to find more information about grassland management and nature friendly beef or purchase nature friendly beef (Table 1), notable portions of respondents indicated that they are very likely to do so (Figures 1 and 2). Similarly, while respondents indicated that various value-added meat attributes are moderately important to important on average (Table 2), some respondents indicated that these attributes are very important (Figure 3).

Given that less than 10% of respondents make beef purchases for environmental reasons, it is important to consider what other attributes might be combined with nature friendly to constitute a viable branding strategy. Such strategies should consider consumers' perceptions regarding the complementarity of attributes and also complementarity in cost of attribute provision. Respondents' selections for attributes that complement nature friendly beef and the one that seemed to be the best complement are reported in Table 3. Over half of respondents indicate that U.S. and locally produced (59% and 51%), all natural (57%), and grass-fed/lean (53%) complement the nature friendly attribute. The two traits most often selected as the best complement to the nature friendly attribute are all natural (30%) and grass-fed/lean (20%).

Correlations among importance ratings and factor analysis of complementarity and importance ratings provide further insights. Again, all natural and grass-fed/lean are related to nature friendly as only low carbon footprint and organic are more correlated with nature friendly (Table 4). Factor analysis of respondents' selections of attributes complementing nature friendly (see the first three columns of Table 5) reveals two components or factors with eigenvalues greater than 1 (i.e., the conventional K-1 rule due to Kaiser). Organic, all natural, and low

carbon footprint comprise the first component, as indicated by factor loadings in excess of 0.40. The second component consists of grass-fed/lean and locally and U.S. produced. These represent two potential attribute bundling strategies for branding. Corresponding analysis of respondents' importance ratings reveals only one component using the conventional rule of eigenvalues greater than one (columns 4 and 5 of Table 5). Since bundling multiple attributes in a brand may also entail additional costs, a more stringent degree of distinction is considered by selecting components with eigenvalues greater than 0.80 (last three columns of Table 5). This approach suggests two components or possible attribute bundling strategies for branding—one comprised of nature friendly, low carbon footprint, organic, all natural, and grass-fed/lean and a second comprised of locally and U.S. produced and possibly all natural and grass-fed/lean.

Summary statistics for respondents' reported willingness-to-pay for Kansas City strip steaks with various value-added attributes and for other cuts with any combination of these attributes are reported in Table 6. Table 7 compares the mean premiums to more conservative Turnbull lower bound estimates of the premiums consumers are willingness-to-pay. In each case, the highest premiums are indicated for grass-fed/lean, organic, and all natural at nearly $1 per pound (a 10% premium) on average with lower bounds between $0.60 and $0.70 per pound. Lower premiums are indicated for low carbon footprint, U.S. and locally produced, and nature friendly attributes. These values are similar to those reported in other studies. In a study on consumer perceptions of beef with environmental and habitat conserving attributes, Belcher, Germann, and Schmutz (2007) report mean (median) willingness-to-pay premiums of 14% (10%) for food products with environmental attributes. Lusk, Fields, and Prevatt (2008) report that consumers are willing to pay premiums of $1.07 and $0.82 per *choice occasion* for pasture-grazed ground beef and steak, respectively. Xue, *et al*. (2009) report somewhat higher mean

willingness-to-pay premiums between $1.66 and $2.07 per pound for pasture-fed relative to conventional New York strip steaks, depending on location.

Table 8 shows marginal effects for two-limit tobit models of respondents' reported willingness-to-pay for Kansas City Strip Steaks with various value-added attributes based on demographics and previous meat purchases. Ordered probit regressions yield qualitatively similar results, in terms of sign and significance of coefficients and poor R^2, and are available from authors upon request. Generally, those with higher incomes and females are willing to pay significantly more for the selected attributes. Females are willing to pay between $0.25 and $0.60 per pound more, depending on attribute. An additional year younger implies a willingness-to-pay of about $0.01 per pound more for organic steak. Respondents who purchase grass-fed/lean and organic meat are also willing to pay significantly more for many of the selected value-added attributes.

