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Consumer Preferences and Willingness to Pay for Specialty Processed Foods: Do Multiple Labels Make a Difference?

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Abstract

This study examines consumer preferences and willingness to pay (WTP) for specialty-labeled processed foods, focusing on the impacts of dual-product labeling. Data were collected via a 2024 online survey of U.S. West consumers and employed choice experiments for three processed products, displaying two or fewer of four possible labels. Results show respondent low label familiarity but high consumption frequency. Respondent WTP for dual-labeled products exceeded that of single-labeled by $1.60 to $4.60 per item, depending on the product. Overall, study findings indicate that combination labeling can increase consumer WTP and support product differentiation, but preferred labels vary by product.

Keywords: choice experiment, processed foods, specialty labels, willingness to pay

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Introduction

Specialty-labeled foods have grown in popularity due to the important information they provide on product attributes, especially for credence attributes, which cannot be observed or experienced by consumers. Common food labels include organic, local, non-GMO, natural, eco-friendly, fair-trade, and grass-fed, among others. Previous literature found that consumer preferences and willingness to pay (WTP) for specialty-labeled foods often depend upon the type of product, such as fresh versus processed, virtue versus vice, and perishable versus low or non-perishable (Van Doorn and Verhoef, 2011; Grebitus, Lusk, and Nayga, 2013; Mugera, Burton, and Downsborough, 2017; Blare, Donovan, and del Pozo, 2019; Drugova, Curtis, and Akhundjanov, 2020a, 2020b).

Additionally, the literature indicates that for products exhibiting two or more labels, some consumers see the labels as substitutes, or redundant, while others view the labels as complements, depending on the labels employed (He and Bernard, 2011; Wilson and Lusk, 2020; Ufer, Ortega, and Wolf, 2022; Papoutsi, 2023). Also, consumers tend to ignore one or more labels when choosing multiple-labeled products for a variety of reasons, including, but not limited to, decision simplification, lack of interest in or understanding of the label, etc. (Drugova, Curtis, and Akhundjanov, 2020a; Drugova and Curtis, 2025). These complexities, both real and perceived, can make it difficult for food system stakeholders to identify which specialty labels or label combinations appeal most to their market(s) and thus enhance their profit maximization strategies.

As some labeling programs, such as certified organic, require large upfront costs and long-term planning, it is imperative that producers have credible market information. Hence, this study was undertaken to provide such information to agricultural producers and food processors in the U.S. West. Specifically, the study explores consumer preferences and WTP for specialty-labeled processed foods, including packaged beef jerky, bottled mild salsa, and bottled tart cherry juice. These products were chosen due to their popularity with stakeholders and the availability of product inputs in the region. The analysis focuses on common specialty product labels, including organic, grass-fed, and non-GMO.

Study data were collected via a 2024 online survey of consumers across the U.S. West in which respondents participated in choice experiments. Data were analyzed using product-specific random parameter logit (RPL) models. Results indicate low respondent overall familiarity with the examined specialty labels, although they consumed local- or organic-labeled foods frequently. The highest valued single labels were grass-fed for beef jerky and organic for tart cherry juice and mild salsa. Depending on the product, respondent willingness to pay was \$1.60–\$4.60 higher for a dual-labelled product over the single-labelled product. The grass-fed and local label combination was most valued for beef jerky, and the organic and non-GMO label combination for the other two products. These findings suggest that product-specific combination labeling strategies do enhance consumer WTP and offer food industry stakeholders a pathway to enhance product differentiation and competitiveness. Production cost differences were not examined.

Methods

Study data were collected via an online survey conducted via Qualtrics in the summer of 2024, where 1,150 valid responses were obtained from residents of 13 U.S. Western states and three territories. The survey included questions related to respondent sociodemographics, familiarity and attitudes toward each of the specialty labels employed, past consumption of specialty-labeled foods in general, and consumption and spending related to the three examined products. The survey also included hypothetical choice experiments for three processed products. Each respondent was randomly assigned to complete the experiment for two of the three products, thus completing 12 choice tasks per product, or 24 in total. Each choice task consisted of an opt-out option and two product alternatives, which varied in the labels presented, and price (four levels). To determine product price levels, we observed average prices online for two major grocery chains operating in the U.S. West in 2024. Then, a 50% discount and 100% premium was applied to the price averages to obtain the four price levels for each product (Caputo et al., 2018; Van Loo et al., 2018). The processed products included an 8 oz. package of beef jerky ($9.99; $13.99; $17.99; $21.99), a 32 oz. bottle of tart cherry juice ($3.99; $6.99; $9.99; $12.99), and a 16 oz. bottle of mild salsa ($1.49; $3.99; $6.49; $8.99).

The choice experiment data were analyzed using three product-specific RPL models. For example, for the beef jerky product, the utility function of respondent *n* associated with alternative *i* in choice scenario *t* is then

$$U_{nit} = ASC_{n,NoBuy} + \beta_{price} Price_{nit} + \beta_{n,organic} Organic_{nit} + \beta_{n,grassfed} Grassfed_{nit} + \beta_{n,local} Local_{nit} + \beta_{n,organic\times grassfed} Organic \times Grassfed_{nit} + \beta_{n,organic\times local} Organic \times Local_{nit} + \beta_{n,grassfed\times local} Grassfed \times Local_{ni} + \varepsilon_{nit}, \quad (1)$$

where $ASC_{n,NoBuy}$ is an alternative-specific constant for the opt-out alternative; $Price_{nit}$ is the price of the product; $Organic_{nit}$, $Grassfed_{nit}$, $Local_{nit}$, and their interactions are dummy variables equal to 1 when the labels and their combinations are present and 0 otherwise; ε_{nit} is unobserved utility, assumed to be *i.i.d.* type I extreme value; and β coefficients measure marginal effects on overall utility. Except for the price, all β coefficients were allowed to vary across respondents following a normal distribution $f(\beta_n \mid \theta)$. The parameters of each distribution—mean and standard deviation—were estimated. If the standard deviation was statistically insignificant for any label or their interaction term, we restricted the respective standard deviation coefficient to 0 (i.e., assuming fixed preferences) and re-estimated the model. We estimated similar models and followed the same process for the tart cherry juice and salsa products, while replacing the *grass-fed* label with *non-GMO* label in the utility function.

Results

Table 1 summarizes respondent sociodemographics. The largest share of respondents were 35 to 54 years old (37%), female (65%), Caucasian (68%), and employed (58%). Quotas used in the data collection process required responses representative of regional demographics for income,

education level, and age. Table 2 shows that respondent familiarity with the examined specialty labels was low and similar across labels. Half of the respondents were not at all or only slightly familiar with the labels, and only a quarter of the respondents claimed to be very or extremely familiar with the labels. However, Table 2 also shows that respondents consumed organic and locally labeled products frequently. Further, respondents often consumed and were most familiar with mild salsa and were least familiar with tart cherry juice (see Table 3). Per purchase, respondents spent the most on beef jerky ($13.63) and the least on tart cherry juice ($9.15), not accounting for unit size and pricing.

Table 1. Sample Sociodemographics

Characteristic	Coding	Mean
Age	1 = 18–34, 2 = 35–54, 3 = 55–64, 4 = above 64	2.26
Female	1 = female, 0 = male	0.65
Caucasian	1 = yes, 0 = no	0.68
Children under 18	1 = yes, 0 = no	0.37
Education	1 = middle school, 2 = some high school, 3 = high school/GED, 4 = associate's degree/some college, 5 = bachelor's degree, 6 = graduate degree or higher	4.17
Employed	1 = yes (full- or part-time), 0 = no	0.58
Income	1 = < $10,000, … 6 = $50,000–$59,999, 7 = $60,000–$69,999, … 12 = $150,000 or more	6.75
N		1,150

Table 2. Labeled Product Experience

Label	Label Familiarity*	Consumption Frequency**
Organic	2.66^{ab}	3.11^{a}
Local	2.66^{ab}	3.17^{a}
Non-GMO	2.64^{a}	3.01^{b}
Grass-fed	2.68^{b}	2.85^{c}

Notes: *1 = not at all familiar, 2 = slightly familiar, 3 = moderately familiar, 4 = very familiar, 5 = extremely familiar

**1 = never, 2 = once a month or less, 3 = several times a month, 4 = once a week, 5 = several times a week

Same letter (per column) indicates that the means are not significantly different at the 10% level or better.

Table 3. Product Consumption and Spending Habits

Product	Consumption Frequency*	Spending per Purchase
Packaged beef jerky	2.40^{a}	$\$13.63^{a}$
Bottled tart cherry juice	1.88^{b}	$\$9.15^{b}$
Bottled medium salsa	2.85^{c}	$\$10.75^{c}$

Notes: *1 = never, 2 = one serving a month or less, 3 = several servings per month, 4 = several servings per week, 5 = at least one serving per day

Same letter (per column) indicates that the means are not significantly different at the 10% level or better.

Table 4 provides the results of the three product-specific RPL models. The positive and significant coefficient estimates for the individual labels indicate that respondents derive positive utility from each label when presented alone, which is reflected in their positive WTP values (see Table 5). But relative preferences for individual labels varies by product. The organic label is valued most among the examined labels for tart cherry juice ($3.65) and salsa ($3.12), but for beef jerky, WTP for the organic label ($4.07) was not significantly different from the other two labels. The significant standard deviations for the individual labels also show that the preferences for the individual labels are not fixed but vary by respondent.

Table 4. RPL Model Coefficient Estimates

	Beef Jerky		Tart Cherry Juice		Mild Salsa	
Coefficient	**Mean**	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**
Price	-0.20***	-	-0.26***	-	-0.31***	-
Organic	0.83***	1.21***	0.96***	1.00***	0.96***	1.01***
Grass-fed	0.91***	1.09***	n/a	n/a	n/a	n/a
Non-GMO	n/a	n/a	0.70***	0.90***	0.81***	0.85***
Local	0.86***	0.79***	0.73***	0.76***	0.72***	0.72***
Organic × Grass-fed	0.04	0.27**	n/a	n/a	n/a	n/a
Organic × Non-GMO	n/a	n/a	0.06	0.31***	-0.04	-
Organic × Local	-0.30***	-	-0.25***	-	-0.21***	-
Grass-fed × Local	0.03	-	n/a	n/a	n/a	n/a
Non-GMO × Local	n/a	n/a	0.11**	-	0.03	-
Opt-out	-5.55***	4.13***	-4.54***	3.95***	-4.00***	3.16***
Log-likelihood	-11,165		-11,675		-12,129	
Prob > chi2	0.000		0.000		0.000	

Note: Double, and triple asterisks (**, ***) denote significance at the 5% and 1% level, respectively.

Table 5. Willingness-to-Pay Estimates

Label	Beef Jerky	Tart Cherry Juice	Mild Salsa
Organic	$4.07***^{a1}	$3.65***^{d1}	$3.12***^{h2}
Grass-fed	$4.47***^{a}	n/a	n/a
Non-GMO	n/a	$2.67***^{e3}	$2.63***^{i3}
Local	$4.23***^{a4}	$2.77***^{e5}	$2.35***^{i6}
Organic × Grass-fed	$8.73***^{b}	n/a	n/a
Organic × Non-GMO	n/a	$6.55***^{f7}	$5.61***^{j8}
Organic × Local	$6.81***^{c9}	$5.48***^{g10}	$4.76***^{k11}
Grass-fed × Local	$8.86***^{b}	n/a	n/a
Non-GMO × Local	n/a	$5.85***^{g12}	$5.08***^{k13}

Notes: Triple asterisks (***) denote significance at the 1% level.
Within product comparison: Same letter indicates that the means are not significantly different at the 10% level or better. Across product comparison, per label: Same number indicates that the means are not significantly different at the 10% level or better.

The interaction term coefficients in Table 4 show that respondents typically do not derive additional utility from label combinations. An exception is the combination of the non-GMO and local labels on tart cherry juice, where the positive interaction indicates the labels complement each other, and thus, respondents are willing to pay more than the sum of their WTP for the labels alone. The negative interaction term for the organic and local labels across all three products indicates that respondents perceive the labels as substitutes, but respondent WTP for the combination of the organic and local labels is higher than WTP for each label alone. Additionally, standard deviations demonstrate the low variability or homogeneous perceptions among respondents concerning the combination of the organic and local labels.

For the remaining label combinations, the insignificant coefficient estimates for the interaction terms indicate that the labels are independent and their WTP is additive. But if the standard deviation is non-zero (organic and grass-fed on beef jerky and organic and non-GMO on tart cherry juice), them some respondents view the labels as complementary and others as substitutes. Overall, WTP estimates in Table 5 show that for beef jerky, respondents were willing to pay most for the combination of the grass-fed and local labels ($8.86). The combination of the organic and non-GMO labels was most valued for both tart cherry juice ($6.55) and salsa ($5.61).

Conclusions

We examined consumer willingness to pay for three specialty-labeled processed food products—beef jerky, tart cherry juice, and mild salsa. Our focus was to compare respondent WTP for single- and dual-labeled products to determine whether consumers value products with multiple labels over single-labeled products. We found that while dual-labeled products did not boost respondent WTP beyond the sum of their WTP for the single labels, respondent WTP for dual-labeled products was higher than for single-labeled products. However, valued label combinations differed by product such that for beef jerky, the combination of the grass-fed and local labels was most valued. For tart cherry juice and salsa, the combination of the organic and non-GMO labels was most valued—a strange result, given that organic and non-GMO are redundant, in that organic products must also be non-GMO. However, this finding is in line with research showing that consumers will pay premiums for products with redundant or superfluous labels (Wilson and Lusk, 2020). Across all products, respondents considered the organic and local labels as substitutes. For the other label combinations, respondents exhibited heterogeneity, meaning some viewed the labels as complementary, while others saw them as substitutes, similar to that described by Papoutsi (2023).

