Hispanic Consumers' Preferences and Willingness-to-Pay for Pasture-Fed Beef in Virginia

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ABSTRACT

Experimental Economics methods are used to determine Hispanic consumers' sensory acceptance of pasture-fed beef and evaluate visual and taste influences on their overall preferences and willingness-to-pay (WTP). Two hundred and thirty-one Hispanic consumers in four experimental sites in Virginia participated in a laboratory experimental procedure where they visually examined and tasted pasture-fed and conventionally produced grain-fed beef, and then participated in a non-hypothetical Multiple Price Lists (MPL) experiment to determine their WTP. Hispanic consumers perceived significant differences between pasture-fed and grain-fed beef's appearance and taste. Visual and taste acceptances are closely correlated to and significantly influence overall preferences. More than fifty percent of Hispanic consumers prefer pasture-fed beef and the majority of them consistently are willing to pay a price premium. Approximately, half consumers who generally prefer pasture-fed beef consistently consider the appearance and taste of pasture-fed beef more favorable but another half of them indicated discrepant visual and taste acceptances. Nevertheless, this inconsistency doesn't lead to a lower WTP for pasture-fed beef.

Keywords: Pasture-Fed Beef, Experimental Economics, Multiple Price Lists, Preference, Willingness- to-pay

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In U.S beef markets, consumers are showing increasingly heterogeneous preferences for beef attributes and are increasing their consumption of beef produced using alternative production methods (Boland and Schroeder 2000, Field et al. 2006). One such product, pasture-fed beef (PFB), comes from cattle that are fed grass, forage, or silage and graze on pasture over their lifespan. PFB is promoted as more healthy, nutritious, and environmentally benign than conventionally produced grain-fed beef (GFB), and is gaining increasing interest in the U.S. beef market (Lozier 2003, Rayburn 2003, Robinson 2004). Due to the different feeding practices used, PFB presents distinct quality and sensory attributes from conventional GFB. Numerous studies have shown that PFB has darker meat muscles and yellow fat rather than cherry-red muscles and white fat typically seen with conventional GFB (Bowling et al. 1977, Crouse 1984, Marts 2000, Miur 1998, Robinson 2004). Pasture-fed cattle's carcass are also leaner than conventional GFB, and the use of grass-based diets make the flavor of PFB different from conventional GFB so that it may seem "intense" to consumers who typically eat conventional GFB (Martz 2000, Rayburn 2003). As the U.S. bases its beef production primarily on feedlot and high-energy grain feed, the distinct visual appearance and taste of PFB sees mixed acceptance by mainstream consumers who are accustomed to conventional GFB (Bowing et al. 1977, Martz 2000, Robinson 2004, Umburger 2002). In contrast, beef production systems in many Hispanic/ Latin countries, such as Mexico, Venezuela, Brazil, and Argentina are typically grass-based and people in these countries traditionally consume grass-fed beef products (Myers 1980, Paganini 2004, USDA/FAS 1997**).** Thus, as heavy beef eaters and the fastest-growing ethnic population in the U.S, Hispanics are hypothesized to constitute a promising potential market for PFB. However, no known research has been done to understand Hispanic consumers' preferences and values on PFB. This study uses experimental economics methods to evaluate Hispanics' preferences and WTP for PFB and explore the potential market in the context of Virginia given the ethnic-diverse population and fast-growing Hispanic group in this region. The overall objective of this paper is to assess Hispanic consumers' acceptance of and willingness to pay for PFB.

A secondary objective of the paper is to investigate Hispanic consumers' visual and taste acceptance for PFB and link these to their overall acceptance of and WTP for the product. Generally,

consumers use different criteria to evaluate the quality of beef products at different stages of consumption. At the time of purchasing, consumers develop their expectations of beef quality by inspection of its visual attributes, such as color, cuts, and marbling (Acebron and Dopico 2000, Becker 2000, Grunert 1997). The expected quality determines consumers' visual satisfaction on the beef product and consequently affects their purchase decision. At the time of consumption, consumers obtain actual eating experience and form their taste acceptability by examining taste attributes such as flavor, tenderness, and juiciness. Nevertheless, previous studies suggest that consumers' visual and taste experience are not always consistent and possibly have counteracting roles in determining the potential acceptance of beef products. (Acebron and Dopico 2000, Melton et al. 1996, Umburger 2002). For example, Umburger (2002) shows that a low level of marbling preferred by consumers may lead to an unfavorable taste experience. Melton et al.(1996) reveals contradictory visual and taste acceptance across presentation formats. Thus a secondary objective of the research is to ascertain whether conflicting responses exist among Hispanic consumers and how these affect their overall preferences and WTP for PFB.

Objectives

Through experimental economics methods, this study aims to understand Hispanic consumers' visual and taste acceptance for PFB and assess the visual and taste influences on Hispanic consumers' overall preferences and WTP for PFB. Specifically, the objectives of this study are to: 1) evaluate Hispanic consumers' visual and taste acceptances for PFB and determine the sensory attributes that are important in their visual and taste evolutions; 2) examine the relationship and assess the consistency between visual, taste, and overall preferences; explore the specific visual and taste influences on their preference; 3) evaluate Hispanic consumers' WTP for PFB and investigate the relationship between Hispanic consumers' sensory preferences and valuations for PFB.

Theoretical and Empirical Model

According to Lancaster's (1966) approach to consumer theory, consumers' utilities or preference orderings are defined as a function of the characteristic bundle of the product. Here, we classify two types of product characteristics, visual and taste attributes, to determine the consumers' expected and experienced preferences. The widely perceived visual cues include freshness, cut, color, marbling, meat texture, and fat lumps whereas tenderness, juiciness and flavor are typically identified as relevant

experienced quality attributes (Acebron and Dopico 2000, Becker 2000, Miller 2007, Grunert 1997, Umburger 2007). In this study, six sensory attributes, lean meat color, fat color, meat texture, tenderness, juiciness and flavor, are chosen given their importance in consumers' visual and taste appraisals.

We extend Lancaster to include consumers' characteristics in that they are significant indicators in consumers' preferences and WTP as shown in various studies. Moreover, information such as beef eating and consumption behavior are also considered important in predicating consumers' preference (Evans 2007, Lusk et al. 2001, Umberger 2002 and 2007).