Conclusion

This paper investigates consumers' perceptions of and willingness-to-pay for various meat attributes. Consumers' place notable importance on most of the attributes considered. Results of factor analysis suggest that nature friendly, organic, all natural, low carbon footprint, and posssibly grass-fed/lean are perceived to be similar in terms of complementarity and perhaps importance, as are a second group comprised of locally and U.S. produced and possibly all natural and grass-fed/lean attributes. These results are consistent with consumers' responses regarding which attributes (best) complement the nature friendly beef attribute. Hence, one branding strategy may be to combine nature friendly with organic or all natural and possibly grass-fed/lean attributes. It may be easier to certify all natural than organic, so costs and benefits

should be weighed between the two alternatives. While correlation and factor analysis suggests that respondents perceive grass-fed/lean to be somewhat less related to nature friendly than organic and all natural, two limit tobit regressions indicate that respondents who purchase grass-fed/lean meat are willing to pay significantly more for nature friendly beef. These regressions provide further insights into who may be willing-to-pay greater premiums for such value-added attributes. In general, younger people, females, and those with higher incomes appear more receptive of branded products with several of these attributes.

Future research may evaluate additional demographic variables' impacts on willingness-to-pay for such attributes in a larger national survey to better define and target key consumer segments for branding strategies and to determine the generalizability of results presented here. Future work may also collect information on cost and process of delivering individual attributes to determine complementarities in provision. In combination with consumers' perceptions of attribute complementarity, complementarities in cost of attribute provision will help determine appropriate attribute bundling strategies.

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Endnotes:

[1] See Haab and McConnell (1997) for a description of the theoretical underpinnings of the Turnbull estimator and a derivation of the corresponding log-likelihood function. Since the first-order conditions to maximize the log-likelihood function are found by solving recursively, we outline the appropriate steps here.

Table 1. Summary Statistics for Respondent Demographics and Purchasing Patterns.

	Minimum	Maximum	Mean	Std. Deviation
Age	21	65	44.19	13.35
Female	0.00	1.00	0.72	0.45
Income	12,500	150,000	78,001	40,844
Currently Buys:				
All Natural	0.00	1.00	0.35	0.48
Grass-fed/Lean	0.00	1.00	0.31	0.46
Locally Produced	0.00	1.00	0.36	0.48
Low Carbon Footprint	0.00	1.00	0.04	0.20
Organic	0.00	1.00	0.20	0.40
U.S. Produced	0.00	1.00	0.67	0.47
Commodity/Standard	0.00	1.00	0.12	0.33
Reasons for purchases:				
Environmental	0.00	1.00	0.08	0.27
Healthy	0.00	1.00	0.62	0.49
Support local producers	0.00	1.00	0.22	0.41
Animal welfare	0.00	1.00	0.09	0.28
Likelihood Respondent will: [a]				
Research Nature Friendly Beef	1.00	4.00	2.63	0.81
Research grassland preservation	1.00	4.00	2.71	0.76
Visit Nature Friendly farms	1.00	4.00	2.18	0.84
Ask Grocer for Nature Friendly	1.00	4.00	2.56	0.79
Ask Restaurant for “ ”	1.00	4.00	2.28	0.78
Purchase Nature Friendly Meat	1.00	4.00	2.89	0.75

Note: N = 406.

[a] Scale is from 1=“very unlikely” to 4=”very likely”

Table 2. Importance of Value-Added Meat Attributes.

	Minimum	Maximum	Mean	Std. Deviation
Importance of attribute: [a]				
All Natural	0.00	4.00	2.99	0.76
Grass-fed/Lean	0.00	4.00	2.95	0.76
Locally Produced	0.00	4.00	2.85	0.72
Low Carbon Footprint	0.00	4.00	2.45	0.77
Nature Friendly	0.00	4.00	2.74	0.77
Organic	0.00	4.00	2.47	0.90
U.S. produced	0.00	4.00	3.17	0.86

Note: N = 406.