In summary, this study provides evidence that consumers value specialty labels, including organic, local, non-GMO, and grass-fed on processed products and are willing to pay a higher premium for dual-labelled products. Thus, producers and food processors may benefit from using multiple labels on processed foods, taking into account product-specific differences. However, the costs (record-keeping, inspection fees, packaging, etc.) associated with placing multiple labels on food products should be considered to fully understand which label combinations might maximize profits for food industry stakeholders. Finally, this study was conducted in the U.S. West, and thus,

the results may not apply to other regions of the United States nor those outside of the United States.

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Are Americans Willing to Pay to Improve Food Access for Others? Evidence from a Real Donation Experience

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Abstract

We quantify Americans' willingness to donate to Feeding America by comparing hypothetical and real-payment decisions within an identical choice context. Respondents completed six discrete choice sets varying donation amounts ($1, $3, $5) and match-based impact. Mixed logit estimates reveal cost sensitivity and positive valuation of charitable impact in both groups. Hypothetical elicitation overstates giving: donate probability is 0.580 versus 0.458 ($1.55 versus $1.20). This 30% hypothetical bias equals $0.50 per respondent, about five meals. Formal tests confirm no significant differences in preference parameters or scale. These findings provide a real-payment benchmark and 1.30× calibration factor for stated-preference measures in food-access contexts.

Keywords: charitable giving, discrete choice experiment, food insecurity, hypothetical bias, incentive compatibility, scale equivalence, stated preferences

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Introduction

Food insecurity affects approximately 44 million Americans annually, including 13 million children (Rabbitt et al., 2023). Feeding America, the nation's largest hunger-relief organization, operates roughly 200 food banks and 60,000 pantries, with individual donations representing a major source of its revenue (Feeding America, 2022). For organizations that depend on donations, two questions are critical: "How much are Americans truly willing to donate?" and "Can survey-based measures be trusted?"

Measuring true donation willingness through surveys presents challenges. The common approach is to ask about donation intentions through a questionnaire, but when choices carry no real monetary consequences, stated intentions tend to exceed actual behavior—a phenomenon termed hypothetical bias (Diamond and Hausman, 1994; Penn, Hu, and Ye, 2024). A meta-analysis by Penn and Hu (2018) finds that hypothetical willingness-to-pay (WTP) overstates real payments by a factor of 2.29 on average. In the charitable giving domain, List and Gallet (2001) find overstatement of approximately 35%, though evidence remains limited. Potential mechanisms for hypothetical bias include: the psychological satisfaction from merely expressing donation intentions (Andreoni, 1990), social desirability bias (Krosnick, 1999), or the more broadly defined insufficient consideration of budget constraints in hypothetical elicitation (Penn and Hu, 2018). Accurately measuring donation willingness usually requires real-payment experiments.

However, existing real-payment research in charitable giving has limitations. First, evidence on hypothetical bias comes primarily from environmental goods or international disaster relief (e.g., Champ and Bishop, 2001; Penn, Hu, and Ye, 2024), leaving high-salience domestic causes like hunger relief underexplored. Second, many studies vary both incentive structure and choice set context simultaneously, confounding the pure effect of hypothetical versus real-payment elicitation (e.g., Fang et al., 2021; Lusk and Schroeder, 2004). Third, few studies provide domain-specific calibration factors applicable to similar settings.

This study addresses these gaps. We use a discrete choice experiment (DCE) to elicit donation preferences for Feeding America under both hypothetical and real-payment elicitation, employing a between-subjects design with identical choice context. The experiment varies two attributes: donation amount ($1, $3, $5) and match-generated additional impact—chosen based on findings from the charitable giving literature that donations are cost-sensitive (Clotfelter, 1985) and that donors positively value match-amplified impact (Eckel and Grossman, 2003; Karlan and List, 2007). Our contributions are threefold: (i) we provide incentive-compatible estimates of willingness to donate to hunger relief; (ii) we offer clean identification of hypothetical bias by holding choice context constant; and (iii) we quantify the bias magnitude and provide a calibration factor. In addition, because we implemented our study online without the need for researchers to interact with the respondents in the process, we are able to expand the literature by performing fully automated online real experiments. Results show that under real-payment conditions, donate probability is 0.458 with average donation of $1.198; the hypothetical treatment group overstates by approximately 30%, yielding a 1.30× calibration factor. Formal scale and preference tests

further confirm that the two groups are statistically indistinguishable in their underlying parameters.

Methodology

Survey Design and Administration

Our study uses a DCE survey conducted in May 2021 through Qualtrics, an online survey platform. The survey elicits consumer preferences for donations to Feeding America. Following Carson and Groves (2007), our DCE uses repeated binary choices, presenting a single alternative plus an opt-out option per choice set. Evidence indicates that repeated binary choices have the advantage of being incentive-compatible, enhancing the probability of eliciting truthful preferences (Carson, Groves, and List, 2014; Vossler, Doyon, and Rondeau, 2012;).

In each choice set, the respondent decides whether or not to donate based on the donation profile shown, which is composed of three attributes: (i) the amount to be donated (*Contribute*), (ii) the amount of a match to receive from the researcher and decided by a multiplier (*Multiplier*), and (iii) the chance of receiving that match (*Chance*). The survey randomly displays one of the three contribution amounts: $1, $3, or $5. If the respondents choose to contribute, they will be entered into a lottery to win the match. The lottery has two features: the amount of match—additional funds donated to the charity by the researcher through the multiplier (0, 0.5×, 1×, 2×)—and the chance of receiving that match (0%, 20%, 40%, 60%). If the lottery is won, the respondent's contribution will be matched by the researchers with the multiplier, generating a total donation equal to *Contribute* + *Contribute* × *Multiplier*. If the lottery is not won, the donation amount *Contribute* will not change.

Figure 1 illustrates an example. If respondents choose to contribute, the $3 contribution amount will be entered into a draw with a 20% chance of winning. If they win the drawing, the $3 contribution is matched by the winning multiplier ($3 × 2), generating an extra $6 donation, with a $9 donation in total to Feeding America; otherwise, the total donation is $3. Each choice set incorporates varying attribute levels, and Table 1 details the attributes and their corresponding levels. The design of these attributes is informed by a related study examining risk aversion behaviors (Penn, Howard, and Hu, 2024).

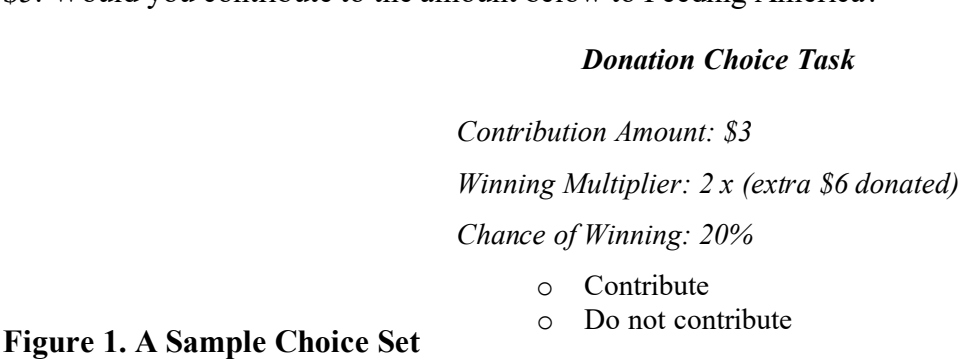

Figure 1. A Sample Choice Set

Table 1. Discrete Choice Experiment Attributes and Levels

Attribute	Levels	Description
Contribute	$1, $3, $5	Amount of money to support the targeted organization
Multiplier	0, 0.5, 1, 2	The multiplier of additional donations if the respondent wins the lottery
Chance	0%, 20%, 40%, 60%	The probability to win the lottery

Our design also allows explicit capture of risk preferences. However, while one can follow relevant work to incorporate various forms of risk preferences (Harrison et al., 2014; Wu, Mentzakis, and Schaafsma, 2022), they are not the focus of this study. We therefore follow the standard assumption of risk neutrality to isolate the effect of the matching mechanism. We construct a variable, *Match*, defined as the product of *Contribute*, *Multiplier*, and *Chance*, representing the expected dollar value of the additional donation in the lottery. This variable reflects the anticipated researcher-provided match amount based on the probability of winning. *Match* is mathematically equivalent to including a *Multiplier* and *Chance* separately. We also conduct robustness checks using *Match* = *Multiplier* × *Chance* and *Multiplier* and *Chance* separately.

To create the choice sets, we apply a standard blocked full-factorial design (Louviere et al., 1999). A total of six blocks of six repeated binary choice sets was generated. The DCE design contained a restriction such that *Multiplier* = 0 and *Chance* = 0 must always occur together.

Between-Subject Treatment Design

To test hypothetical bias, we need to implement both a hypothetical and a real-payment elicitation. We adopt a between-subject design, where respondents were randomly assigned to either a hypothetical or a real-payment treatment group. This method helps avoid potential ordering and anchoring effects from a within-respondent sequential design (Day et al., 2012; Penn and Hu, 2021). Respondents in both the hypothetical treatment group and real-payment treatment group received a $5 participation payment. The initial sample included 319 (hypothetical) and 312 (real-payment) respondents. After removing respondents who failed the attention-check question introduced by Malone and Lusk (2019) (see Appendix for the attention-check question), the final sample consists of 267 respondents (hypothetical) and 277 respondents (real-payment). Table 2 reports sample demographics by treatment group; the two groups are broadly comparable on observables. In the hypothetical treatment group, choices are hypothetical: each respondent completes a DCE comprising one of the six blocks of choice sets randomly assigned to them. Each block contains six binary choice sets pertaining to hypothetical elicitation, in which the DCE informs the respondent prior to the choice tasks that no actual payment occurs regardless of the choice made.

Table 2. Sample Characteristics

Variable	Hypothetical Sample (N = 267)	Real Sample (N = 277)	Difference (Hypo-Real)	2020 ACS (Adults 18+)
Age (%)				
18–24	10.76	8.40	2.36	12.56
25–34	22.15	21.37	0.78	17.94
35–44	18.99	18.58	0.41	16.26
45–54	13.29	13.49	-0.20	16.39
55–64	15.19	14.25	0.94	16.65
65–74	13.29	17.30	-4.01	12.07
75–84	5.70	5.85	-0.15	6.06
85+	0.63	0.76	-0.13	2.58
Female (%)	48.73	52.93	-4.20	50.76
Race (%)				
American Indian/Alaskan Native	1.23	1.72	-0.49	0.68
Asian	2.47	3.93	-1.46	7.70
Black or African American	14.20	12.29	1.91	12.05
Native Hawaiian/Pacific Islander	0.00	0.25	-0.25	0.19
White	79.63	78.62	1.01	76.53
Other	2.47	2.46	0.01	0.51
Prefer not to answer	0.00	0.25	-0.25	—
Education (%)				
Some high school or less	0.65	0.77	-0.12	11.55
High school diploma/GED	15.58	14.69	0.89	27.32
Some college/2-year degree/technical school	35.06	35.82	-0.76	30.74
Bachelor's degree	33.12	33.25	-0.13	19.20
Graduate/advanced degree	14.94	15.21	-0.27	11.18
Prefer not to answer	0.65	0.26	0.39	—
Income (%)				
Under $15,000	9.49	7.12	2.37	9.90
$15,000 to $24,999	8.23	8.40	-0.17	8.50
$25,000 to $34,999	8.86	11.45	-2.59	8.60
$35,000 to $49,999	11.39	12.98	-1.59	12.00
$50,000 to $74,999	20.89	21.12	-0.23	17.20
$75,000 to $99,999	15.19	14.76	0.43	12.80
$100,000 to $149,999	17.09	14.25	2.84	15.60
$150,000 to $199,999	3.80	3.82	-0.02	7.10
$200,000 or more	3.16	3.31	-0.15	8.30
Prefer not to answer	1.90	2.80	-0.90	—

Notes: Entries are percentages. Difference (Hypo − Real) reports values in the hypothetical treatment group minus those in the real-payment treatment group. Population shares are from the 2020 American Community Survey (ACS) for adults aged 18 and above. "—" denotes not collected or not available.

In the real-payment treatment group, each respondent is randomly assigned to one of the same six blocks of choice sets, except that among the six choice sets, one of the sets will be randomly chosen by the survey system as binding. Respondents will make an actual donation according to their decision recorded in the binding choice set. If a respondent chose to donate in the binding choice

set, the specified amount was deducted from the $5 payment and transferred to Feeding America. Participants must acknowledge and agree to a statement confirming they understand that one and only one of the six choice sets will be randomly selected as binding and their decision recorded in that choice set will be implemented.

Empirical Model

Our empirical strategy is grounded in the random utility model. We employ a mixed logit model to analyze respondent choices, allowing for the incorporation of unobserved preference heterogeneity across individuals. Each respondent completes repeated binary donation choices. Normalizing the utility associated with the no-donate option to zero, utility from donating in choice set *t* for respondent *n* is:

$$U_{nt} = \alpha + \beta_1 Match_{nt} + \beta_2 \ln(1 + Contribute_{nt}) + \epsilon_{nt} \quad (1)$$

with ϵ_{nt} i.i.d. Type I largest extreme value. The log specification captures diminishing marginal disutility of cost. Following the suggestion of Hu et al. (2022), we dummy-code *Donate* alternative-specific constant (ASC) α. We then treat it as a fixed parameter across the respondents and specify (β_1, β_2) as random coefficients. The model is estimated by simulated maximum likelihood with standard errors clustered at the respondent level.