According to random utility model (RUM), if an individual consumes alternative beef product j from the choice set {1, 2, ..., J}, s/he obtains conditional utility:

$$U_{ij} \equiv \beta_{ij}^{'} x_{ij} + \varepsilon_{ij}$$

Where x is a vector of independent variables, including visual and taste attributes for alterative j, individual *i*'s demographic and socio-economic characteristics, and other relevant factors such as the individual's beef consumption behavior. ε_{ij} is i.i.d and subject to normal distribution.

Individual i choose alternative j over choice k if and only if

$$\Delta U_j > 0 \; where \; \Delta U_j = U_{ij} - U_{ik}, \;\; j,k \in \{1,2,\dots,J\}, j \neq K$$

Due to the unobservability of utility, we can only observe the choice outcomes of consumers. In the study, consumers face two choices, PFB and conventional GFB. Therefore, the *ith* individual's choice outcomes are binary with 1 representing PFB and 0 otherwise,

$$y_i = \begin{cases} 1, & if \; \Delta U_i > 0 \\ 0, & otherwise \end{cases}$$

Where $\Delta U_i = U_{iPFB} - U_{iGFB}$

Three types of preferences are evaluated in this study: visual, taste, and overall preferences, so we have

$$y_{im} = 1 \; if \; \Delta U_{im} > 0 \; and \; 0 \; otherwise, for \; m \in \{1,2,3\}$$

where *m* represents the three types of preferences with 1 for visual, 2 for taste, and 3 for overall preference. Since the error terms of the three latent utilities are correlated, a Multivatirate Probit model may be appropriate to test the relationship between the three types of preferences (Green 2000).

$$\Pr(y_{im}, m = 1,2,3|\beta,\Sigma) = \int_{A1}\int_{A2}\int_{A3} \phi(z_1, z_2, z_{2,}\rho_{12,}\rho_{13}, \rho_{23}) dz_1 dz_2 dz_3)$$

$$\Sigma = \begin{bmatrix} 1 & \rho_{12} & \rho_{13} \\ & 1 & \rho_{23} \\ & & 1 \end{bmatrix}$$

where ϕ is the density function of a multivariate normal distribution with mean vector 0 and the variance-covariance matrix (correlation matrix) Σ, β is a vector of explanatory variables, and A_i is the interval $(-\infty, \beta_i' X_i)$ if $y_{im} = 1$ and $(\beta_i' X_i, \infty)$ if $y_{im} = 0$ (Chib and Greenberg 1998, Choo and Mokhtarian 2008)

Experiment Procedure

From September to November 2008, laboratory experiments were conducted in four sites in Virginia to evaluate Hispanic consumers' preferences and WTP for PFB in comparison with conventional GFB. The four experimental sites, Galax, Roanoke, Richmond, and Blacksburg, were chosen to maximize the diversity of subjects so that broad representation of different socio-economic groups within the Hispanic population in Virginia could be achieved. In order to detect consumers' preference heterogeneity, experiments were conducted with non-standard subjects[1] rather than standard student subjects[2] typically in conventional laboratory experiments (Harrison and List 2004). Subjects were required to consume and purchase beef products regularly in order to ensure that they were familiar with the values of various beef products and had an underlying willingness to consume beef. Two hundred and thirty one subjects were recruited among Hispanic consumers at area Hispanic or Spanish-speaking churches, Hispanic restaurants, supermarkets and grocery stores, Hispanic or international food stores, libraries, and universities. Respondents were primarily from Mexico, El Salvador, Honduras, Colombia, Puerto Rican, Cuban, Dominican, or other Hispanic/Latino countries.

There were five to seven sessions in each experiment site. Each session typically had 8-15 subjects and lasted 1 to 1.5 hours. Subjects were assigned to one session according to their time preferences and availability. By considering income levels and the transportation costs in each experiment site, subjects were paid to compensate their participation ($30 in Galax and Roanoke and 50$ in Richmond and Blacksburg, respectively). Five instruments were used in the experiments: a written survey, visual evaluation, taste test, overall evaluation, and a Multiple Price Lists (MPL) experiment. As a contingent valuation method, the application of MPL has a long history in elicitation of hypothetical valuation (Harrison et al. 2004). Andersen et al. (2007) conducted in-lab MPL

[1] Recruited in fields rather than an academic setting, therefore presenting diverse demographic characteristics and information. (Harrison and List 2004)

[2] Primarily consists of students due to easy accessibility to experimenters. (Harrison and List 2004)

experiments in a non-hypothetical setting and indicate that non-hypothetical MPL leads to robust valuations in laboratory experiments. In order for incentive compatibility, this study was` designed to apply MPL to a non-hypothetical environment since real products (PFB and conventional GFB), real money, actual transactions involved.

On arrival to experiment facility at a scheduled session and time, subjects participated in a five-step experiment as illustrated in figure 1.

Step 1: Subjects filled out a written survey. This survey collected data regarding subjects' demographic and socio-economic characteristics, beef consumption and purchase behavior, ethnic background, and other relevant information. Questions in the ethnic background section were used to measure subjects' acculturation degree.

Step 2: After written survey, subjects were presented two different types of beef steak labeled "Sample A" and "Sample B." The two beef samples were displayed in polystyrene plates for evaluation. Both samples were New York Strip at the same marbling level (USDA Select) and were similar in size, seam fat distribution, and trim level. Sample A was conventional GFB and sample B was PFB steak. Subjects were not informed what type of beef each sample was. They visually evaluated the two beef samples and rated individual visual attributes of lean meat color, fat color, and meat texture for each sample using seven-point scales (See table 3). After rating attributes for both samples, subjects indicated which one, Sample A or Sample B, they preferred visually.

Step 3: After visual evaluation, subjects tasted two types of beef steak labeled 'Sample #1' and 'Sample #2.' Sample A was conventional GFB and Sample B was PFB. Both samples were New York Strip with the same degree of marbling (USDA Select) and had similar size, seam fat distribution, and trim level. Beef samples in the taste test were cooked to medium or medium-well done. Upon sampling each type of beef, subjects rated tenderness, juiciness, and flavor for each sample based on seven-point scales (See table 4). They were not told that Sample #1 was conventional GFB and Sample #2 was PFB; they were supposed not to know Sample #1 in the taste test was the same type of beef as sample A in the visual evaluation, and Sample #2 was same as sample B in the visual evaluation. Therefore, both visual evaluation and taste test were blind tests. After rating taste attributes for the two samples, subjects indicated which sample's taste they preferred.