[a] Scale is from 1="very unimportant" to 4="very important"

Table 3. Complementarity of Other Attributes with Nature Friendly Meat.

	Minimum	Maximum	Mean	Std. Deviation
Complements:				
All Natural	0.00	1.00	.57	0.50
Grass-fed/Lean	0.00	1.00	.53	0.50
Locally Produced	0.00	1.00	.51	0.50
Low Carbon Footprint	0.00	1.00	.20	0.40
Organic	0.00	1.00	.36	0.48
U.S. Produced	0.00	1.00	.59	0.49
None	0.00	1.00	.06	0.24
Best Complements:				
All Natural	0.00	1.00	.30	0.46
Grass-fed/Lean	0.00	1.00	.20	0.40
Locally Produced	0.00	1.00	.09	0.29
Low Carbon Footprint	0.00	1.00	.06	0.24
Organic	0.00	1.00	.13	0.34
U.S. Produced	0.00	1.00	.16	0.37
None	0.00	1.00	.03	0.18

Note: N = 406.

Table 4. Correlations among Importance Ratings.

	All Natural	Grass-fed/ Lean	Locally Produced	Low Carbon Footprint	Nature Friendly	Organic	US produced
All Natural	1.00	0.58	0.41	0.45	0.58	0.51	0.40
Grass-fed/ Lean	0.58	1.00	0.45	0.43	0.48	0.45	0.34
Locally Produced	0.41	0.45	1.00	0.45	0.44	0.33	0.40
Low Carbon Footprint	0.45	0.43	0.45	1.00	0.67	0.49	0.22
Nature Friendly	0.58	0.48	0.44	0.67	1.00	0.49	0.27
Organic	0.51	0.45	0.33	0.49	0.49	1.00	0.33
U.S. produced	0.40	0.34	0.40	0.22	0.27	0.33	1.00

Note: N = 406.

Table 5. Factor Analysis Rotated Component Matrices.

(Eigenvalues >1)			(Eigenvalues >1)		(Eigenvalues >0.8)		
	Complementary Components			Importance Component		Importance Component	
	1	2		1		1	2
All Natural	**0.61**	0.14	All Natural	0.79	All Natural	**0.63**	0.49
Grass-fed/Lean	0.34	**0.41**	Grass-fed/Lean	0.75	Grass-fed/Lean	0.57	0.49
Local	0.16	**0.71**	Local	0.68	Local	0.42	**0.59**
Low Carbon Footprint	**0.61**	0.11	Low Carbon Footprint	0.75	Low Carbon Footprint	**0.85**	0.08
Organic	**0.81**	-0.06	Nature Friendly	0.80	Nature Friendly	**0.85**	0.18
U.S.	-0.09	**0.78**	Organic	0.72	Organic	**0.66**	0.31
			U.S.	.552	U.S.	.045	**0.91**

Note: N = 406. Extraction Method: Principal Component Analysis of Correlation Matrix. Rotation Method: Varimax with Kaiser Normalization.

Table 6. Summary Statistics of Willingness-to-Pay for Meat with Various Attributes.

	Minimum	Maximum	Mean	Std. Deviation
Kansas City Strip Steak ($):				
Nature Friendly	9.00	16.00	10.77	1.31
All Natural	9.00	16.00	10.95	1.35
Grass-fed/Lean	9.00	16.00	11.09	1.58
Locally Produced	9.00	16.00	10.83	1.38
Low Carbon Footprint	9.00	16.00	10.49	1.12
Organic	9.00	16.00	11.00	1.57
U.S. Produced	9.00	16.00	10.69	1.26
Any combination of Attributes:				
(-1="less", 0="same", 1="more")				
Hamburger	-1.00	1.00	-0.02	0.557
Ribs	-1.00	1.00	0.02	0.537
Roast	-1.00	1.00	0.08	0.510
Stew	-1.00	1.00	-0.10	0.525

Note: N = 406.