With the log cost specification, marginal willingness-to-pay (MWTP) for the *Donate* ASC and *Match*, evaluated at contribution level *c*, is：

$$MWTP_{Donate}(c) = -\frac{\alpha}{\beta_2}(1 + c) \quad (2)$$

$$MWTP_{Match}(c) = -\frac{\beta_1}{\beta_2}(1 + c) \quad (3)$$

We report MWTP at *Contribution* = $3 and assess robustness at *Contribution* = $1 and $5. MWTP standard errors are obtained via the delta method using the estimated variance–covariance matrix.

To connect preference estimates to donation behavior, we compute model-implied donate probabilities and expected donations at the choice sets level and report sample means by treatment group.

Results

Preference Estimates

Table 3 reports mixed logit estimates. The *Donate* ASC is positive and significant in both treatment groups, indicating general respondent support to donating to Feeding America. The coefficient on *ln(1+Contribute)* is negative and significant, confirming cost sensitivity. *Match* enters positively

and significantly, implying respondents value match-generated impact. Because models under the hypothetical treatment group and real-payment treatment group are estimated separately, coefficient magnitudes should not be compared directly due to potential scale differences. We therefore base comparisons on MWTP. To formally test whether preference parameters differ across treatment conditions, we estimate a pooled mixed logit model with treatment interaction terms. None of the interaction terms are statistically significant (*Hypo* × *Donate*: $p = 0.501$; *Hypo* × *Match*: $p = 0.408$; *Hypo* × ln(1+*Contribute*): $p = 0.749$), indicating no significant preference differences between the hypothetical and real-payment groups. We further implement the Swait and Louviere (1993) scale-adjusted test, which confirms that neither scale ($\mu^* = 0.80$, $p = 0.443$) nor preference parameters ($p = 0.753$) differ significantly between the two groups. These results validate our MWTP-based comparison, as MWTP derived from coefficient ratios is invariant to multiplicative scale differences. Nonetheless, the absence of significant parameter differences does not imply identical MWTPs: because MWTP is a nonlinear ratio of parameters, opposite-direction deviations across the numerator and denominator compound into the observed 30% behavioral gap. Additionally, a Poe test confirms that neither the *Donate* ASC MWTP ($p = 0.251$) nor the *Match* MWTP ($p = 0.299$) differs significantly between the two groups, further supporting the conclusion of minimal hypothetical bias at the preference level.

Table 3. Mixed Logit Estimates for Donation Choices: Hypothetical vs. Real

Variables	Hypothetical	Real
Panel A. mean coefficients		
Donate	1.638**	1.378***
	(0.692)	(0.480)
Match	0.662*	0.481**
	(0.404)	(0.203)
ln(1 + contribute)	-1.553**	-1.599***
	(0.748)	(0.513)
Panel B. standard deviations of random coefficients		
SD(match)	0.705	0.045
	(1.194)	(0.189)
SD[ln(1 + contribute)]	2.296***	2.884***
	(0.789)	(0.499)
# of respondents	267	277
# of observations	1,602	1,662
Log likelihood	-198.163	-173.356
McFadden pseudo R2	0.0984	0.0724

Notes: Standard errors (in parentheses) are cluster-robust at the respondent level. The base alternative is No-donate (ASC corresponds to *Donate*). *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Observations refer to individual choice sets.

Willingness-to-Pay

Table 4 reports MWTP evaluated at *Contribute* = \$3. MWTP for the *Donate* ASC is \$4.22 in the hypothetical treatment group versus \$3.45 in the real-payment treatment group. MWTP for *Match* is \$1.71 versus \$1.20 in the two respective treatment groups. Both donation propensity and valuation of match impact are higher under hypothetical elicitation, consistent with upward hypothetical bias predicted by the literature.

Table 4. Marginal Willingness to Pay Estimates: Hypothetical vs. Real

Attribute	Hypothetical	Real	Poe Test (*p*-value)
Donate	4.217***	3.447***	0.251
	(0.911)	(0.657)	
Match	1.705**	1.201***	0.299
	(0.698)	(0.436)	

Notes: Entries are marginal WTP in USD, implied by Table 3 and evaluated at *Contribute* = \$3. Standard errors (reported in parentheses) are obtained using the delta method based on the estimated variance–covariance matrix. Hypothetical and Real denote hypothetical and real-payment elicitation, respectively. The last column reports one-sided *p*-values from the Poe, Giraud, and Loomis (2005) test of the null hypothesis that hypothetical MWTP equals real MWTP (Hypo/Real = 1); a *p*-value greater than 0.10 indicates failure to reject equality. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Predicted Donation Behavior

Table 5 translates estimates into behavioral predictions. We report three outcome measures: donate probability (extensive margin), expected out-of-pocket donation (intensive margin), and expected total dollars reaching Feeding America (actual charitable impact). Mean donate probability is 0.580 in the hypothetical treatment group versus 0.458 in the real-payment treatment group, a 27% overstatement. Expected out-of-pocket donations are \$1.55 versus \$1.20 in the two respective treatment groups, a 30% overstatement. Expected total dollars are \$2.23 versus \$1.73 in the hypothetical treatment group and real-payment treatment group, respectively—a gap of \$0.50 per respondent, or approximately 5 meals using Feeding America's conversion (\$1 ≈ 10 meals). These results establish that: (i) Americans exhibit substantial real willingness to donate to hunger relief (45.8% probability; and about \$1.20 average); (ii) hypothetical elicitation overstates donation behavior by approximately 30%; and (iii) the implied calibration factor is 1.30×.

Table 5. Model-Implied Donation Probabilities and Expected Donations: Hypothetical vs. Real

Outcome	Hypothetical	Real	Difference
Mean donate probability	0.580	0.458	0.122
Expected out-of-pocket donation (USD)	1.554	1.198	0.356
Expected total donation (USD)	2.228	1.727	0.501
Expected total donation (meals)	22.284	17.274	5.010

Notes: Entries are model-implied sample means computed separately for hypothetical treatment group and real-payment treatment group. "Expected out-of-pocket donation" is the predicted amount paid by the respondent. "Expected total donation" is the predicted amount received by Feeding America, equal to the respondent's contribution plus the expected researcher-funded match-lottery add-on ("*Match*"). Difference equals Hypothetical minus Real. \$1 = 10 meals.

Robustness

Appendix tables confirm robustness. Table A1 shows MWTP patterns held at alternative contribution levels ($1 and $5), with the hypothetical treatment group consistently higher. Tables A2–A3 replace *Match* = *Multiplier* × *Chance* × *Contribution* with *Match* = *Multiplier* × *Chance*; results are qualitatively unchanged. Tables A4–A5 enter *Multiplier* and *Chance* separately; estimates are less precise due to increased parameterization, supporting our use of *Match* as a more efficient specification. Across all specifications, the hypothetical-real gap persists.

To examine whether hypothetical bias varies across sociodemographic subgroups, we estimate a pooled mixed logit model with three-way interaction terms (*Donate* × *Hypo* × *Demographic*). The results (see Table A6) show that hypothetical bias in donation propensity is significantly larger among low-income respondents (coefficient = 1.749, p = 0.040), whereas no significant differences are found for gender (p = 0.266) or education (p = 0.506). This finding suggests that the overall hypothetical bias is driven disproportionately by low-income respondents, who face stronger budget constraints under real-payment conditions. These findings diverge from (Mjelde et al., 2012), who found that education—but not income or gender—significantly influences the hypothetical bias ratio across three South Korean contingent valuation studies. While both studies find no gender effect, income is significant in our context of charitable giving, whereas education does so in theirs, suggesting that demographic determinants of hypothetical bias may be context-dependent.

Conclusion

This study quantifies Americans' real willingness to donate to hunger relief and the magnitude of hypothetical bias. Using an online discrete choice experiment with hypothetical and real-payment elicitation implemented through a random-binding mechanism, we find two main results. First, respondents exhibit clear willingness to donate: the real-payment elicitation donate probability is 0.458, indicating substantial baseline support for Feeding America. Second, hypothetical choices overstate giving in that model-implied participation in donation, out-of-pocket donations, and estimated total dollars reaching the charity are all higher in the hypothetical elicitation. The 30% overstatement corresponds to approximately five meals per respondent. By holding choice sets constant across treatment groups, we provide clean identification of hypothetical bias and a 1.30× calibration factor. Notably, this calibration factor is relatively modest compared to the meta-analytic average of 2.29× reported by Penn and Hu (2018). One possible explanation for this finding is respondents' relatively high familiarity with Feeding America as a nationally recognized hunger-relief organization; greater familiarity with a charitable cause may stabilize preferences and reduce hypothetical bias relative to less familiar goods.

These findings address the three gaps identified in the literature. First, existing evidence on hypothetical bias comes primarily from environmental goods or international disaster relief; we extend this research to hunger relief, a high-salience domestic cause. Second, many studies confound incentive structure and choice set context; by holding choice set context constant between real-payment and hypothetical elicitation, we isolate the effect of hypothetical bias. Third,

we provide a domain-specific calibration factor directly applicable to food-access contexts. Additionally, our fully automated online implementation demonstrates that real-payment experiments can be conducted at scale without researcher-respondent interaction.

For practitioners, our findings suggest that survey-based donation amounts to be deflated by approximately 30% (or divided by 1.30) when projecting actual giving. For charitable organizations like Feeding America, this calibration can improve operational planning and resource allocation. For researchers, the results reinforce the importance of incentive-compatible elicitation when measuring charitable preferences with policy or operational implications.

This study has limitations. Our real-payment elicitation is capped at $5, which may dampen observed cost sensitivity relative to uncapped settings. Consequently, the 1.30× calibration factor is estimated within this low-stakes context, and its applicability to higher-donation settings remains an open empirical question. While our between-subjects design eliminates order effects, it precludes within-person comparisons. Such analysis can be important for understanding how individual preferences shift between hypothetical and real decisions. Future research could also implement higher budgets and validate predictions from hypothetical elicitations against field fundraising outcomes. Additionally, future work could examine whether hypothetical bias varies across charitable causes or donor populations. Our analysis of demographic heterogeneity reveals that hypothetical bias is significantly larger among low-income respondents, while no significant differences are found for gender or education. The precision of this type of subgroup-specific calibration factors would benefit from larger samples designed with stratified recruitment across demographic cells.

Data Availability Statement

The data used in this study were collected from a private survey and contain confidential respondent information. Due to privacy and confidentiality agreements, the data are not publicly available but can be provided by the corresponding author upon reasonable request.

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Appendix: Attention Check Question

Recent research on decision making shows that choices are affected by context. Differences in how people feel, their previous knowledge and experience, and their environment can affect choices. To help us understand how people make decisions, we are interested in information about you. Specifically, we are interested in whether you actually take the time to read the directions; if not, some results may not tell us very much about decision making in the real world. To show that you have read the instructions, please ignore the question below about how you are feeling and instead check only the 'none of the above' option as your answer. Please check all the words that describe how you are currently feeling."

- o Fear
- o Anger
- o Sadness
- o Joy
- o Disgust
- o Surprise
- o Trust
- o Hope
- o None of the above

Table A1. MWTP Robustness by Donation Amount (Contribute = $1, $3, $5): Hypothetical vs. Real

	Donate (USD)		Match (USD)	
Contribute ($)	**Hypothetical**	**Real**	**Hypothetical**	**Real**
1	2.108*** (0.456)	1.724*** (0.326)	0.853** (0.349)	0.601*** (0.218)
3	4.217*** (0.911)	3.447*** (0.652)	1.705** (0.698)	1.201*** (0.436)
5	6.325*** (1.367)	5.171*** (0.977)	2.558** (1.048)	1.802*** (0.654)

Notes: Entries are MWTP (USD). Standard errors in parentheses are computed using the delta method from the estimated variance–covariance matrix. Hypothetical and Real correspond to hypothetical treatment group and real-payment treatment group. *, **, and *** denote significance at the 10%, 5%, and 1% levels.

Table A2. Robustness Check: Mixed Logit Estimates (Match = Multiplier × Chance): Hypothetical vs. Real

Variables	Hypothetical	Real
Panel A. Mean coefficients		
Donate	1.487**	0.905*
	(0.697)	(1.226)
Match	0.0251*	0.0152**
	(0.0138)	(0.00598)
ln(1 + contribute)	-1.409**	-1.255***
	(0.643)	(0.457)
Panel B. standard deviations of random coefficients		
SD(match)	0.0842***	2.941***
	(0.031)	(0.513)
SD[ln(1 + contribute)]	1.736**	-0.00194
	(0.69)	(0.0154)
# of respondents	267	277
# of observations	1,602	1,662
Log likelihood	-200.174	-189.365
McFadden pseudo R2	0.143	0.0762

Notes: Standard errors (in parentheses) are cluster-robust at the respondent level. The base alternative is No-donate (ASC corresponds to *Donate*). *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table A3. Robustness Check: MWTP Estimates (Match = Multiplier × Chance): Hypothetical vs. Real

Attribute	Hypothetical	Real
Donate	4.223***	2.886***
	(0.991)	(0.930)
Match	7.123**	4.845**
	(3.554)	(2.149)

Notes: Entries are marginal WTP in USD implied by Table A1 and evaluated at *Contribute* = $3. Standard errors (reported in parentheses) are obtained using the delta method based on the estimated variance–covariance matrix. Hypothetical and Real denote hypothetical treatment group and real-payment treatment group, respectively. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table A4. Robustness Check: Mixed Logit Estimates (Multiplier and Chance): Hypothetical vs. Real

Variables	Hypothetical	Real
Panel A. mean coefficients		
Donate	2.547	0.779
	(1.681)	(0.603)
Multiplier	0.842	0.519*
	(0.727)	(0.301)
Chance	0.00639	0.0132
	(0.0179)	(0.00870)
ln(1 + contribute)	-2.297	-1.489**
	(1.674)	(0.584)
Panel B. standard deviations of random coefficients		
SD(multiplier)	4.156*	0.995
	(2.498)	(1.388)
SD(chance)	0.0501	2.17e-05
	(0.0529)	(0.00281)
SD[ln(1 + contribute)]	2.264	3.014***
	(1.508)	(0.572)
# of respondents	267	277
# of observations	1,602	1,662
Log likelihood	-197.287	-173.356
McFadden pseudo R2	0.0853	0.0836

Notes: Cluster-robust standard errors (respondent level) in parentheses. The base alternative is No-donate; the ASC corresponds to *Donate*. Standard deviations are reported in absolute value. *, **, and *** denote significance at the 10%, 5%, and 1% levels.