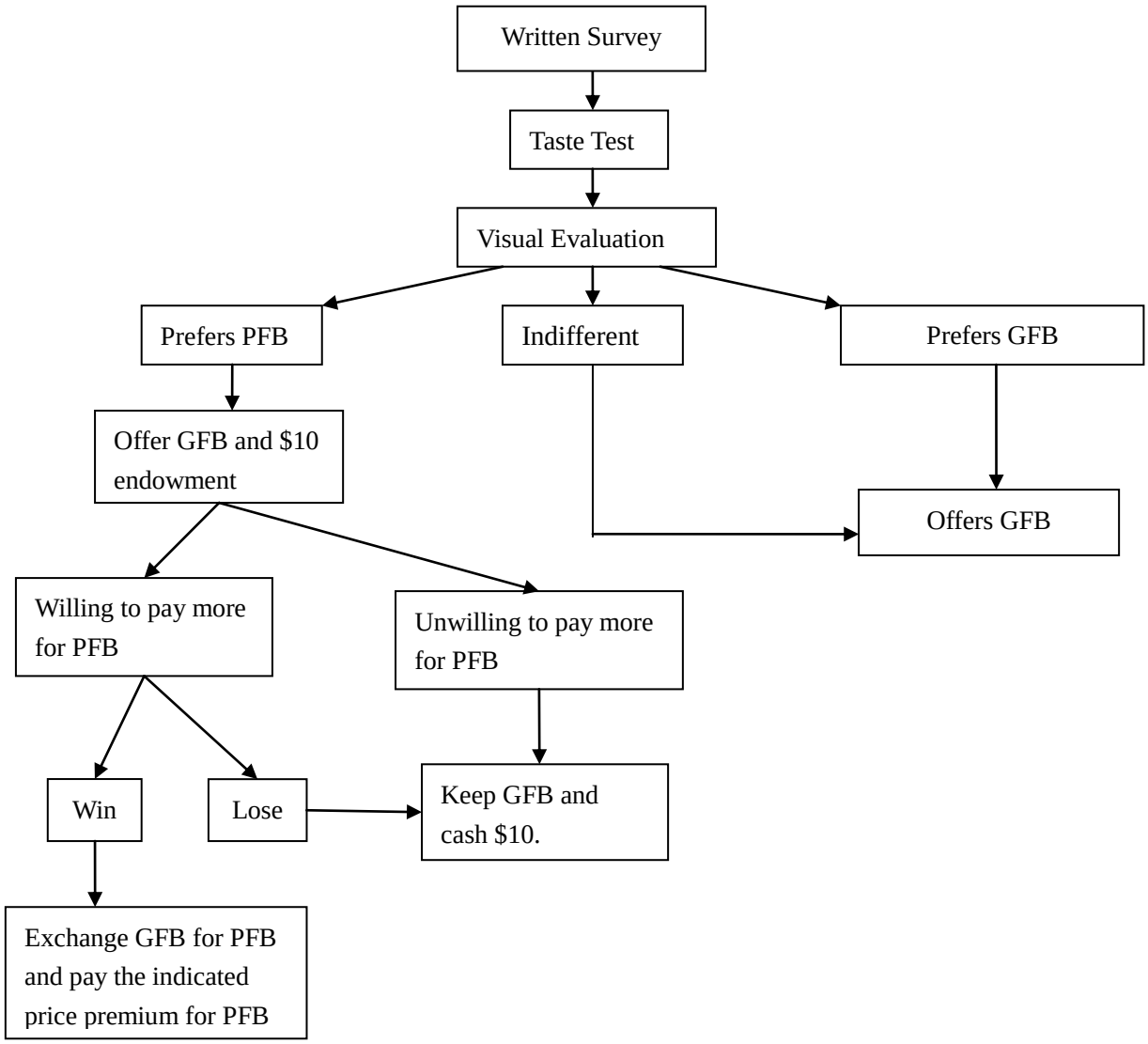
Step 4: Subjects were told that beef sample #1 in the taste test was the same type of beef as sample A in the visual evaluation, and sample #2 in the taste test was the same as sample B in the visual evaluation. They were asked to state which sample (A/#1 or B/#2) they preferred overall based on their

visual and taste evaluations.

Step 5: Subjects were given, free of charge, a pound of steak that was from the same type of beef (conventional GFB) as sample #1/A. If they preferred sample #1/A overall, the experiment was finished and they could leave with the pound of beef given to them. If they preferred sample #2/B, each of them was given $10 cash as endowment to participate in the MPL experiment. In the MPL experiment, subjects were told that the pound of beef sample #1/A given to them was conventional GFB and its retail price was posted. Subjects were asked if they would be willing to exchange their conventional GFB to a pound of beef steak from sample #2/B by giving up any amount of money from the endowment, that is, by paying a price premium for sample #2/B. If they were unwilling to pay, they finished their experiment and left with the pound of conventional GFB and cash $10. If they were willing to trade in, then they filled out a MPL form to indicate how much they would like to pay to exchange their conventional GFB for a pound of beef sample #2/B, that is, a pound of PFB. After filling out the MPL form, a random number was drawn to determine which price premium would be implemented. If the randomly drawn price was lower than the maximum amount of money the subject was willing to pay for the exchange, s/he could make the exchange by paying the drawn price and kept the rest of endowment. If the price drawn was higher than the subject's WTP, then the exchange was not made and the subject kept the conventional GFB and $10 cash endowment.

Two treatments were used in order to determine if there existed order effects in the visual evaluation and taste test. In treatment A, the taste test was conducted immediately before visual evaluation. Treatment B switched the order of visual evaluation and taste test of treatment A. That is, visual evaluation was conducted first and then taste test right after. Treatments alternated between sessions with subjects assigned to treatments based on the sessions they participated in.

