

Consumer preferences for lab-cultured and traditional meat in Ghana

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Abstract. Owusu R. 2025. *Consumer preferences for lab-cultured and traditional meat in Ghana.* *Asian J Agric* 9: 482-497. There is a growing demand for meat as a source of protein in the human diet because of the increasing population. This has raised ethical and environmental concerns, highlighting the need for alternative protein sources, including lab-cultured meat. While interest in consumer preferences for alternative meat has grown globally, evidence from emerging economies like Ghana remains limited. This study investigates consumer preferences for alternative meat sources using a choice experiment approach. Specifically, the study aims to (i) assess baseline awareness of lab-cultured meat to identify public education needs, (ii) uncover cultural or economic barriers to adoption for targeted interventions, and (iii) quantify consumer preferences and willingness to pay to guide market pricing strategies. It employs a descriptive survey design, utilizing a sample of 265 consumers from the Cape Coast Metropolis, with data collected through questionnaires. The empirical specifications were estimated using a Bayesian mixed logit model in preference and willingness to pay (WTP) spaces to account for preference heterogeneity and improve WTP estimations. The econometric modeling results indicate that sampled consumers are price-sensitive, with affordability, limited availability, and low awareness emerging as the most significant barriers to consumption. Plant-based meat was positively valued in WTP space, while consumers generally are indifferent towards lab-cultured meat, which becomes more acceptable as an ethical and sustainable alternative, for the younger and higher income earners when socioeconomic interactions were incorporated, suggesting a heterogeneous but emerging market. Additionally, the results show that consumers prefer locally produced meat over imported meat, with origin being a key factor in their purchasing decisions. Furthermore, a low carbon footprint influences consumers' choice of meat alternatives. While the sample provides insights into urban consumer behavior, rural preferences may differ. The results suggest targeted marketing of lab-cultured meat as an ethical choice and support for local production to enhance acceptance.

Keywords: Choice experiment, demand, environmental concerns, lab-cultured meat, plant-based meat

INTRODUCTION

Global population growth, and urbanization have increased meat demand, particularly in developing countries like Ghana where rising incomes are shifting preferences (Latino et al. 2020). However, traditional livestock production faces sustainability challenges because it is resource-intensive, contributes to deforestation, greenhouse gas emissions, water pollution, and biodiversity loss (Sakadevan and Nguyen 2016). The global food system, and for that matter Ghana faces mounting pressure to reconcile increasing meat demand with the urgent need for sustainable production practices. Furthermore, climate change threatens livestock production (Melak et al. 2021), creating a complex feedback loop where livestock contributes to environmental degradation, undermining livestock productivity. This necessitates exploring alternative protein sources, such as lab-cultured meat, that are environmentally friendly, economically viable, and socially acceptable. Lab-cultured meat, which requires fewer natural resources and emits fewer greenhouse gases than conventional livestock, could mitigate these pressures—if accepted by consumers.

Despite burgeoning global research on consumer perceptions of lab-cultured meat, a significant gap remains in understanding consumers' perspectives in West African countries, particularly Ghana. Much of the current literature focuses on Europe, North America, and Asia, with limited

attention to the cultural, social, and economic factors shaping consumer attitudes in Africa (Slade 2018; Bryant and Dillard 2019); however, main findings from other regions may not directly apply to the Ghanaian context. This highlights the need for context-specific research to understand how Ghanaian consumers perceive lab-cultured meat and what factors might encourage or hinder its acceptance. Although several studies have examined consumer preferences for lab-cultured meat in other parts of the world (Mouat and Prince 2018), there is none yet in Ghana. This study, therefore, seeks to fill this gap by predicting Ghanaian consumers' preferences for lab-cultured meat and investigating the key variables influencing their acceptance of this novel food product. By exploring these preferences, the study aims to contribute to the broader discourse on how alternative proteins can help build sustainable food systems that align with Ghanaians' nutritional and cultural needs.

One robust method for analyzing consumer preferences is the choice experiment approach. Choice experiments allow researchers to assess consumer preferences across multiple product attributes, such as price, taste, nutritional content, and environmental impact. They enable the estimation of substitution patterns and consumers' trade-offs between different product features (Owusu et al. 2024). Most studies have utilized classical statistical frameworks in the existing literature on choice modeling, typically relying on maximum likelihood estimation (MLE) or simulated maximum

likelihood estimation techniques (Balcombe et al. 2009). While widely used, the classical framework has limitations. Balcombe et al. (2009) note that the likelihood function in MLE may be multimodal, leading to inference based on a single mode that may not represent the global optimum.