Table A5. Robustness Check: MWTP Estimates (Multiplier and Chance): Hypothetical vs. Real

Attribute	Hypothetical	Real
Donate	4.434***	2.092*
	(0.925)	(1.128)
Multiplier	1.466	1.394**
	(1.0433)	(0.670)
Chance	0.0111	0.0354
	(0.0281)	(0.0277)

Notes: Entries are MWTP (USD) implied by Table A3 and evaluated at *Contribute* = $3. MWTP standard errors (in parentheses) are obtained using the delta method. *Multiplier* is measured in multiplier units; *Chance* is measured in percentage points, so MWTP for *Chance* corresponds to a 1-percentage-point increase in winning probability. *, **, and *** denote significance at the 10%, 5%, and 1% levels.

Table A6. Pooled Mixed Logit with Demographic Heterogeneity in Hypothetical Bias

Variable	Pooled
Panel A. mean coefficients	
Donate	2.257***
	(0.653)
Donate × hypo	-0.988
	(0.742)
Donate × male	-0.583
	(0.492)
Donate × low-income	-1.211**
	(0.508)
Donate × low-edu	-0.556
	(0.509)
Donate × hypo × male	0.879
	(0.789)
Donate × hypo × low-income	1.749**
	(0.850)
Donate × hypo × low-edu	0.539
	(0.811)
Match	0.564***
	(0.214)
ln(1 + contribute)	-1.437***
	(0.456)
Panel B. standard deviations of random coefficients	
SD(Match)	0.316
	(1.026)
SD[ln(1 + Contribute)]	2.707***
	(0.485)
# of respondents	492
# of observations	2,952
Log likelihood	-514.238
McFadden pseudo R2	0.0518

Notes: Standard errors (in parentheses) are cluster-robust at the respondent level. The base alternative is No-donate (ASC corresponds to *Donate*). *Hypo* is a binary indicator equal to one for respondents in the hypothetical treatment group. *Low-income* is defined as household income below $50,000. *Low-edu* is defined as not having a 4-year college degree. *Male* is a binary indicator for male respondents. After excluding respondents who preferred not to report demographics, the estimation sample consists of 492 respondents (2,952 observations). *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

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United States Mainstream Meat Market Entry: An Analysis of Specialty Goat Meat Products

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Abstract

This study uses data from a national consumer survey conducted in February 2024 to examine factors influencing acceptance of goat meat in the U.S. market. Understanding willingness to purchase products, such as sausage, jerky, patties, burgers, and meat sticks, is critical for market entry. Results show that men under 55, with some college education or less, household incomes above $80,000, and frequent engagement with culinary media are more likely to purchase. Additional predictors include reading food labels and valuing taste, tenderness, leanness, and lower cholesterol. Targeted marketing should emphasize key demographic characteristics including age, gender, income, and education segments groups.

Keywords: consumer preferences, logistic models, market entry, specialty goat products

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Introduction

The U.S. meat market is dominated by three primary options: beef, pork, and poultry. However, consumer preferences are evolving as individuals become increasingly conscious of factors influencing their purchasing decisions, such as animal welfare, feeding practices, and product origin. Goat meat, although less common in the United States, has emerged as a growing industry in recent years (Riley, 2018). Incorporating goat meat into the American diet offers several benefits, including its nutritional profile. Goat meat is classified as red meat but contains less saturated fat than traditional beef products (Silva et al., 2024).

The rising ethnic diversity in the United States has contributed significantly to increased demand for goat meat. Many ethnic communities incorporate goat meat into cultural and religious celebrations, including Christmas, Easter, Ramadan, Eid al-Fitr, Eid al-Adha, weddings, and even national holidays such as the Fourth of July. Despite this growing demand, domestic producers often struggle to meet consumer needs due to structural challenges within the industry (Riley, 2018). Unlike the poultry industry, which is vertically integrated, the goat meat industry remains fragmented and lacks a well-developed supply chain. This disconnect between producers and consumers creates inefficiencies in point-of-sale transactions and limits market accessibility.

As global population growth accelerates, ensuring adequate protein supply for future generations has become a critical concern. Goat meat, widely consumed worldwide (Mazhangara et al., 2019), represents a viable alternative protein source. Although its popularity in the United States remains limited, demand is increasing. Educating consumers about the nutritional benefits of goat meat—such as its lower saturated fat content compared to beef (Rhee, 2003)—could position it as a healthier red meat option for health-conscious individuals. Goat meat offers a unique combination of nutritional advantages, cultural relevance, and sustainable production practices, making it an attractive alternative in the evolving protein market.

Although consumer perceptions often associate goat meat with inferior quality, toughness, or strong flavor, goat meat is leaner than other red meats and contains lower levels of saturated fat and cholesterol, making it a healthier choice (Mazhangara et al., 2019). With the growing segment of health-conscious consumers, goat meat can occupy a niche market by offering a protein source that aligns with nutritional goals better than traditional red meat options.

Unlike beef, pork, and poultry, the goat meat industry lacks a structured supply chain. Approximately 152,000 goat operations exist in the United States, with an average herd size of 20 animals (Riley, 2018). While the industry is expanding, inadequate infrastructure limits domestic producers' ability to meet demand. Many consumers prefer fresh goat meat over frozen imports, creating logistical challenges and requiring customers to travel long distances to access quality products.

Light (2020) examined consumer preferences for four specialty goat meat products: patties, burgers, sausage, and jerky. Her findings revealed that demographic factors, such as gender, age, and primary shopper status along with product attributes like quality, price, freshness, and

cholesterol content, significantly influenced willingness to purchase. Male consumers and younger age groups demonstrated higher purchase intent across all products. Regional differences were also observed, with greater willingness to buy goat burgers in the western and southern United States. Interestingly, while males were more likely to purchase goat meat products, the primary household shopper, more often female, was a consistent predictor across all models. These insights underscore the importance of demographic and behavioral factors in shaping consumer demand.

Building on Light's (2020) research, the current study extends the analysis to include goat meat sticks and uses a more recent nationally representative dataset. The objectives of this study are:

1. To identify and estimate key factors influencing consumers' willingness to purchase various goat meat products.
2. To develop a demographic and behavioral profile of individuals most likely to purchase four goat meat products: burgers, patties, sausage, and jerky.

Methods

The study uses consumer utility maximization theory to analyze willingness to purchase specialty goat meat products if made available in retail stores. This framework can be viewed as one where a utility depends not only on the product attributes, but also on the personal characteristics of the consumer. The logit model, which predicts the likelihood that the independent variable would occur solely on the consumer's socioeconomic characteristics and other product value attributes, is used in this study. Logit models have been widely used to model consumer behavior in applied economics.

The relationship between consumer willingness to purchase specialty goat meat products and products' attributes and consumer characteristics is explored by modeling the indicator variable Z_i, for the i^{th} consumer as a function of their economic, demographic, and value attributes associated with the meat product as follows:

$$Z_i = \beta X_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + K + \beta_k x_{ik} + v_i, \text{ i = 1, 2, K, n} \quad (1)$$

where X_{ij} denotes the j^{th} attribute of the i^{th} respondent, β = (β0, β1, …, βk) is the parameter vector to be estimated and vi is the random error or disturbance term associated with the ith consumer. Under the logistical distributional assumption for the random term, the probability P_i (that the i^{th} consumer will be willing to buy goat meat products) can now be expressed as.

$$P_i = F\left(Z_i\right) = F(\beta_0 + \sum_{j=1}^{k} \beta_j x_{ij}) = F(\boldsymbol{\beta}\mathbf{X}_i) = \frac{1}{1+\exp\left(-\boldsymbol{\beta}\mathbf{X}_i\right)} \quad (2)$$

The estimated β-coefficients of the above equation do not directly represent the marginal effects of the independent variables on the probability P_i that the consumer will be willing to purchase goat meat products. For binary explanatory variables, the marginal effect is determined as (source):

$$\partial P_i / \partial x_{ij} = P\left(x_{ij} = 1\right) - P\left(x_{ij} = 0\right) \tag{3}$$

The conceptual framework and empirical model is implemented using the data from a national survey on consumer preferences for goat meat in food diet. The analysis utilizes data from a 2024 national consumer survey on goat meat conducted between February 27 and March 4. An online consumer survey was sent to residents in all 50 states in the United States. Quotas were set to ensure balances in gender, ethnicity, and certain regions perceived to consume more goat meat. The survey target sampling frame was the civilian population over 18 years of age who had consumed goat meat at some point in their lifetime or were willing to try it. The target sample size was 2002 (+/- 3% sampling error). The survey took 15 minutes to complete.

Questions on the survey asked about the importance of goat meat product attributes, including freshness, leanness, taste, quality, cholesterol level, and price on consumer preferences. Additionally, questions regarding whether participants considered grass-fed, genetically modified, or locally grown attributes in their willingness to buy a product. Also included were questions about demographics, such as age of participant, education, gender, annual gross household income, and household size, as potential predictors of goat-meat product preferences.

Findings

Tables 1 and 2 present descriptive statistics of variables and the marginal effects of the independent variables on the dependent variable (i.e., willingness to purchase the specialty goat-meat products). The results show that age, gender, education, income, and regional residence significantly influenced willingness to purchase goat sausage and other products. The meat attributes of taste, tenderness, leanness, and lower cholesterol content had a strong positive impact on purchase intent. Additionally, cultural and seasonal occasions (e.g., Eid al-Fitr, Christmas, Independence Day) were associated with increased willingness to buy specialty goat meat products.

Across all five product categories (sausage, jerky, patties, sticks, burgers), respondents ages 18–54 were 8%–21% more likely to purchase compared to those over 54. Meat attributes of tenderness, skinless cuts, and lower cholesterol ranged between a 2% and 12% increase in likelihood of purchases. Low-to-medium income respondents were 5%–8% more likely to buy compared to high-income respondents. Watching cooking shows increased purchase likelihood by 4%–8% compared to those who rarely watched culinary events. Respondents with less education than a college degree were 2%–6% less likely to buy compared to the more educated. The ethnicity variables showed that Caucasians compared to other races were 5% more likely to purchase goat meat jerky but were 7% less likely to buy goat meat patty.

Table 1. Descriptive Statistics of Explanatory Variables Used in the Analysis

Variable	Description of the Variable	Mean	Std.Dev.
WLBL_SAU	1 = willing to buy sausage; 0 = otherwise	0.44	0.50
WLBL_JER	1 = willing to buy jerky; 0 = otherwise	0.41	0.49
WLBL_PAT	1 = willing to buy patties; 0 = otherwise	0.41	0.49
WLBL_BUR	1 = willing to buy burgers; 0 = otherwise	0.48	0.50
WLBL_STI	1 = willing to buy sticks; 0 = otherwise	0.24	0.43
FEMALE	1 = respondent is female; 0 = otherwise	0.49	0.50
YOUNG	1 = age less than 35 years; 0 = otherwise	0.32	0.47
MIDAGE	1 = age is between 35 and 54 years; 0 = otherwise	0.35	0.48
MATURE *	1 = age 55 years or higher; 0 = otherwise	0.33	0.47
NORTHEAS	1 = resident of Northeast region; 0 = otherwise	0.18	0.38
MIDWEST	1 = resident of Midwest region; 0 = otherwise	0.21	0.41
SOUTH	1 = resident of Southern region; 0 = otherwise	0.37	0.48
WEST *	1 = resident of Western region; 0 = otherwise	0.24	0.43
DAILY_WEEKLY SHOW	1 = watches cooking shows daily or once a week; 0 = otherwise	0.58	0.49
READLAB	1=consumer reads label ;0=otherwise	0.67	0.47
ATTR_QUALTY	1 = consume goat meat for Christmas; 0 = otherwise	0.86	0.35
ATTR_PRICE	1 = identifies quality as important; 0 = otherwise	0.66	0.47
ATTR_FRESHNES	1 = identifies price as important; 0 = otherwise	0.65	0.48
ATTR_LEANNESS	1 = identifies freshness as important; 0 = otherwise	0.47	0.50
ATTR_CHOLESTO	1 = identifies leanness as important; 0 = otherwise	0.37	0.48
HSE_SIZE	1 <= 2 residents in household; 0 = otherwise	0.55	0.50
LTHSCH	1 = Less than high school education; 0 = otherwise	0.26	0.44
SOMECOL	1 = Some college education; 0 = otherwise	0.34	0.47
DEGMASTER*	1 = College graduate; 0 = otherwise	0.40	0.49
INCOMLT4	1 = (annual) income < than $40,000; 0 = otherwise	0.34	0.47
MID4180	1 = (annual) income between $40,000 and $80,000; 0 = otherwise	0.32	0.47

Table 1 (cont.)

Variable	Description of the Variable	Mean	Std.Dev.
HIGHINC *	1 = (annual) income >$80,000 0 = otherwise	0.33	0.47
MARRIED	1 = respondent is married; 0 = otherwise	0.40	0.49
WHITE	1 = respondent is white; 0 = otherwise	0.73	0.45

Note: Asterisk implies that the variable was dropped during estimation to avoid dummy variable trap.