Figure 1: Flow Diagram of Experiment -- Treatment A



Data and Results

As shown in table 1 and table 2, a total of 231 subjects participated in the laboratory experiments conducted in four sites: 39 in Galax (accounting for 17% of all subjects), 82 in Roanoke (36%), 68 in Richmond (29%), and 42 in Blacksburg (18%). Sixty four percent of subjects were female and 36% were male. The average age was 37.7 and average education attainment was some college. Most subjects (more than 70%) worked full-time or part-time and three-quarters of them lived with family, including such situations as living with spouse only, with spouse and children, with children only, and with extended family. Their average annual before-tax household income was between $30,000 and

$40,000. The vast majority (more than 90%) of subjects were foreign-born, including immigrants and naturalized citizens. The main countries of origin were Mexico (35%), El Salvador and Honduras (23%), and Columbia (22%). The rest of subjects, approximately 20%, originated from other Hispanic countries such as Puerto Rico, Peru, Ecuador, Venezuela**,** and Cuba.

Subjects were classified as PFB preferring and conventional GFB preferring according to their overall preferences. With respect to sensory evaluations, 60% of subjects visually preferred PFB and 40% preferred conventional GFB. In contrast, about 40% preferred the taste of PFB and 60% preferred conventional GFB. In general, approximately half of subjects preferred PFB and another half of them preferred conventional GFB (Figure 2). T-tests were conducted to compare the visual attribute ratings of PFB and conventional GFB (See Table 3). On average, all subjects perceived that PFB had darker lean meat muscles, yellower fat, and finer meat texture than conventional GFB. P-values for the three visual attributes are below .02 and indicate significant differences of average ratings of visual attributes between PFB and conventional GFB. Both PFB- and conventional GFB-preferring groups had largely consistent evaluations of visual attributes of PFB with the exception of meat texture. Table 4 reports the average ratings of individual taste attributes. Overall, subjects felt PFB tastes tougher than conventional GFB. The average tenderness ratings on the two types of beef were significantly different by all subjects and by conventional GFB-preferring group ($p<.000$). For all subjects, average ratings of juiciness and flavor were not significantly different between PFB and conventional GFB. PFB-preferring subjects, however, perceived that PFB was juicier ($p<.000$) and had more intense flavor ($p<.002$) than conventional GFB.

Table 5 lists the consistency of taste, visual, and overall preferences. There were 118 subjects preferring pasture-fed beef, accounting for 51% of the respondents. Forty nine percent of PFB-preferring subjects consistently preferred the taste and visual appearance of PFB. Eighteen percent preferred the taste of PFB but the visual appearance of conventional GFB, and 33% preferred the taste of PFB but visually preferred conventional GFB. The subjects who consistently preferred the taste and visual appearance of PFB didn't indicate higher price premium for PFB than subjects who had dispersant visual and taste preferences. On the contrary, they were willing to pay $.70 less than the subjects who preferred the taste of PFB but the appearance of conventional GFB. Similarly, they paid $.54 less than the subjects who preferred the taste of conventional GFB but the appearance of PFB. Therefore, the consistency of sensory preferences didn't directly determine consumers' WTP. The MPL experiment that elicited price premium for PFB was completed only by PFB-preferring subjects;

therefore the WTP by conventional GFB-preferring subjects was unobservable and might be negative. Their WTP was censored by value zero. As shown in table 6, the average WTP by PFB-preferring subjects was $3.62 and varied across experiment sites with the highest in Galax ($4.20) and lowest in Blacksburg ($2.64). A large proportion of subjects in Blacksburg were university students, which may partly explain the low average WTP in this location.

Empirical Models and Results

The empirical models that evaluate visual, taste, and overall preferences and examine their relationship are listed as follows:

$$VP_i = f\ (MCOLOR, FCOLOR, TEXTURE, GALAX, ROANOKE, RICHMOND, TREATMENT, FEMALE, AGE, EDU, EMPLOY, INCOME, LVSTAT, HHDSIZE, CHILD, MEXICAN, SALHON, COLUMBIAN, ACLT, FHOME, FAWAY, BAMNT, DONE, GRADE, EPFB)$$

$$TP_i = f\ (TENDERNESS, JUICINESS, FLAVOR, GALAX, ROANOKE, RICHMOND, TREATMENT, FEMALE, AGE, EDU, EMPLOY, INCOME, LVSTAT, HHDSIZE, CHILD, MEXICAN, SALHON, COLUMBIAN, ACLT, FHOME, FAWAY, BAMNT, DONE, GRADE, EPFB)$$

$$PREF_i = f\ (MCOLOR, FCOLOR, TEXTURE, TENDERNESS, JUICINESS, FLAVOR, GALAX, ROANOKE, RICHMOND, TREATMENT, FEMALE, AGE, EDU, EMPLOY, INCOME, LVSTAT, HHDSIZE, CHILD, MEXICAN, SALHON, COLUMBIAN, ACLT, FHOME, FAWAY, BAMNT, DONE, GRADE, EPFB)$$

where *VP*, *TP*, and *PREF* are binary variables to represent consumers' visual, taste, and overall preferences, respectively. They take the value of 1 if consumers prefer PFB and 0 if consumers prefer conventional GFB or is indifferent between them. Meat color (*MCOLOR), fat color (FCOLOR),* and meat texture (*TEXTURE*) are visual attribute variables that represent the differences of visual attributes ratings between PFB and conventional GFB. *TENDERNESS, JUICINESS* and *FLAVOR* are taste attribute variables that represent the differences of taste attribute ratings between PFB and conventional GFB. Variables that capture consumers' socio-demographic characteristics and beef consumption behavior are also included and are described in Table 2.

Estimation results of the Multivariate Probit models are reported in table 7. In the visual preference model, the two visual attribute variables, *MCOLOR* and *FCOLOR*, were insignificant. Meat texture (*TEXTURE*) was strongly significant with negative sign, which indicates that a subject was less

likely to visually prefer PFB if s/he perceived the meat texture of PFB to be coarser than conventional GFB. When it comes to taste attribute variables, three taste attribute variables, *TENDERNESS*, *JUICINESS*, and *FLAVOR*, were negatively significant at 1% level. A subject was more likely to prefer the taste of PFB if s/he felt it more tender, juicer, and more intense than conventional GFB. In overall preference model, among the six sensory attributes, only tenderness and juiciness were significant and carried negative signs, which implies that the more tender and juicier a consumer perceived PFB relative to conventional GFB, the more likely s/he preferred PFB over conventional GFB.