Table 7. Mean and Turnbull Lower Bound Estimates of Willingness-to-Pay for Steak with Various Attributes.

	Mean Premium	Turnbull Lower Bound
Kansas City Strip Steak ($):		
Nature Friendly	0.77	0.57
All Natural	0.95	0.67
Grass-fed/Lean	1.09	0.70
Locally Produced	0.83	0.57
Low Carbon Footprint	0.49	0.39
Organic	1.00	0.63
U.S. Produced	0.69	0.49

Note: N = 406.

Table 8. Marginal Effects for Tobit Regressions of Willingness-to-Pay.

	Nature Friendly	U.S. Produced	Locally Produced	Grass-fed/ Lean	Low Carbon Footprint	Organic	All Natural
AGE	-0.0057	0.0058	-0.0026	-0.0088	0.0038	-0.0101*	-0.0042
	(0.0050)	(0.0050)	(0.0054)	(0.0061)	(0.0045)	(0.0058)	(0.0053)
FEMALE	0.4019***	0.4143***	0.3419**	0.3188*	0.2487*	0.6092***	0.0756
	(0.1468)	(0.1481)	(0.1590)	(0.1806)	(0.1308)	(0.1706)	(0.1566)
INCOME	0.0031*	0.0009	0.0031*	0.0068***	0.0025*	0.0042**	0.0029*
	(0.0016)	(0.0017)	(0.0018)	(0.0020)	(0.0015)	(0.0019)	(0.0018)
All Natural	0.0146	0.0523	-0.0391	0.1125	0.0676	0.0670	0.2091
	(0.1465)	(0.1480)	(0.1591)	(0.1801)	(0.1306)	(0.1695)	(0.1566)
Grass-Fed/ Lean	0.3561**	0.3850**	0.3372**	0.7864***	0.3287*	0.1631	0.4638***
	(0.1497)	(0.1513)	(0.1622)	(0.1840)	(0.1336)	(0.1733)	(0.1601)
Locally	0.1943	-0.0095	0.4295***	0.2569	0.0297	-0.0026	0.1442
	(0.1384)	(0.1399)	(0.1500)	(0.1702)	(0.1233)	(0.1605)	(0.1481)
Low Carbon Footprint	0.5973*	0.3097	0.0014	-0.3971	0.7040	-0.0140	0.1028
	(0.3427)	(0.3469)	(0.3728)	(0.4207)	(0.3053)	(0.3954)	(0.3663)
Organic	0.7965***	0.5190***	0.9404***	0.8017***	0.6330	1.8866***	0.6280***
	(0.1838)	(0.1858)	(0.1993)	(0.2259)	(0.1636)	(0.2127)	(0.1967)
US	0.3292**	0.2568*	0.1023	0.1984	0.0898	0.3323**	0.1448
	(0.1385)	(0.1398)	(0.1501)	(0.1701)	(0.1235)	(0.1606)	(0.1480)
N censored at WTP ≤ 9	29	29	34	35	37	41	3
Uncensored N	375	374	368	366	366	360	373
N censored at WTP ≥ 16	2	3	4	5	3	5	30
R^2	0.0521	0.0285	0.0449	0.0473	0.0443	0.0821	0.0340

Note: N = 406.