Table2: Marginal Effects of Independent Variables on Willingness to Buy: Goat Meat Products

	Sticks	Burger	Patty	Jerky	Sausage
Constant	-0.50	-0.38	-0.43	-0.47	-0.39
FEMALE	0.04*	0.07*	0.07*	0.08*	0.10*
YOUNG	0.07*	0.21*	0.14*	0.15*	0.10*
MIDAGE	0.09*	0.13*	0.09*	0.14*	0.12*
NORTHEAS	-0.02	-0.01	0.00	-0.10*	0.01
MIDWEST	0.07*	-0.05	0.00	0.02	0.00
SOUTH	0.01	-0.02	-0.01	-0.06*	-0.04
READLAB	0.05*	0.07*	0.05*	0.06*	0.06*
DAILY_WE	0.08*	0.09*	0.12*	0.07*	0.09*
QUALTY	0.05*	0.12*	0.12*	0.06*	0.13*
PRICE	-0.01	0.00	-0.01	0.00	-0.01
FRESHNES	0.01	0.04	0.03	0.03	0.02
LEANNESS	0.05*	0.07	0.09*	0.05*	0.04
CHOLESTO	0.02	0.03	0.01	0.00	0.00
HSE_SIZE	0.00	-0.02	0.00	0.00	0.02
LTHSCH	0.01	-0.06*	-0.03	0.09*	-0.02
SOMECOL	-0.02	-0.07*	-0.06*	0.06*	-0.01
INCOMLT4	0.05*	0.05*	0.06*	0.04	0.01
MID4180	0.06*	0.05*	0.03	0.03	0.03
MARRIED	0.01	-0.01	0.03	-0.01	-0.01
WHITE	0.02	-0.02	-0.07*	0.05*	-0.03
Loglikelihood	-1,065.73	-1,305.68	-1,278.81	-1,293.73	-1,320.40
DF	20.00	20	20	20.00	20
Restricted LL	-1,111.29	-1,385.14	-1,351.12	-1,351.87	-1,374.17
McFadden's R2	0.04	0.06	0.05	0.04	0.04
Chi-square	91.13	158.91	144.62	116.29	107.54
Prediction success	75.75	61.35	62.95	60.85	60.60

Note: *Significant at less than 5%

Conclusions and Implications

To successfully enter the mainstream U.S. meat market, it is critical to identify consumer segments most willing to purchase goat meat products (e.g., sausage, jerky, patties, burgers, sticks). Findings suggest that younger to middle-aged males (< 55 years) with less than a college education or who have a college education, have an annual income below $80,000, and who watch culinary shows regularly, read food labels, and value meat quality attributes (taste, tenderness, leanness, and lower cholesterol) represent the most promising target market.

Strategies to expand goat meat consumption in the United States should focus on age, gender, income, and education; emphasize marketing based on highlighting meat attributes; and leverage media influence. Additionally, aligning marketing to cultural and holiday seasons will contribute to goat meat market penetration.

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Positioning Goat Meat in the U.S. Meat Market: Evidence from Sensory Quality Attribute Analysis

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Abstract

This study examines how intrinsic sensory attributes of goat meat influence consumer acceptance and purchase behavior in the United States. Consumers evaluated barbecued goat meat based on appearance, juiciness, texture, flavor, and aftertaste using a 9-point hedonic scale. Factor, cluster, and regression analyses identified three key sensory dimensions: meat quality, meat validation, and appearance. Two consumer segments emerged, differing in emphasis on experiential versus visual attributes. Age, gender, and education significantly affected sensory ratings, whereas income had limited influence. Production attributes, including local, grass-fed, organic, and genetically modified labels, also shaped evaluations, highlighting opportunities to position goat meat as a sustainable protein alternative.

Keywords: cluster analysis, consumer preferences, factor analysis, goat meat, hedonic scales, meat quality, regression, sensory evaluation

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Introduction

The U.S. meat market is traditionally dominated by beef, poultry, and pork, whereas mutton and goat meat constitute only a small share of national consumption (Kantor and Blazejczyk, 2022). Increasing awareness of the environmental impacts of livestock production and heightened public health concerns have motivated consumers to seek more sustainable and nutritious alternatives. High consumption of conventional red meat has been associated with cardiovascular disease, certain cancers, and obesity (Godfray et al., 2018), which has contributed to a rising interest in healthier protein choices.

Most of the demand for goat meat in the United States comes from the immigrant population. Demand for many U.S. citizen consumers is low, as many do not buy goat meat because they fear the flavor will not match what they know (Guerrero et al., 2014). However, in a survey by Nelson et al. (2004), most respondents rated the flavor of goat meat better than or the same as beef, and half rated it better than pork. Guerrero et al. (2014) found that lamb was preferred over goat because the respondents were accustomed to it, but there was no statistical difference between the two meats. On the other hand, McMillin and Brock (2005) stated that higher fat content led to more intense flavor, which is considered less desirable. Therefore, a lower-fat goat meat alternative would have a more acceptable flavor to the American consumer.

Goat production confers several ecological advantages, including relatively lower greenhouse gas emissions compared with cattle, strong adaptability to marginal environments, and ecosystem benefits, such as weed control and biodiversity enhancement (Gutiérrez-Peña et al., 2019; Rahimi et al., 2022). Despite these benefits, mainstreaming goat meat in the U.S. market depends on understanding how its sensory attributes align with consumer expectations. Sensory evaluation allows direct measurement of consumer reactions to actual products, in contrast to discrete choice experiments that rely on hypothetical scenarios and emphasize credence attributes (Palma, Johnson, and Anderson, 2019).

Meat quality remains a fundamental driver of satisfaction and purchase behavior. Attributes such as texture, flavor, juiciness, and appearance are central to quality perception and reflect variations in production systems and processing conditions. Understanding how consumers evaluate these characteristics is essential for developing targeted marketing strategies and product positioning.

This study contributes to the emerging literature on alternative red meats by applying a comprehensive sensory analysis of barbecued goat meat. Our objectives are threefold:

i. Identify dominant sensory dimensions that shape consumer perceptions of goat meat;
ii. Classify consumers into market segments based on their sensory preferences; and
iii. Examine how sociodemographic characteristics, health beliefs, and production system perceptions influence evaluations of goat meat's sensory attributes.

The insights generated provide implications for market expansion strategies and opportunities to position goat meat as a high-quality, sustainable protein option for U.S. consumers.

Data and Methodology

Sensory Evaluation Procedure

A sensory evaluation instrument was developed jointly by researchers at Missouri State University and Fort Valley State University. The study protocol received Institutional Review Board (IRB) approval. Data were collected at the 2024 Sunbelt Ag Expo in Moultrie, Georgia, attended by approximately 50,000 visitors. A total of 120 participants were randomly recruited over three days. All participants completed informed consent procedures before participating.

Participants sampled standardized servings of lightly seasoned, professionally prepared barbecued goat meat. Five intrinsic attributes—appearance, juiciness, texture, flavor, and aftertaste—were rated on a 9-point hedonic scale. Following the tasting, participants completed a questionnaire covering demographic information, health and nutritional perceptions, production system preferences, and prior exposure to goat meat.

Empirical Analysis

The empirical analysis of this research was conducted in multiple phases. First, the principal components factor analysis (PCA) was used to reduce the five sensory variables into latent factors/dimensions. In the second stage, standardized factor scores (identified in stage one) were subjected to a two-stage cluster analysis identifying clusters of respondents with similar perceptions of the sensory variables. Finally, regression analysis was used to explore the relationship between the sensory dimensions and the socioeconomic and value attributes of the consumers, including demographics, household characteristics, health and nutritional perceptions, production system preferences, and prior tasting experience.

Results and Discussion

Table 1 presents the means, standard deviations, and factor loadings from the principal component analysis (PCA) obtained after a Varimax rotation of sensory variables. The factor/dimensions were ranked in order of the variance explained and labeled to reflect the latent stimulus. Descriptive statistics indicate high consumer ratings across all sensory attributes, with appearance, juiciness, texture, and flavor averaging close to 8 on the 9-point scale. Aftertaste exhibited slightly greater variation. These results suggest broad sensory appeal of goat meat among sampled consumers. Three sensory dimensions were identified for goat meat consumption.

Table 1: Summary Statistics for Physical Attributes and Varimax Rotated Factor Loadings Component Matrix: Sensory Evaluation Dimensions

	Mean	Standard Deviation	Meat Quality Factor 1	Meat Validation Factor 2	Grilling Factor 3
JUICENESS	8.08	1.174	.909		
TEXTURE	7.88	1.393	.716		
AFTERFTASTE	7.52	1.919		.930	
FLAVOR	8.11	1.390		.625	
APPEARANCE	8.20	1.021			.944
Percentage of total variance explained			36	30	23

Meat Quality (Factor 1)

Goat meat quality is dominated by juiciness and texture (with loadings .91 and .72). This dimension, which captures immediate sensation, signals potential acceptance and purchase of goat meat. Goat meat tenderness and mouthfeel here are linked to consumer satisfaction. It is the largest factor, accounting for 36% of the error variance.

Meat Validation (Factor 2)

This factor with factor loadings of .63 and .93 for flavor and aftertaste, respectively, accounts for 30% of the error variance. This factor reflects the lingering taste experiences and overall satisfaction attributes influenced by volatile compounds and cooking processes and strongly predict repeat consumption.

Appearance Cue (Factor 3)

This factor loaded highly on meat appearance (.94), reflecting visual appeal and perceived grilling quality. Since visual cues often drive initial expectations, this dimension influences consumers' readiness to try goat meat. The factor accounted for 23% of the error variance. Approximately 80% of respondents rated appearance positively.

Cluster Analysis

Two distinct segments emerged. The first cluster, which is identified as the meat validation segment, where 77% of goat meat consumers for those consumers who highly rated juiciness, texture, flavor and aftertaste. These goat meat consumers' bracket represents the primary target group for sensory-based marketing. Comprising 23% of the market segment were those goat consumers considering meat appearance as important. Based on this segment, marketing of goat meat based on display and product aesthetics may be preferable marketing approaches.

Regression Analysis

The regression results of the relationship between the sensory dimensions and the socioeconomic and value attributes of the consumers was carried out on the three dimensions. Important findings of this analysis are summarized below. Overall model fit statistics indicate strong explanatory power for the meat quality and meat validation models ($p < 0.05$).

The meat quality dimension was positively influenced by consumers' preference for locally produced goat meat and presence of children in households. Regarding preference for organic production, male respondents and primary shoppers responded negatively. The meat validation dimension (the intricate taste feeling of what lingers in the mouth after chewing and swallowing the meat) was positively impacted by prior taste of goat meat, presence of children in a household, and importance of low cholesterol. In contrast, the variables that negatively impacted meat validation were gender (male), type of shopper (primary), and household income (medium). Finally, high education attainment impacted the appearance dimension of goat meat positively, and organic production impacted it negatively.

Study Conclusions and Implications

This study had three primary objectives: (i) to identify the dominant sensory dimensions shaping consumer perceptions of goat meat; (ii) to segment consumers based on sensory preferences; and (iii) to examine how sociodemographic characteristics and value orientations influence sensory evaluations. The findings indicate that market entry and expansion strategies for goat meat can be effectively structured around three key sensory dimensions: meat quality (juiciness and texture), meat validation (flavor and aftertaste), and appearance.

The results reveal clear market segmentation. A majority of consumers prioritized experiential attributes, particularly juiciness, texture, and flavor, suggesting that distribution and promotional strategies should emphasize eating quality, taste satisfaction, and the potential for repeat consumption. A smaller but meaningful segment placed greater importance on visual appeal, indicating opportunities for targeted retail merchandising, packaging enhancements, and improved product presentation within food distribution channels.

Regression analysis further demonstrated that sociodemographic and value-based characteristics significantly shape sensory perceptions. Positive evaluations were associated with preferences for locally produced meat, prior tasting experience, the presence of children in the household, and health considerations, such as low cholesterol. In contrast, gender, income level, and preferences for organic production showed mixed effects across sensory dimensions. These findings provide actionable insights for food distributors, retailers, and producers seeking to position goat meat within mainstream U.S. markets.

A key limitation of this research is that data were collected exclusively from attendees at the Sunbelt Ag Expo, who may not be fully representative of the broader U.S. consumer population. Consequently, future research should incorporate more diverse and nationally representative

samples. Additional studies should also examine multiple cooking methods, cultural influences, labeling strategies, and direct comparisons with beef, pork, and lamb to further clarify goat meat's competitive positioning and market opportunities in the United States.

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Willingness-to-Pay Premium for Climate-Smart (CS) Food Across Age Groups: The Moderating Role of Knowledge

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Abstract

Climate-smart (CS) agriculture is increasingly promoted as a pathway to mitigate climate change while maintaining agricultural productivity. Consumer willingness-to-pay (WTP) premiums for food grown using CS practices is essential for scaling CS food systems, yet such willingness may vary systematically across age groups and levels of farming knowledge among buyers. Data for the study was collected in October 2024 using household survey across six Midwestern states (n = 2,016). Ordered probit models were estimated to examine differences across age groups in WTP for CS food and the moderating role of CS farming knowledge. Differences across age groups in WTP for CS food were substantial but contingent on knowledge. Policies and marketing strategies that elevate CS-specific knowledge—particularly among younger cohorts—may accelerate adoption of climate-smart agriculture.

Keywords: climate-smart agriculture; consumer farming knowledge; generational cohorts; moderating effects; price premiums; ordered probit models; sustainable food systems; willingness-to-pay

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Introduction

Climate change mitigation and adaptation have become central objectives of global food-system transformation, with agriculture occupying a critical position due to its dual role as both a contributor to and a potential mitigator of greenhouse gas emissions. Climate-smart (CS) agriculture has emerged as a widely endorsed framework that integrates productivity, resilience, and environmental sustainability objectives (Poore and Nemecek, 2018; Parlasca and Qaim, 2022). While producer-side adoption of CS practices is necessary, sustained market demand for food produced using such practices is essential for long-term scalability.