The location variable, *RICHMON*, was significant in all visual, taste, and overall preference models. Subjects in Richmond tended to favor PFB over conventional GFB. The order effects of the visual evaluation and taste test were detected merely in the taste preference model. Subjects with treatment A were more likely to prefer the taste of PFB over conventional GFB. The effects of acculturation (*ACLT*) were positive as opposed to our expectation and statistically significant in visual preference. The more acculturated a subject was, the more likely s/he visually preferred PFB. Among the country of origin variables, *MEXICAN* was significant in both visual and overall preference showing that Mexican and Mexican-American subjects were more likely to like the appearance of PFB and preferred it overall. *COLOMBIAN* was also significant in the overall preference model meaning that consumers of Colombia were more likely to prefer PFB overall. As for subjects' socio-demographic variables, living arrangement (*LVSTAT*) had a significant and negative influence on taste preference, which indicates that subjects living with family were less likely to prefer the taste of PFB. Household size (*HHDSIZE*) and the number of children in the household (*CHILD*) were significant variables but carry opposite signs in taste preference model. That is, respondents from bigger households and those with fewer children present in the household were more likely to prefer the taste of PFB.

With respect to the variables for beef consumption behavior, the preferred cooking doneness of steak (*DONE)* was negatively significant in the overall preference model. That is, the more well-done a subject typically liked beef steak to be cooked, the less likely s/he preferred PFB overall. Other beef consumption behavior variables, however, were insignificant in all three preference models.

In this study, consumers' WTP is defined as the price premium a subject was willing to pay for a pound of PFB in the MPL experiment. Our empirical WTP model takes the following form:

$WTP_i = f$ (*VISUAL, TASTE, GALAX, ROANOKE, RICHMOND, TREATMENT, FEMALE, AGE, EDU, EMPLOY, INCOME, LVSTAT, HHDSIZE, CHILD, MEXICAN, SALHON, COLUMBIAN, ACLT, FHOME, FAWAY, BAMNT, DONE, GRADE, EPFB*)

where *WTP* is the price premium consumer *i* is willing to pay for a pound of PFB; *VISUAL* and *TASTE* represent visual and taste preferences for PFB with value 1 if preferring PFB and 0 if preferring conventional GFB or indifferent. *GALAX*, *ROANOKE*, and *RICHMOND* are dummy variables to describe specific experiment sites. Variables that capture consumers' socio-demographic characteristics and beef consumption behavior are included and described in Table 2. The error term is assumed to i.i.d and subject to normal distribution.

The estimates from the Tobit model are reported in table 8, which suggest that taste and visual preferences both had significantly positive effects on subjects' WTP. Marginal effects were presented for expected unconditional values and conditional values on being uncensored. According marginal effects, all subjects' WTP increased $1.61 if they preferred the taste of PFB and $1.97 if they preferred the visual appearance of PFB, respectively. The significance and magnitude of the two estimates suggest that visual and taste satisfactions were the most important determinants of WTP. For subjects who were willing to pay a non-zero premium, visual and taste acceptability for PFB had similar impacts on their WTP. They were willing to pay $1.31 if they preferred the taste of PFB and $1.50 if they preferred the visual appearance of PFB. However, to all subjects, visual influences seemed larger than taste with the difference of marginal effects at $.37.

As opposed to Umberger et al's (2007) finding, our results show that the number of children in the household presents a strong positive effect on WTP. The marginal effects of variable *CHILD* indicate that one more child in the household will increase the premium by $.53 for all subjects and $.42 for the subjects who are willing to pay more for PFB. Nevertheless, the increase in household size has negative marginal effects on WTP with -$.28 and -$.22 for unconditional expected values and uncensored values, respectively. The coefficients of living status (*LVSTAT*) were positive and significantly different from zero. Subjects living with family were willing to pay a positive premium for PFB. Marginal effects were $.88 for all subjects and $.73 for subjects with non-zero WTP. Income level didn't exert significant influence on consumers' valuation on PFB as expected and its coefficient had negative sign.

With respect to beef consumption behavior, our finding reveals that subjects who more often consumed beef prepared away from home and who had previous experience of consuming PFB were willing to pay more to PFB. In contrast, the preferred cooking doneness (*DONE*) negatively affected consumers' WTP—those who preferred a higher level of doneness were willing to pay less for PFB. One level increase of doneness translated to $.22 and $.18 decrease in WTP by all subjects and the subjects with non-zero WTP, respectively.

Conclusion

This research employs experimental economics methods to assess the potential Hispanic market of PFB in Virginia and attempts to contribute to the literature in this growing field. The main objectives are to determine Hispanic consumers' preference and WTP for PFB and investigate visual and taste influences on their overall preference and WTP for PFB. As indicated in the results, more than fifty percent of Hispanic consumers prefer PFB and the majority of them are willing to pay price premiums, which suggest that a promising Hispanic market for PFB exists in Virginia. The visual and taste evaluations show that Hispanic consumers can distinguish the appearance and taste between PFB and conventional GFB. Visual and taste satisfactions play vital roles in their overall preferences and directly translate to WTP for PFB. Nevertheless, their visual and taste preferences are not always consistent. Approximately fifty percent of subjects with inconsistent sensory preferences generally prefer PFB and another half of them prefer conventional GFB. This implies uneven visual and taste importance in determining overall preference. In principal, out of the six sensory attributes, tenderness and juiciness are highly important to subjects' overall preferences. For all subjects, visual preferences seem more important than taste preference in determining WTP for PFB. The visual and taste importance are quite similar for the subjects who are willing to pay more for PFB.

The research has implications for policy, services, and marketing efforts to support the development of Hispanic markets of pasture-fed beef. Its findings provide insights and knowledge into Hispanic consumers' purchase and consumption decision-making process and developing practical marketing strategies to meet their demand and narrow down the possible inconsistency between their visual and taste preferences.