Figure 1. How Likely are You …

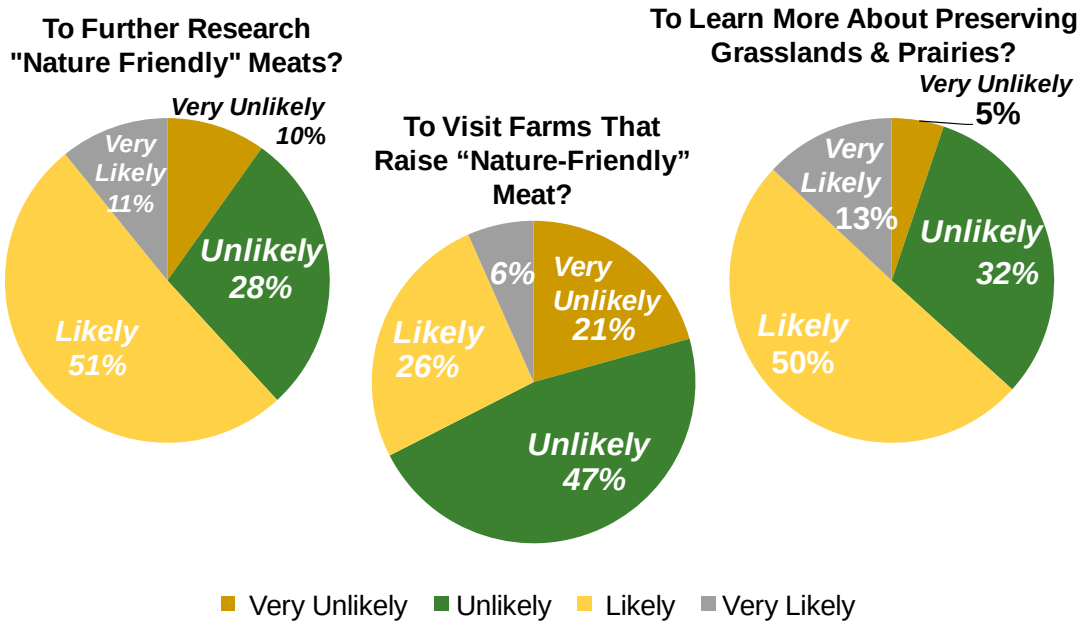

Figure 2. How Likely are You to Purchase Nature-Friendly Meat …

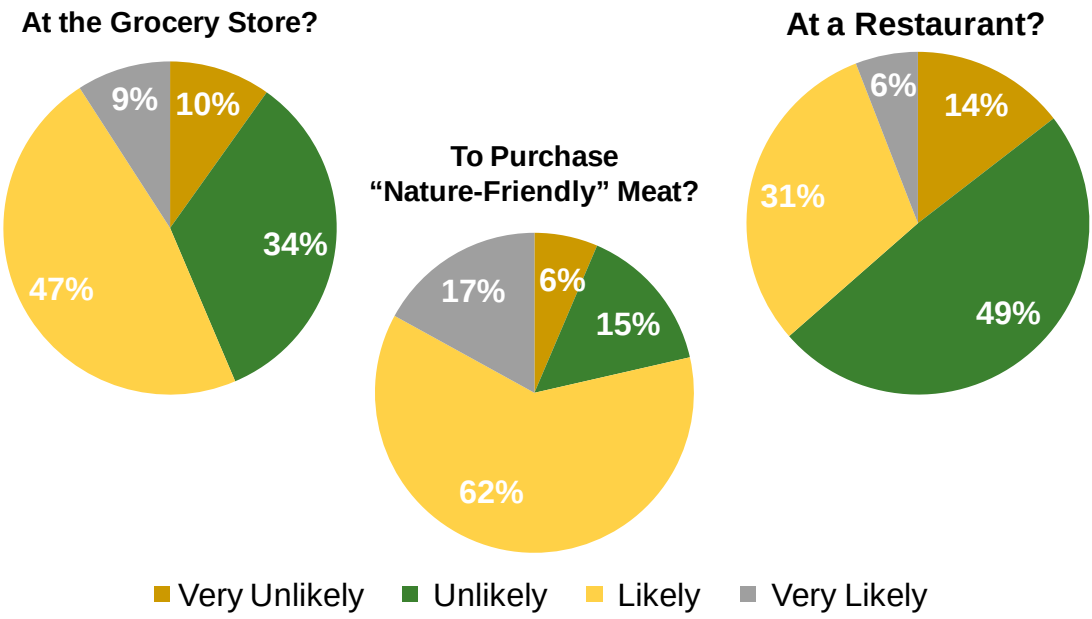

Figure 3. Importance of Selected Meat Attributes.