Consumer demand for sustainably produced food has grown alongside increasing awareness of the environmental impacts of dietary choices. Younger generations, in particular, report stronger pro-sustainability values and greater concern for climate and environmental issues (Dimock, 2023; Liang et al., 2024). However, willingness-to-pay (WTP) for sustainability attributes is heterogeneous and influenced by sociodemographic factors, trust, and consumer knowledge (Nuttavuthisit and Thøgersen, 2017; Li and Kallas, 2021).

Despite growing literature on sustainable food consumption, limited empirical research has explicitly examined how knowledge of climate-smart farming moderates generational differences in WTP. Addressing this gap is particularly relevant for policy design and communication strategies aimed at scaling CS agriculture. This study therefore asks: i) How does WTP for CS food vary across age groups? and ii) Does CS-specific knowledge moderate this relationship? By answering these questions, the study contributes to the literature on sustainable consumption, generational consumer behavior, and the role of information in agri-food markets.

A substantial body of literature documents the environmental impacts of food consumption, particularly the higher climate footprint of meat-intensive diets relative to plant-based alternatives (Poore and Nemecek, 2018; Parlasca and Qaim, 2022). As awareness of these impacts has increased, some consumers have reduced meat consumption for environmental reasons (Sanchez-Sabate and Sabaté, 2019) or switched to substitutes that have less impact on climate. These dietary shifts are often accompanied by greater WTP for sustainability attributes, such as organic, local, or environmentally friendly production methods (Li and Kallas, 2021).

Millennials and Generation Z are the most racially and ethnically diverse cohorts in U.S. history and have been shaped by heightened discourse on climate change and sustainability (Dimock, 2023). Empirical studies find that younger cohorts are more likely to support sustainable consumption, though heterogeneity exists within cohorts based on education, income, and household composition (Tung, Tsay, and Lin, 2015; Liang et al., 2024). Recent research on Generation Z finds strong environmental attitudes and interest in sustainable food (e.g., plant-based alternatives), yet price sensitivity remains significant, limiting actual premium payments (Meixner, Malleir, and Haas, 2024). Cross-national evidence also shows that younger cohorts are more responsive to sustainability branding and ethical attributes, often associating them with identity and lifestyle (Goedertier, Weijters, and Van den Bergh, 2024). Younger consumers, therefore, have higher environmental awareness and report strong stated willingness-to-pay

premium over conventionally grown food, but their realized premiums tend to lower due to income constraints. Middle-aged consumers, including Generation X, tend to exhibit moderate but consistent willingness-to-pay premium. Older consumers, including Baby Boomers and the Silent Generation, exhibit lower environmental concerns compared to younger consumers, are more price conscious, and are willing to pay premium if it sustainably overlaps with health (e.g., organic) and food safety (Goedertier, Weijters, and Van den Bergh, 2024).

Consumer knowledge reduces information asymmetry and increases perceived value of credence attributes, such as sustainable production practices. Meta-analyses and experimental studies consistently find a positive association between objective or perceived knowledge and WTP for sustainable food (Nuttavuthisit and Thøgersen, 2017; Li & Kallas, 2021). Recent studies suggest that knowledge may moderate generational effects, with younger consumers more likely to translate knowledge into purchasing decisions, whereas older consumers rely more heavily on trust and certification cues (Kovacs and Keresztes, 2022; Laing, Cao, and Zhang, 2024).

Conceptual Framework and Hypotheses

Building on consumer utility theory, willingness-to-pay for CS food depends on the additional utility derived from climate-smart attributes relative to conventionally produced food. This incremental utility reflects both observable components (e.g., price, labels) and unobservable components (e.g., values, beliefs, and knowledge).

Membership of consumers in different age groups is hypothesized to influence WTP directly, whereas degree of CS farming knowledge moderates this relationship by conditioning how generational values translate into purchasing behavior.

Accordingly, we test the following hypotheses:

H1: Consumers' age is significantly associated with willingness-to-pay premiums for climate-smart food, with younger consumers, including those belonging to Generation Z and Millennials, exhibiting higher WTP than older cohorts.

H2: The relationship between age groups and willingness-to-pay is moderated by the level of CS farming knowledge, such that higher knowledge strengthens WTP among younger cohorts.

Materials and Methods

Data Collection

Data for the study were collected in October 2024 through a household survey using online techniques across six Midwestern states: Missouri, Arkansas, Illinois, Oklahoma, Iowa, and Kansas. The survey was conducted by Dynata, an international market research and data company. The final analytical sample included 2,016 U.S. consumers and is regionally representative at the 95% confidence level with a margin of error of approximately ±1.2%. The survey collected

detailed information on food purchasing behavior, willingness-to-pay premiums for climate-smart food, self-reported knowledge of specific CS farming practices, environmental attitudes, and sociodemographic characteristics.

Measures

The dependent variable (see Table 1) is consumers' stated willingness-to-pay premium for food produced using climate-smart practices relative to conventionally produced food. This variable is treated as an ordered categorical outcome reflecting increasing premium levels. The lowest category is unwilling to pay any premium, and the highest category is more than 20% above the average price of conventionally grown food.

Table 1. Description of Variables

Variable Name	Description	Mean
WTP Premium	Willingness-to-pay premium for CS food above conventionally grown food 0 = not willing to pay; 1 = 1%–4% above; 2 = 5%–9% above; 3 = 10%–14% above; 4 = 15%–20% above; 5 = more than 20% above	1.60
Gender	1 = female; 0 = male	0.51
Children	1 = households with children; 0 = otherwise	0.33
Race	1 = white/Caucasian; 0 = other racial categories	0.76
Education	1 = college degree and above; 0 = less than college degree	0.36
Married	1 = married; 0 =otherwise	0.42
Employed	1 = full- or part-time employed; 0 = otherwise	0.59
AvSpend	Average amount spent per grocery trip is $100–$150; 1 = if above average; 0 = otherwise	0.59
Urban	1 = if live in urban areas; 0 = otherwise	0.35
Rural	1 = if live in the rural area; 0 = otherwise	0.21
Suburban#	1 = if live in the suburban area; 0 = otherwise	0.43
AgeGroups	1 = ages 18 to 24; 2 = ages 25 to 34; 3 = ages 35 to 44; 4 = ages 45 to 54; 5 = ages 55 to 64; and 6 = ages 65 and above	1.65
Knowledge	Degree of knowledge regarding climate-smart farming practices, score values are a minimum of 12 and a maximum of 60	25.04

Notes: #dropped variables in regression models
Survey script for WTP premium question: How much price premium are you willing to pay for food grown using Climate-Smart growing practices compared to conventionally grown food products?
Not willing to pay premium.
1%–4%
5%–9%
10%–14%
15%–20% greater than 2

Key explanatory variables include age of respondents measured using six groups; the youngest group is between 18 to 24 years old and the oldest is above 65 years old in 2024. These groups closely align with generational cohorts as described by Dimock (2023) at Pew Research Center. Next is the level of CS farming knowledge among respondents. Knowledge is measured using respondents' self-assessed familiarity with 12 specific CS practices, including conservation crop rotation, cover crops, no-till systems, windbreaks, field borders, and alley cropping. Respondents were asked to report how informed they feel about the specific climate-smart farming practices (1 = "not informed at all" to 5 = "extremely informed"). A knowledge score was created summing the reported value for each of the practices. The maximum value of the score is 60, and the minimum value is 12. An interactive variable was created multiplying age groups and knowledge score. This interactive variable was included in the full model to test for the moderation hypothesis.

Control variables include gender, presence of children in the household, race/ethnicity, education, marital status, employment status, average food expenditure, and urban, suburban, or rural residence.

Econometric Specification and Moderation Model

Given the ordinal nature of the dependent variable, ordered probit regression models are estimated. Model 1 includes only sociodemographic controls. Model 2 introduces age groups. Model 3 includes CS knowledge variable. Model 4 is the full moderation model, incorporating age groups and CS knowledge and an interactive variable, which is the multiplication of age groups and CS Farming Knowledge.

Following are the specifications for the regression models included in the study:

Model 1:

$$WTP^* = \alpha + \beta_1 Gender + \beta_2 Children + \beta_3 Race + \beta_4 Education + \beta_5 Married + \beta_6 Employed + \beta_7 AvSpend + \beta_8 Urban + \beta_9 Rural + \varepsilon_1 \quad (1)$$

Model 2:

$$WTP^* = \alpha + \beta_1 Gender + \beta_2 Children + \beta_3 Race + \beta_4 Education + \beta_5 Married + \beta_6 Employed + \beta_7 AvSpend + \beta_8 Urban + \beta_9 Rural + \beta_{10} AgeGroups + \varepsilon_2 \quad (2)$$

Model 3:

$$WTP^* = \alpha + \beta_1 Gender + \beta_2 Children + \beta_3 Race + \beta_4 Education + \beta_5 Married + \beta_6 Employed + \beta_7 AvSpend + \beta_8 Urban + \beta_9 Rural + \beta_{10} Knowledge + \varepsilon_3 \quad (3)$$

Model 4:

$$WTP^{*} = \alpha + \beta_1 Gender + \beta_2 Children + \beta_3 Race + \beta_4 Education + \beta_5 Married + \beta_6 Employed + \beta_7 AvSpend + \beta_8 Urban + \beta_9 Rural + \beta_{10} AgeGroups + \beta_{11} Knowledge + \beta_{12}(AgeGroups \times Knowledge) + \varepsilon_4 \quad (4)$$

The moderating role of knowledge is assessed by examining changes in the magnitude and significance of variable representing age groups after CS Farming Knowledge is added, as well as through sign and significance of the interactive variable in Model 4. Marginal effects and predicted probabilities of each of the premium categories were calculated based on the estimated coefficients in Model 4 following Long (1997). This approach is appropriate when moderation is conceptualized as a conditioning effect along with an interaction term. Regression results, marginal effects, and predicted probabilities of paying a premium are reported in Tables 3, 4, and 5.

Results and Discussions

Descriptive Statistics

Table 1 summarizes descriptive statistics of the variables included in the regression models. The sample means closely represent the population averages for the six states from which samples were drawn. Sample mean for the price premium is approximately 5% above the price paid for conventionally grown food. Table 2 reports a cross tabulation of WTP price premiums and age groups with statistical significance of Chi-square values. About a third of the respondents are unwilling to pay any price premium. Only about 10% are willing to pay more than 15% above the price for the conventionally grown food. Approximately 60% are willing to pay between 1% and 15% above conventionally grown food. Younger cohorts report higher stated willingness-to-pay premium compared to older groups. Nearly 50% of the consumers aged 55 and above, approximately representing Baby Boomers and the Silent Generation, are not willing to pay any premium compared to only 19% among ages 18 to 24 years and slightly more than 20% among ages 25 to 34 years. These two groups closely represent Generation Z and Millennials discussed above.

Table 2. Reported Willingness-to-Pay by Age Groups

	Not Willing-to-pay	1 = 1%–4% above	2 = 5%–9% above	3 = 10%–14% above	4 = 15%–20% above	5 =More than 20% above	Total
Age 18–24 years*	40 (19.4%)	33 (16.0%)	46 (22.3%)	49 (23.8%)	20 (9.7%)	18 (8.7%)	206 (5.1%)
Age 25–34 years*	146 (22.1%)	121 (18.3%)	151 (22.9%)	142 (21.5%)	58 (8.8%)	44 (6.6%)	662 (28.2%)
Age 35–54 years	116 (33.4%)	70 (20.2%)	61 (17.6%)	67 (19.3%)	14 (4.0%)	19 (5.5%)	347 (24.3%)

Table 2 (cont.)

	Not Willing-to-pay	1 = 1%–4% above	2 = 5%–9% above	3 = 10%-14% above	4 = 15%-20% above	5 = More than 20% above	Total
Ages 55 and above*	313 (39.1%)	201 (25.1%)	163 (20.3%)	81 (10.1%)	30 (3.7%)	13 (1.6%)	801 (37.4 %)
Total	615 (30.5%)	425 (21.1%)	421 (20.9%)	339 (16.8%)	122 (6,1%)	94 (4.7%)	2016

Notes: Figures in (-) are total percentage of respondents reported for price premium category.
*Chi-square values significant at $\alpha < 0.00$.

Ordered Probit Estimates

Results from the ordered probit models are presented in Table 3 for all four models. Standardized Akaike Information Criteria (AIC/N), McFadden Pseudo R Squared and Chi-squared values are reported for all four models to assess the overall fitness and performance of the models. AIC/N evaluates how well the latent-variable structure explains the ordinal outcomes for the models while penalizing for extra thresholds or covariates. Lower AIC/N is better**.** It implies a better tradeoff between fit and parsimony. The reported results show that AIC/N value decreases for every subsequent model estimated. The value is the lowest for the full model, suggesting that added variables have improved the likelihood without penalizing the complexity. McFadden Pseudo R squared value is highest for the full model as well. Overall, all four models are significant at *p*-value < 0.001 as represented by Chi-squared values.

Table 3. Results of Ordered Probit Regression Models

	Basic (Model 1)	Across Age Groups (Model 2)	CS Farming Knowledge (Model 3)	Moderating Effects with Interaction (Model 4)
Intercept	0.306***	0.705**	0.631***	-0.740***
	(0.077)	(0.108)	(0.093)	(0.179)
Gender	-0.091	-0.072	0.120**	0.128***
	(0.048)	(0.048)	(0.050)	(0.050)
Children	0.349***	0.263***	0.187***	0.159***
	(0.055)	(0.057)	(0.056)	(0.058)
Race	-0.217***	-0.171***	-0.149**	-0.128**
	(0.058)	(0.059)	(0.059)	(0.059)
Education	0.177***	0.220***	0.126**	0.148***
	(0.052)	(0.053)	(0.053)	(0.054)
Married	-0.132**	-0.081	-0.166***	-0.141***
	(0.052)	(0.053)	(0.053)	(0.053)

Table 3 (cont.)