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APPENDIX

Table 1: Subject Demographic and Socio-Economic Characteristics

Variable		Frequency	Percentage
Location	Galax	39	17
	Roanoke	82	36
	Richmond	68	29
	Blacksburg	42	18
Gender	Female	147	64
	Male	84	36
Education	Less than high school diploma	47	20
	High school diploma or equivalent	70	30
	Some College/technical school	27	12
	Associates Degree	18	8
	Bachelors degree;	54	23
	Graduate or Professional Degree	15	7
Employment status	Full time or part time	159	69
	Other	72	31
Living arrangement	Live with family	174	75
	Other	57	25
Income	>$20,000	78	34
	$20,000-$39,999	73	32
	$40,000-$59,999	43	19
	$60,000-$79,999	17	7
	$80,000-$99,999	10	4
	$100,000+	10	4
Country of origin	Mexican and Mexican American	82	35
	Salvadoran and Honduran	53	23
	Colombian	50	22
	Other Hispanics	46	20
Citizenship			
	Foreign-born	210	91
	US-born citizen	21	9
		Mean	**Std. Dev**
Age		37.7	13.74
Household size		3.54	1.48
The number children in the household		1.04	1.25
Acculturation level		5.87	1.36

Table2: Variable Definition and Descriptive Statistics

Variable	Description	Mean	Std
WTP	Price premium placed on PFB	1.95	2.69
TASTE	1 if preferring the taste of PFB ; 0 otherwise	.39	.49
VISUAL	1if visually preferring PFB ; 0 otherwise	.60	.49
PREFER	1if overall preferring PFB ; 0 otherwise	.51	.50
GALAX	1 if experiment location is Galax; 0 otherwise	.17	.38
ROANOKE	1 if experiment location is Roanoke; 0=otherwise	.35	.48
RICHMOND	1 if experiment location is Richmond; 0=otherwise	.29	.46
TREATMENT	1=Treatment A; 0=Treatment B	.72	.45
FEMALE	1= Female; 0=Male	.64	.48
AGE	Age in years	37.7	13.7
EDU	1= Less than high school diploma; 2= High school diploma or equivalent; 3= Some College; 4= Associates Degree; 5= Bachelors degree; 6= Graduate or Professional Degree	3.03	1.65
EMPLOY	1= Employed full time or part time; 0= otherwise	.69	.46
INCOME	1= less than $10,000; 2=$10,000 - $19,999; 3=$20,000 - $29,999; 4=$30,000 - $39,999; 5=$40,000 - $49,999; 6=$50,000 - $59,999; 7=$60,000 - $69,999; 8=$70,000 - $79,999; 9=$80,000 - $89,999; 10=$90,000 - $99,999; 11= $100,000+	4.0	2.68
LVSTAT	1 if living with family; 0 otherwise	.75	.43
HHDSIZE	The number of people in a household	3.55	1.48
CHILD	The number of children under 18 years old in the household	1.04	1.25
MEXCIAN	1if the subject's country of origin is Mexico; 0=otherwise	.35	.48
SALHON	1if the subject's country of origin is Salvador or Honduras; 0=otherwise	.23	.42
COLOMBIAN	1if the subject's country of origin is Colombia; 0=otherwise	.22	.41
ACLT	The degree of Acculturation	.59	.14
FHOME	1= Less than once a month; 2= 1-2 times a month; 3= 1-2 times a week; 4= More than 3times a week	3.07	.81
FAWAY	1= Less than once a month; 2= 1-2 times a month; 3= 1-2 times a week; 4= More than 3times a week	2.21	1.08
BAMNT	The $ spent on beef per week	$26.07	19.34
DONE	Preferred doneness of beef steak	4.21	1.19
GRADE	USDA grade of beef steak usually purchased: 1=USDA select; 2=USDA Choice, 3=USDA Prime; 0= Not graded or Don't know	3.59	1.57
EPFB	1 if the subject has experience of consuming PFB; 0 otherwise		
TENDERNESS	The difference between tenderness ratings of PFB and conventional GFB	.57	2.09
JUICINESS	The difference between juiciness ratings of PFB and conventional GFB	-.15	1.93
FLAVOR	The difference between flavor ratings of PFB and conventional GFB	.09	1.87
MCOLOR	The difference between lean meat color ratings of PFB and conventional GFB	1.43	1.48
FCOLOR	The difference between fat color ratings of PFB and conventional GFB	.48	1.67
TEXTURE	The difference between meat texture ratings of PFB and conventional GFB	-.36	2.31