	Basic (Model 1)	Across Age Groups (Model 2)	CS Farming Knowledge (Model 3)	Moderating Effects with Interaction (Model 4)
Employed	0.249***	0.149***	0.162***	0.126**
	(0.052)	(0.056)	(0.053)	(0.056)
AvSpend			0.201***	
	0.239***	0.193***	(0.051)	0.181***
	(0.051)	(0.052)		(0.052)
Urban	0.177***	0.165***	0.100	0.094
	(0.054)	(0.054)	(0.056)	(0.055)
Rural	-0.117	-0.129	-0.255***	-0.249***
	(0.064)	(0.065)	(0.065)	(0.066)
AgeGroups		0.093***	-	0.040
		(0.018)		(0.038)
Knowledge			0.043***	0.053***
			(0.002)	(0.005)
AgeKnowledege				-0.003**
				(0.001)
Standardized Akaike Information Criteria (AIC/N)	3.16	3.14	2.97	2.96
McFadden Pseudo R sq.	0.035	0.039	0.093	0.094
Chi-square (d.f.)	226.84***	253.56***	607.75***	619.45***
	(9)	(12)	(11)	(14)

Note: ***$p < 0.01$; **$p < 0.05$ (two-tailed). Standard errors in parentheses.

Nearly all control variables are statistically significant at $P < 0.05$ for all four models. Signs of the coefficients have also remained consistent across the models, barring few exceptions. Since Model 4 is determined to be the best fit based on several criteria as discussed above, we will focus on Model 4 results. Women exhibit higher willingness-to-pay for sustainable and healthy food than men, consistent with previous studies (Alsubhi et al., 2023; Goerditier et al., 2024). Similarly, households with children exhibit higher WTP for CS food products, perhaps driven by parental concerns for nutrition and safety. However, competing budget constraints can reduce WTP for premium-priced sustainable goods, especially in lower-income households (Nam and Suk, 2024). Married individuals or couples tend to have more stable consumption patterns with greater emphasis on food quality, which may increase WTP. However, similar to households with children, larger households' financial responsibilities can dampen willingness-to-pay premiums. This study finds that marital status is negatively related to WTP premiums. Employment status is closely tied to education and income among the strongest predictors of WTP. Hence, highly educated and employed individuals are more likely to pay premiums compared to those who are unemployed.

Higher income individuals who are employed consistently show greater willingness-to-pay premiums for sustainable food (Li and Kallas, 2021; Hu et al., 2024). Food insecurity or unstable employment significantly reduce WTP (Nam and Suk, 2024). This study finds that geographic residence plays an important role in WTP premium for CS food. Urban households are more likely to pay premiums than suburban households, whereas rural households are less likely to pay premiums than suburban households. Large-scale cross-country analyses confirm that regional and spatial factors significantly influence WTP estimates (Li and Kallas, 2021). Urban consumers generally exhibit higher WTP for sustainable food, likely due to greater exposure to sustainability messaging, higher incomes, and better access to such products. Race and ethnicity are underexplored but increasingly important variables explaining food preference and WTP. In this study, white respondents are less likely to pay premium compared to non-whites. This result is likely tied with results related to geographic residence. The urban population is more diverse with a larger percentage of minorities; hence, they report higher WTP in niche markets tied to cultural or ethnic consumption. In the Midwest, from where study samples were drawn, suburban and rural populations tend to be predominantly white and have less inclination to pay premium. This factor is further confounded by income disparities between urban and rural households.

Across all of the estimated models, except Model 4, variables representing age groups exhibit statistically significant and negative coefficients, indicating a higher likelihood of paying a premium for CS food among younger groups compared to older groups. However, the case is different when both age and knowledge are included in the model with the variable representing an interaction between age and knowledge. Therefore, age alone does not have a direct effect on WTP.

Results from regression models show that CS Farming Knowledge is a strong predictor of WTP premiums. When the knowledge variable is included in Model 4, the magnitude of age group coefficients declines and becomes statistically insignificant, indicating that part of the observed differences across age groups operate through differential levels of CS knowledge. Such moderating effect is strongly demonstrated by the sign and significance of the interactive variable. The effect of knowledge weakens as age increases. That is, younger consumers may act more on knowledge, whereas older consumers' WTP is less responsive to it. These results provide clear support for Hypothesis 2 and confirm that CS knowledge moderates the relationship between age groups and willingness-to-pay premium.

Marginal Effects and Predicted Probabilities

Table 4 reports marginal effects of each of the explanatory variables on two of the six ordinal outcomes in the model: not willing to pay any premium (Y = 0) and premium of more than 20% above the prices of conventionally grown food (Y = 5). Interestingly, the effect of CS knowledge through age on the probability of WTP lowest premium (Y = 0) is exactly the same as that for the highest premium (Y = 5).

Table 4. Marginal Effects for Ordered Probit regression using full model results.

	Partial Effects (Y = 0, no price premium)	Partial Effects (Y = 5, more than 20% above)
Gender	-0.042**	0.006**
Children	-0.051***	0.008**
Race	0.041**	-0.007**
Education	-0.048***	0.008**
Married	0.047***	-0.007***
Employed	-0.042***	0.006***
AvSpend	-0.060***	0.009
Urban	-0.031	0.005
Rural	0.085***	-0.011***
AgeGroups	-0.013	0.002
Knowledge	-0.017***	0.003***
AgeKnowledege	0.001**	-0.001**

Note: ***$p < 0.01$; **$p < 0.05$ (two-tailed). Standard errors in parentheses.

Table 5 reports the predicted probability of WTP for all six levels of premium calculated using the estimated coefficients of the full model following Long (1997) for ordered probit models. According to the calculations, the probability of WTP zero premium is slightly more than 26%, and the 20% plus premium is slightly more than 2%. Using the calculated probabilities as weights and the midpoints for each of the six premium categories, the estimated weighted average premium is approximately 5.6% above the average price of food grown conventionally.

Table 5. Predicted Probability of WTP Premium Using Parameters Estimated from Full Regression Model (Model 4)

Willingness-to-Pay Premium Price above Conventionally Grown Food	Probabilities
0 = Not willing-to-pay premium	26.57%
1 = 1%–4% above	23.89%
2 = 5%–9% above	25.02%
3 = 10%–14% above	17.78%
4 = 15%–20%	4.70%
5 = More than 20% above	2.05%

Discussion

The findings provide strong evidence that both age and CS-specific knowledge shape willingness-to-pay for climate-smart food. Younger groups exhibit greater WTP, consistent with prior research on sustainable consumption, but knowledge plays a crucial role in translating pro-sustainability attitudes into economic behavior. Knowledge of farming techniques has a positive and highly significant effect on consumers' willingness-to-pay premium for food grown using CS methods. However, the negative and significant interaction between age and knowledge indicates that this effect diminishes with age. Specifically, while more knowledgeable consumers are more willing

to pay premium, this relationship is stronger among younger individuals and weakens for older respondents, suggesting that younger consumers are more responsive to knowledge in shaping their valuation of sustainably produced food.

For older cohorts, lower responsiveness to CS knowledge suggests that trust, certification, and simple labeling may be more effective than detailed technical information. While the study does not directly address issues of labeling and trust, they could be potential areas of inquiry for future research. Age differences along with urban–rural differences further highlight information access disparities that may influence WTP.

Conclusions, Implications, and Limitations of the Study

This study demonstrates that generational differences in willingness-to-pay for climate-smart food are real but contingent on consumer knowledge of CS farming practices. Policies and marketing strategies that enhance public understanding of specific CS farming practices can amplify demand, particularly among younger groups of consumers. Investments in education, labeling, and public–private partnerships may therefore play a critical role in scaling climate-smart agriculture.

While the study uncovers many interesting relationships between WTP premium and number of explanatory variables, including age groups and knowledge, it has many limitations. Although the study uses an ordinal measure of WTP, there is a potential for hypothetical bias. Future studies may incorporate methods like cheap talk or certainty followup (Penn and Hu, 2018) to mitigate such bias.

In this study, CS farming knowledge was measured using self-reported level of knowledge about 12 specific CS farming practices. Within the survey environment, verifying the claims of knowledge is difficult. In addition, knowledge is likely endogenous to WTP through reverse causality or omitted variable bias.

Another potential issue is the perceived availability of CS food. If a consumer believes such foods are not already available, they may answer strategically, overstating their WTP because they believe it may increase the probability of the item's availability in the market. Hence, incentive compatibility is a potential issue (Carson and Groves, 2007).

Future research should employ longitudinal designs to disentangle cohort and life-stage effects and incorporate revealed-preference data to validate stated WTP. Despite limitations related to self-reported knowledge and other potential biases, the findings offer actionable insights for promoting sustainable food systems.

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Data Availability Statement

The data used in this study were collected from a private survey and contain confidential respondent information. Due to privacy and confidentiality agreements, the data are not publicly available but can be provided by the corresponding author upon reasonable request.

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Factors Affecting Bread Selection: Strategies for Promoting High-Quality Bread Consumption

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Abstract

Bread forms a cornerstone of the Iranian diet, exhibiting diverse consumption patterns influenced by various household characteristics. This study aims to determine the key socioeconomic factors that shape bread-type selection within Tehran, Iran. Using data collected in 2024 from 401 households across three regions of Tehran via random cluster sampling, and applying the multinomial logit (MNL) model, we find that household income, geographic region, and family size are the most significant determinants of bread selection. This research concludes that successful strategies to promote higher-quality and more nutritious breads must integrate product improvements with targeted consumer education, respecting cultural preferences.

Keywords: bread choice, consumer preferences, Multinomial Logit Model, socioeconomic determinants, Tehran Urban Market

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Introduction

Bread holds a central and indispensable role in the Iranian diet. Reflecting this significance, per capita wheat consumption in Iran is more than double the global average (FAO, 2022), with approximately 80% of wheat dedicated to bread production. The selection and consumption of bread are deeply embedded within cultural contexts, where established beliefs and ingrained habits play a pivotal role (Gava, Bartolini, and Brunori, 2016). These factors suggest that any optimal innovation process within the bread sector must not only respect tradition but also seek to enhance it through the integration of modern technologies and quality improvements (Miolla et al., 2023). Consumer preferences and consumption levels have historically led to a wide variety of bread types (Shahnoushi et al., 2011), and as mentioned, key determinants influencing these choices include quality, daily consumption amount, bread price, and monthly household income.

Globally, bread consumption varies significantly, with roughly half the world's population consuming bulky breads, while many countries in Central America, South America, Africa, and East/Southeast Asia primarily consume flatbreads, often from traditional bakeries (Karizaki, 2017). Recognizing this global diversity, research has explored the multifaceted determinants of consumer bread choice. For instance, De Boni et al. (2019) utilized a choice experiment to assess consumer preferences for high-quality Italian industrial breads, finding that consumer knowledge regarding sustainability, nutritional attributes, price, durability, and waste management significantly influenced choices. Similarly, Gava, Bartolini, and Brunori (2016) investigated consumer determinants in Italy, highlighting the importance of ethical factors (environmental sustainability, origin concerns), sensory quality (taste, freshness, appearance), health considerations (nutritional quality of wheat and flour), and price. Their findings underscored sensory quality as a key determinant of consumer choice, further emphasizing the strong cultural component wherein beliefs and habits are critical. Studies on rye yeast bread, such as Skořepa and Pícha (2016), also identified freshness, appearance, and price as crucial factors, with price sensitivity increasing with age. These studies collectively suggest that promoting specific bread types often requires highlighting their health benefits or addressing salient consumer concerns.

In the specific context of Iran, the consumption landscape is characterized by a dual system of subsidized traditional breads and emerging commercial varieties. While nearly 50% of the global population consumes bulky breads, Iran's market has historically been dominated by traditional flatbreads, such as *Sangak* and *Barbari*. Understanding the drivers behind consumer choices within this complex market is crucial for informing policy and industry strategies aimed at promoting healthier and more sustainable bread options. Therefore, this study aims to identify and investigate the factors influencing the consumption of different bread types in Tehran, enabling a nuanced understanding of consumer behavior and providing a basis for targeted interventions.

Materials and Methods

To investigate the factors affecting bread type choice from the consumers' perspective, the city of Tehran was selected as the statistical population. A representative sample of 401 households was randomly selected via a cluster sampling method (Kerry and Bland, 1998) across three distinct

areas of Tehran (Regions 3, 7, and 11). Data collection was executed using a structured questionnaire administered to the selected participants during the final quarter of 2024 (October–December).

The Multinomial Logit Model (MNL) was utilized for data analysis, implemented using Stata MP17 software. The dependent variable in this study encompasses six categories of bread commonly consumed in Tehran: Sangak, Barbari, Lavash, Taftoon, Bulky bread, and Industrial bread. (see Figure 1).