N=231

Figure 2: The Percentages of Overall, Taste, and Visual Preferences

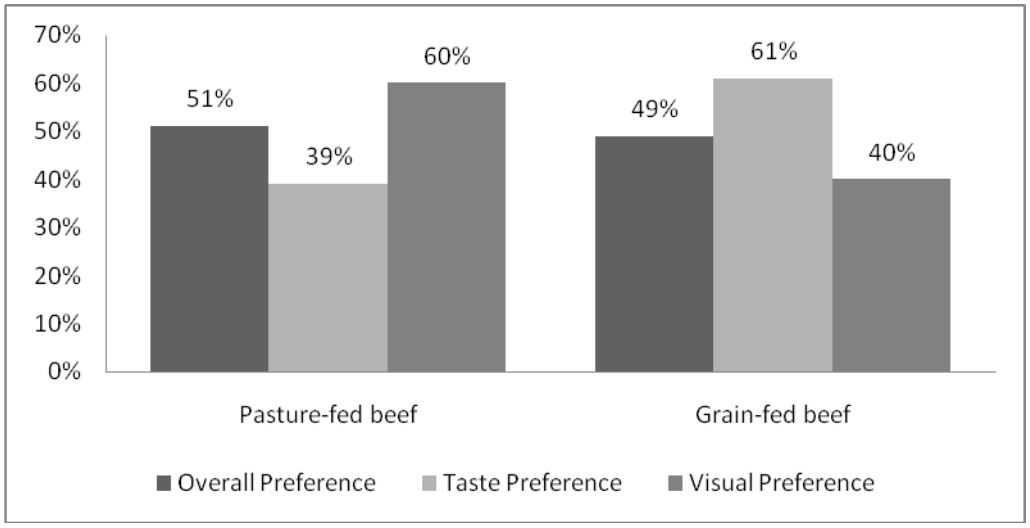

Figure 3: The Average Ratings of Visual Attributes for PFB and Conventional GFB

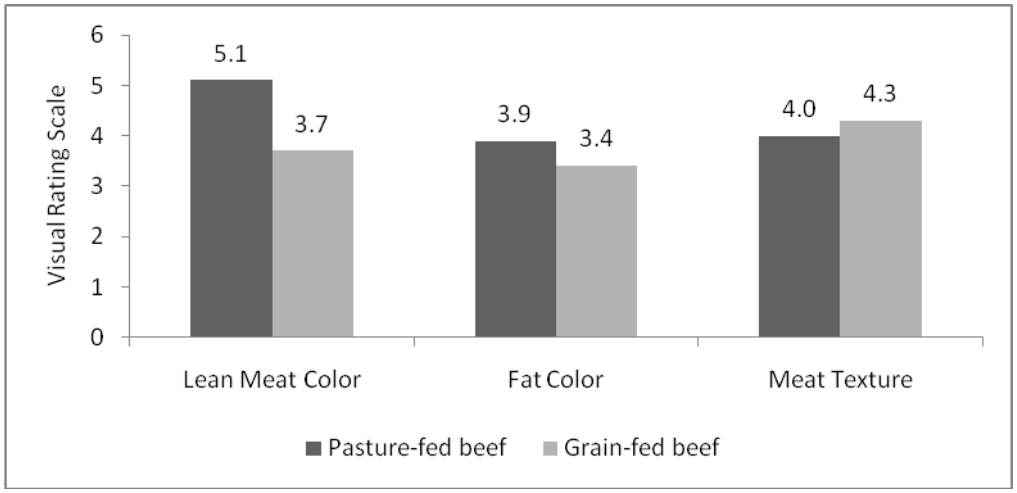

Table 3: Summary Statistics of Visual Attributes Ratings between Preference Groups

	Lean Meat Color[a] (Mean, Std)			Fat Color[b] (Mean, Std)			Meat Texture[c] (Mean, Std)		
	All subjects	Pasture-fed preferring	Grain-fed preferring	All subjects	Pasture-fed preferring	Grain-fed preferring	All subjects	Pasture-fed preferring	Grain-fed preferring
PFB	5.12 (.84)	5.03 (.71)	5.22 (.96)	3.91 (1.30)	3.89 (1.20)	3.96 (1.40)	3.96 (1.64)	3.81 (1.64)	4.12 (1.63)
GFB	3.67 (1.31)	3.45 (1.36)	3.89 (1.22)	3.43 (1.16)	3.30 (1.15)	3.56 (1.16)	4.32 (1.51)	4.41 (1.51)	4.23 (1.51)
Difference	1.46	1.58	1.33	.48	.56	.40	-.36	-.60	-.11
SE	.095	.133	.134	.111	.150	.163	.152	.211	.218
P-value	.000	.000	.000	.000	.000	.016	.019	.005	.627

[a] 1=Very pale, 2= Pale, 3= Somewhat pale, 4= Neutral, 5= Red, 6= Dark, 7= Very dark

[b]1=Very white, 2= White, 3= Somewhat white, 4= Neutral, 5= Somewhat yellow, 6= Yellow, 7= Very yellow

[c] 1=Very fine, 2= Fine, 3= Somewhat fine, 4= Neutral, 5= Somewhat tough, 6= Tough, 7= Very tough

Figure 4: The Average Ratings of Taste Attributes For PFB and Conventional GFB

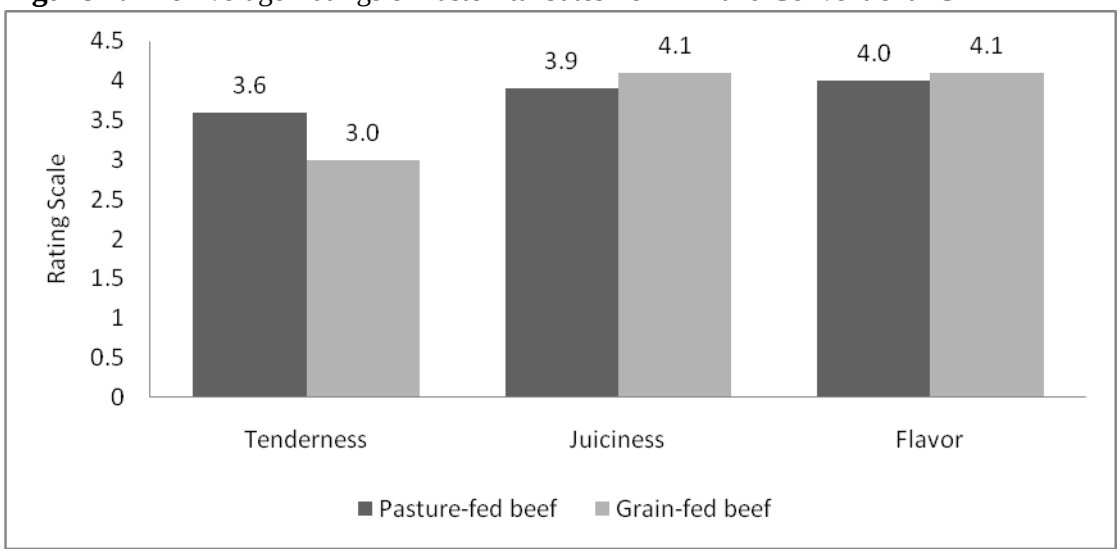

Table 4: Summary Statistics of Taste Attributes Ratings between Preference Groups

	Tenderness[a] (Mean, Std)			Juiciness[b] (Mean, Std)			Flavor[c] (Mean, Std)		
	All subjects	Pasture-fed preferring	Grain-fed preferring	All subjects	Pasture-fed preferring	Grain-fed preferring	All subjects	Pasture-fed preferring	Grain-fed preferring
PFB	3.61 (1.83)	3.09 (1.68)	4.15 (1.85)	3.92 (1.70)	3.43 (1.55)	4.43 (1.71)	4.00 (1.58)	3.74 (1.53)	4.25 (1.60)
GFB	3.04 (1.50)	3.20 (1.46)	2.87 (1.53)	4.08 (1.49)	4.31 (1.41)	3.84 (1.54)	4.11 (1.53)	4.31 (1.67)	3.92 (1.47)
Difference	.57	-.11	1.27	-.15	-.88	.59	-.12	-.56	.33
SE	.138	.192	.175	.128	.162	.173	.122	.179	.154
P-value	.000	.56	.000	.233	.000	.000	.329	.002	.036

[a] 1=Very tender , 2= Tender, 3= Somewhat tender, 4= Neutral, 5= Somewhat tough 6= Tough, 7= Very tough

[b] 1=Very juicy, 2= Juicy, 3= Somewhat juicy, 4= Neutral, 5= Somewhat dry, 6= Dry, 7= Very dry

[c] 1=Very intense, 2= Intense, 3= Somewhat Intense, 4= Neutral, 5= Somewhat bland, 6= Bland, 7= Very bland

Table 5: The Combination of Overall, Taste, and Visual Preferences

Taste Preference		Visual Preference		Overall Preference		WTP
PFB	GFB	PFB	GFB	PFB	GFB	PFB-preferring subjects
√		√		58 (49%)	-	$3.25 (2.42)
	√		√	-	60 (53%)	-
√			√	21 (18%)	13 (12%)	$3.95 (3.31)
	√	√		39 (33%)	40 (35%)	$3.79 (2.65)
				118 (100%)	113 (100%)	$3.62 (2.76)

Table 6: Summary Statistics of WTP between Experimental Sites

	Overall		Galax		Roanoke		Richmond		Blacksburg	
Subjects	Obs	Mean (Std)	Obs	Mean (Std)	Obs	Mean (Std)	Obs	Mean (Std)	Obs	Mean (Std)
Overall	231	$1.95[a] (2.69)	39	$1.67[a] (2.66)	82	$2.23[a] (2.83)	68	$2.29[a] (2.92)	42	$1.13[a] (1.79)
PFB-preferring	118	$3.62 (2.76)	15	$4.20 (2.77)	40	$4.04 (2.79)	45	$3.46 (2.98)	18	$2.64 (1.87)

[a] WTP takes value of zero for the subjects who prefer conventional GFB and do not participate in WTP experiments.

Table7: Estimates of the Multivariate Probit Model

	Visual Preference		Taste Preference		Overall Preference	
Variable	**Coefficient**	**S.E.**	**Coefficient**	**S.E.**	**Coefficient**	**S.E.**
GALAX	-.069	.422	-.285	.449	-.111	.451
ROANOKE	.436	.369	-.324	.410	.237	.400
RICHMOND	.664**	.310	.811**	.330	1.313***	.341
TREATMENT	.061	.311	.534*	.321	.260	.325
FEMALE	-.113	.229	.040	.247	-.109	.239
AGE	.007	.008	.005	.009	-.002	.009
LVSTAT	.498	.329	-.726**	.370	.225	.364
EDU	-.104	.078	.083	.086	.020	.081
EMPLOY	.040	.233	.305	.261	.206	.248
INCOME	.012	.046	.035	.053	-.004	.050
HHDSIZE	.156	.114	.291**	.119	.077	.115
CHILD	-.215	.137	-.351**	.145	-.117	.134
MEXCIAN	.709**	.317	-.200	.399	.710**	.360
SALHON	.201	.341	-.563	.435	-.018*	.387
COLOMBIAN	.431	.325	.005	.403	.633	.364
ACLT	.404***	.102	-.176	.112	.155	.106
FHOME	-.191	.136	-.085	.155	-.202	.147
FAWAY	-.083	.094	-.063	.107	.064	.099
BAMNT	-.001	.007	-.003	.007	.005	.007
DONE	-.025	.095	-.153	.102	-.207**	.101
GRADE	.050	.055	-.101	.062	-.041	.059
EPFB	-.029	.224	-.034	.242	.071	.245
MCOLOR	.077	.074	-	-	.105	.077
FCOLOR	-.049	.069	-	-	-.014	.078
TEXTURE	-.231***	.050	-	-	-.029	.051
TENDERNESS	-	-	-.196***	.064	-.160***	.057
JUICINESS	-	-	-.325***	.075	-.216***	.063
FLAVOR	-	-	-.173***	.068	-.085	.058
CONS	-2.952***	1.112	.919	1.224	-1.021	1.161

*, **, ***denote significance at the 10%, 5%, and 1% levels, respectively.

Number of observations=211

Log likelihood = -276.79331

rho21=.6466

rho31=.6033

rho32=.4581

Table 8: Estimates of the Tobit Model

			Marginal Effects			
			Expected Unconditional Values		Conditional on Being Uncensored	
Variable	**Coefficient**	**S.E.**	**dF/dx**	**S.E.**	**dF/dx**	**S.E.**
TASTE	4.409***	.886	1.606***	.355	1.309***	.277
VISUAL	4.414***	.794	1.974***	.318	1.499***	.248
GALAX	.970	1.501	.418	.601	.318	.468
ROANOKE	1.821	1.329	.774	.532	.592	.415
RICHMOND	1.743	1.161	.763	.465	.577	.362
TREATMENT	.998	1.047	.3782	.419	.301	.327
FEMALE	-.088	.782	-.035	.313	-.028	.244
AGE	-.013	.029	-.005	.012	-.004	.009
LVSTAT	2.583**	1.257	.878*	.504	.733*	.392
EDU	-.299	.274	-.120	.110	-.093	.086
EMPLOY	-.716	.825	-.296	.330	-.228	.257
INCOME	-.058	.166	-.023	.067	-.018	.052
HHDSIZE	-.694*	.395	-.278*	.158	-.217*	.123
CHILD	1.333***	.455	.534***	.183	.416***	.142
MEXCIAN	1.409	1.139	.593	.456	.455	.355
SALHON	1.227	1.269	.533	.508	.404	.396
COLOMBIAN	1.504	1.166	.662	.467	.500	.364
ACLT	.295	.360	.118	.144	.092	.112
FHOME	.030	.479	.012	.192	.009	.150
FAWAY	.948***	.346	.380***	.139	.296***	.108
BAMNT	-.022	.021	-.009	.009	-.007	.007
DONE	-.570*	.311.	-.228*	.125	-.178*	.097
GRADE	-.183	.200	-.073	.080	-.057	.063
EPFB	1.605**	.761	.676**	.305	.518**	.237
CONS	-8.303**	4.173	-3.327**	1.672	-2.592**	1.303

*, **, ***denote significance at the 10%, 5%, and 1% levels, respectively.

Number of observations=217; Left-censored observations=122; Number of uncensored observations=95

Log likelihood = -319.10091

LR chi2(24) = 103.65

Prob > chi2 = 0.0000

Pseudo R2 = 0.1397