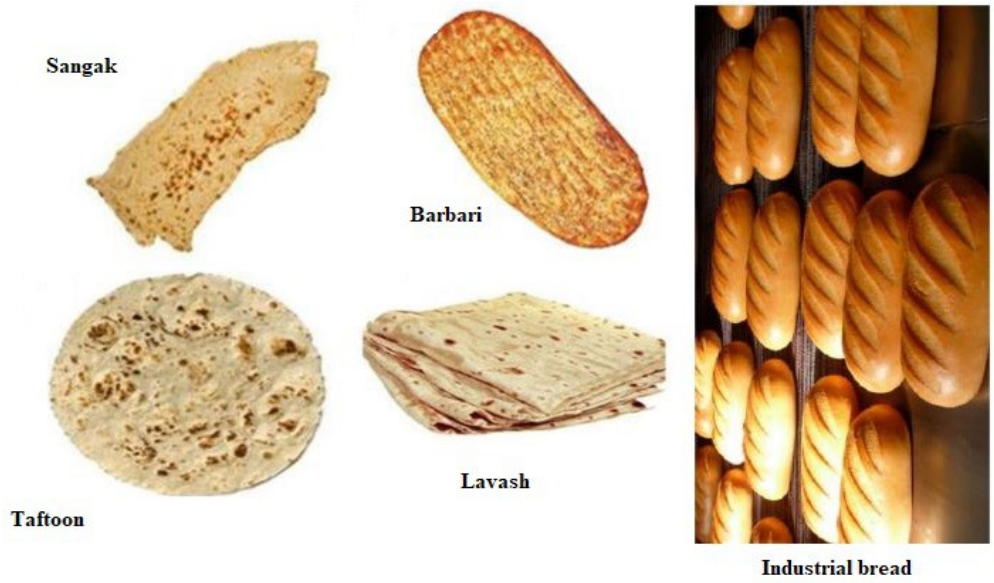

Figure 1. Types of Bread Examined in This Study

The underlying MNL model for investigating the effect of household characteristics on the choice of bread type is specified as equation (1). The Multinomial Logit Model estimates the log-odds ratio of choosing bread type j versus the reference category (Sangak) based on the household characteristics (Long and Freese 2014; Saghaian, Mohammadi, and Jafari, 2023).

$$\ln\left(\frac{P_j}{P_{Sangak}}\right) = Y_j \tag{1}$$
$$= \beta_1 Age_i + \beta_2 gender_i + \beta_3 D_7 + \beta_4 D_{11} + \beta_5 educ_i + \beta_6 incom_i + \beta_7 family_i + \varepsilon_t$$

where Y_j represents the choice of bread type j, and β coefficients denote the estimated parameters for the independent variables (Age, Gender, Region, Education, Income, Family Size) for household i. For categorical variables like Gender and Region, dummy coding was applied with appropriate reference categories, ensuring that each dimension of choice is accurately captured.

Results and Discussion

Table 1 illustrates the frequency distribution, highlighting a significant disparity among the bread choices.

Table 1. Frequency Distribution of Bread Types

Types of Bread	Frequency	Percentage (%)
Sangak (base)	213	53%
Lavash	64	16 %
Barbari	62	15%
Taftoon	32	8%
Industrial	18	4%
Bulky	12	3%
Total	401	100%

Note: Source: Research Findings

As shown, Sangak bread dominates the market share at 53%. Conversely, Bulky (3%) and Industrial (4%) breads represent the lowest consumption levels.

Table 2 provides a summary of the independent variables.

Table 2. Descriptive Statistics for Independent Variables

Variable	Type	Range	Mean	Std. Dev.
Age (household head)	Quantitative	25 to 81 years	42.5	10.2
Income (million rials)	Quantitative	200 to 830 million rials	450.0	110.5
Education (years of schooling)	Quantitative	5 to 22 years	13.2	3.5
Family size (persons)	Quantitative	1 to 7 persons	3.8	1.2
Gender (1 = male, 0 = female)	Qualitative (dummy)	0 or 1	0.72	-
Region 7 (D7)	Qualitative (dummy)	0 or 1	0.30	-
Region 11 (D11)	Qualitative (dummy)	0 or 1	0.25	-

Note: Reference Categories: Gender (Female), Region (Region 3). Source: Research Findings

Multinomial Logit Model Estimation Results

The model estimates the log-odds of choosing bread type j relative to the base category, Sangak. Table 3 shows the impact of independent variables across all alternative choices. It should be noted that Average Marginal Effects (AMEs) represent the expected change in the probability of choosing a particular bread type for a 1-unit change in the independent variable, averaged across all observations in the sample (Mohammadi and Saghaian, 2022).

Table 3. Results of the Multinomial Logit Model Estimation

Variable	Category vs. Sangak	β	S.d.	Z	*p*-value	AME
Income (million rials)	Barbari	0.00018*	0.000077	2.40	0.016	+0.0035
	Lavash	0.000068	0.000097	0.71	0.480	+0.0008
	Taftoon	0.000012	0.0000110	1.09	0.275	+0.0015
	Industrial	0.000009	0.0000130	0.69	0.490	+0.0011
	Bulky	0.000015	0.0000140	1.07	0.284	+0.0018
Region 7 (D7)	Barbari	0.2556*	0.0539	4.74	4.75	+0.0512
	Lavash	0.1252*	0.0598	2.09	0.036	+0.0240
	Taftoon	0.1880*	0.070	2.69	0.007	+0.0370
	Industrial	0.1084	0.1093	0.99	0.321	+0.0130
	Bulky	0.150**	0.090	1.67	0.095	+0.0180
Region 11 (D11)	Barbari	0.051	0.0350	1.46	0.144	+0.0095
	Lavash	−0.082*	0.040	-2.05	0.040	−0.0155
	Taftoon	−0.045	0.0480	-0.94	0.347	−0.0055
	Industrial	−0.020	0.0550	-0.36	0.718	−0.0025
	Bulky	−0.10**	0.0600	-1.67	0.095	−0.0120
Family size	Barbari	−0.233**	0.1265	-1.85	0.065	−0.0350
	Lavash	−0.10	0.1400	-0.71	0.477	−0.0120
	Taftoon	−0.15	0.1600	-0.94	0.347	−0.0180
	Industrial	−0.52*	0.254	-2.05	0.041	−0.0850
	Bulky	−0.705*	0.254	-2.75	0.021	−0.1150
Age (years)	Barbari	−0.010	0.0103	-0.98	0.329	−0.0015
	Lavash	−0.0438*	0.0128	-3.43	0.001	−0.0075
	Taftoon	−0.0144	0.0161	-0.90	0.370	−0.0018
	Industrial	−0.068	0.0180	-3.78	0.000	−0.0110
	Bulky	−0.055	0.020	-2.75	0.006	−0.0090
Gender (male = 1)	Barbari	0.349	0.2930	1.19	0.233	+0.0400
	Lavash	−0.067	0.3535	-0.19	0.849	−0.0070
	Taftoon	−0.0031	0.5176	-0.01	0.995	≈−0.000
	Industrial	−1.295	0.8400	-1.54	0.123	−0.1000
	Bulky	−17.42*	0.8399	-20.9	0.012	≈−0.000
Education (years)	Barbari	−0.1870	0.1586	-1.18	0.238	−0.020
	Lavash	0.3202**	0.1729	1.85	0.064	+0.0480

Table 3 (cont.)

Variable	Category vs. Sangak	β	S.D.	Z	*p*-value	AME
	Taftoon	0.0467	0.28322	0.16	0.869	+0.0050
	Industrial	0.2799	0.3051	0.92	0.359	+0.030
	Bulky	0.4573	0.3051	0.92	0.359	+0.0550

Source: Research Findings. * Significant at the 5% level, and ** significant at the 10% level.

Interpretation of Results

Geographic Influence (Region 7): The strongest and most consistent predictor across several bread categories is the consumer's location in region 7. This region significantly elevates the probability of choosing Barbari (by ≈5.12 percentage points), Taftoon (by ≈3.70 pp), and Lavash (by ≈2.40 pp) relative to the base choice, Sangak. This highlights a strong regional preference for these types of bread.

Socio-Demographic Factors

Age: An increase in consumer age acts as a significant deterrent for Industrial (−1.1pp probability change per year), Lavash (−0.75pp), and Bulky (−0.90 pp) bread choices. This finding suggests a generational shift or evolving preferences away from these types as individuals age.

Family Size: Larger households are significantly less likely to opt for Bulky (−11.50pp) and Industrial (−8.50pp) breads, indicating that they might be less suitable for larger family consumption patterns or economic constraints within larger families.

Income: The effect of Income is highly specific, significantly boosting the probability of choosing Barbari by approximately 0.35pp per million Rials increase. Its impact on other bread types is not statistically significant, suggesting that Barbari is uniquely perceived as a superior good among the analyzed breads.

Education: Higher Education levels are marginally, yet significantly, associated with an increased probability of choosing Lavash (by ≈4.80pp). This finding could reflect an appreciation for artisanal or specific types of bread associated with higher education.

The coefficient estimated for Gender (Male = 1) on the choice of Bulky bread category (β≈−17.4) exhibits an unexpectedly large magnitude, whereas its corresponding Average Marginal Effect (AME) is effectively zero. This outcome is indicative of quasi-separation within the dataset, suggesting the model faces difficulty in reliably estimating the effect due to the scarcity of observations pertaining to this specific combination. Consequently, this finding will be reported with extreme methodological caution, explicitly acknowledging that it does not constitute reliable evidence of a gender-based preference for Bulky bread. Effects for Gender on all other bread categories were found to be statistically non-significant.

Regional Contrasts: While Region 7 shows strong positive associations, Region 11 exhibits a significant deterrent effect on the choice of Lavash (−1.55pp), suggesting distinct market or preference structures in different regions.

Model Specification Tests

A. Independence of Irrelevant Alternatives (IIA) Test—Hausman Test

The Hausman test results confirm the validity of the IIA assumption, as all *p*-values are greater than 0.05, thus endorsing the Multinomial Logit framework.

Table 4. Hausman Test Results for IIA Assumption

Types of Bread	χ2 Statistic	df	*p*-value	Conclusion
Barbari	12.310	10	0.267	Fail to reject H0 (IIA holds)
Lavash	7.995	10	0.628	Fail to reject H0 (IIA holds)
Taftoon	15.650	10	0.107	Fail to reject H0 (IIA holds)
Industrial	11.450	10	0.327	Fail to reject H0 (IIA holds)
Bulky	10.118	10	0.422	Fail to reject H0 (IIA holds)

Source: Research Findings

B. Likelihood Ratio (LR) Test for Category Aggregation

The LR test confirms that the separation of the six categories is statistically justified, as merging the two rarest types (Bulky and Industrial) significantly reduces the model's fit.

Table 5. Likelihood Ratio Test for Combining Bulky and Industrial Breads

Model	Log-Likelihood (LLL)	Number of Parameters (df)	LR Statistic (χ2)	*p*-value	Conclusion
Unrestricted (6 categories)	−475.950	24	-	-	-
Restricted (5 categories)	−478.250	22	5.40	0.020	Reject H0

C. Goodness-of-Fit Criteria

Table 6 provides an overview of the key criteria used to assess the model's overall goodness-of-fit.

Table 6. Multinomial Logit Model Fit Criteria

Criterion	Value
Log-likelihood (intercept only)	−535.18
Log-likelihood (full model)	−475.95
LR test statistic (vs. intercept)	118.47 (with p≈0.000)
McFadden's R^2	0.11
Cragg-Uhler R^2	0.27
AIC	2.58
BIC	−1199.93

Source: Research Findings

The highly significant LR statistic ($\chi 2$ = 118.47 with p≈0.000) indicates that the full model (including independent variables) provides a significantly better fit to the data than the null model (containing only the intercept). This result confirms that the chosen set of variables has significant explanatory power over the choice of bread. McFadden's R^2 measure is 0.11, and in discrete choice models, this value is generally considered acceptable. Cragg-Uhler R^2 value of 0.27 suggests a stronger fit than McFadden's, indicating that the model performs reasonably well in distinguishing between choices, and, finally, AIC/BIC values suggest a balance between model fit and the number of parameters used.

Conclusions and Recommendations

The analysis of bread choice in Tehran, anchored by the Multinomial Logit model (see Table 3), confirms that consumer decisions are significantly driven by a convergence of socioeconomic status and geographic location. The market is overwhelmingly dominated by Sangak (53%), establishing it as the baseline preference.

Key Empirical Findings

Income and Geographic Sorting: Higher household income significantly correlates with increased demand for Barbari—suggesting its perception as a "superior good" in this context—while simultaneously exhibiting a strong deterrent effect on the choice of Industrial and Bulky breads. Furthermore, regional disparity is pronounced: residence in Region 7 acts as a powerful positive incentive for choosing Barbari, Taftoon, and Lavash over Sangak, suggesting embedded local market conditions or established preferences that override purely national socioeconomic factors.

Demographic Constraints: Family size emerges as a practical constraint, significantly pushing larger households away from Bulky and Industrial bread options. Similarly, advancing age is strongly associated with a lower propensity to choose Lavash and Industrial varieties, pointing toward evolving generational dietary patterns.

Recommendations for Policy and Industry

To promote a dietary shift toward nutritionally superior bread alternatives, interventions must skillfully navigate deeply entrenched cultural habits while addressing product limitations:

Prioritize Palatability and Quality for Alternatives: For low-share categories like Bulky and Industrial bread, the primary barrier is likely not just awareness, but perceived quality. Manufacturers must invest in product development that rigorously matches or exceeds the sensory attributes (taste, texture) of traditional breads. If the AMEs show a significant drop-off in demand (e.g., larger families avoiding Industrial bread), the product design needs to better align with larger household utility.

Targeted Geographic and Segmented Campaigns: Consumer education campaigns should be geographically focused. Given the strong positive effect of Region 7 on traditional alternatives, strategies should investigate the success factors in this region and attempt to replicate them elsewhere. Campaigns should specifically highlight the tangible benefits of alternatives, such as extended freshness (counteracting the known short shelf-life of fresh Sangak) or fortified nutritional content.

Support for Traditional Sectors on Standards: Rather than advocating for the outright replacement of Sangak or Lavash, focus resources on optimizing their production. This involves supporting traditional bakeries in standardizing ingredient use (e.g., reducing excess salt or leavening agents) to maintain cultural acceptance while mitigating potential health concerns.

Innovation through Fortification: The most promising path for cultural acceptance alongside health benefits lies in product innovation. Introducing fortified versions of highly preferred breads (like Barbari or Lavash), where the nutritional boost is integrated without altering the core, culturally accepted sensory experience, is recommended to bridge the gap between preference and public health goals.

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