While classical choice models dominate the literature, Bayesian methods improve estimation with limited data—a key advantage in understudied markets like Ghana (Balcombe et al. 2009). A few pioneering studies have employed Bayesian methods in choice experiment contexts. For example, Bayesian estimation has been applied to studies on consumer preferences for quality rice in China (Boonkong et al. 2023), tablet market demand (Choi et al. 2013), consumer preferences for electricity-generating sources (Byun and Lee 2017), and investors' decision-making behaviors (Díaz-Caro et al. 2023), however, there is none in the context of alternative proteins.

Thus, this study represents one of the first empirical efforts in an emerging economy to employ the Bayesian inference approach in analyzing consumer preferences for alternative meat, focusing on lab-cultured meat. The specific objectives of this study are threefold: (i) assess baseline awareness of lab-cultured meat to identify public education needs, (ii) uncover cultural or economic barriers to adoption for targeted interventions, and (iii) quantify consumer preferences and willingness to pay to guide market pricing strategies.

MATERIALS AND METHODS

Study area

The study was conducted in the Cape Coast Metropolis in the Central Region of Ghana. The Cape Coast Metropolis is located within longitudes 1°11'–1°41' W and latitudes 5°7'–5°20' N (Danso et al. 2020). Cape Coast was selected for the study because it is known to experience poverty and malnutrition (Kwadzo 2021). This study adopted a cross-sectional survey design (Greenwood and Levin 2006).

Data collection

The data for the study come from a consumer survey conducted in the Cape Coast Metropolis in the Central Region of Ghana to elicit consumer preferences and willingness to pay for alternative meat sources in addition to awareness, knowledge levels, and adoption barriers. The study population comprises consumers in the Cape Coast Metropolis. A multistage sampling procedure was employed for sample selection. In the first stage, purposive sampling was used to select the Cape Coast Metropolis based on its socioeconomic characteristics, including the documented prevalence of malnutrition (Kwadzo 2021). In the next stage, four communities in the metropolis were selected: Amamoma, Apewosika, Duakro, and Abura. Amamoma (low-income), Apewosika (middle-income), Abura (middle-income), and Kwaprow (low-income) were selected based on municipal-level income and infrastructure data (GSS 2014; CCMA 2022), to capture socioeconomic and spatial variation within Cape Coast. These communities represent a range of consumer

environments relevant to understanding dietary preferences and protein access (GSS 2019). Within each selected community, quota-based sampling was employed to ensure diversity in age, gender, and education levels. Enumerators used pre-defined demographic quotas to recruit participants during household visits, ensuring that the final sample reflected the socioeconomic composition of each community. A face-to-face data collection technique was employed, targeting adults aged 18–65.

The sample size for this study was determined using Yamane's (1967) formula, a widely adopted method in consumer behavior and agricultural research across developing economies. This approach has been applied in similar discrete choice studies, such as those of Sossou et al. (2022), who used it to estimate the sample size of cashew growers in Benin. With a target population of $N = 189,925$ (Cape Coast Metropolis) and a 95% confidence level and 5% precision level, the minimum required sample size was calculated as $n \approx 400$. While Yamane's formula assumes population homogeneity—which may not fully capture Ghana's cultural and economic diversity—it offers a practical baseline for field-based survey design, particularly where complete stratification is constrained by time or resources.

While Yamane's formula provides a baseline, unobserved heterogeneity may require larger samples for robust subgroup analysis. To address concerns about unobserved heterogeneity in preferences, the study employed a Bayesian mixed logit model, which allows for individual-level variation in taste. This modeling approach enhances estimation reliability in data-sparse contexts compared to classical methods. Although a wider margin of error (e.g., 7%) may suffice in exploratory research, the 5% precision level was selected to increase statistical power for detecting subgroup differences and modeling heterogeneity in discrete choice experiments.

The sample size was calculated using the Yamane's formula:

$$n = \frac{N}{1 + N(e)^2}$$

Where: N is the population size and e is precision. Assuming a precision of 0.05, and the population size of Cape Coast is 189,925 (Alani et al. 2024), the sample size is calculated as follows:

$$n = \frac{189,925}{1 + 189,925(0.05)^2} = 399.9 = 400$$

It should be noted that Yamane's formula assumes a homogeneous population and therefore may not be applicable in the context of Ghana's cultural and economic diversity; nonetheless, previous studies (Cuong et al. 2024, 2025) have applied the formula in sample size calculation. Additionally, the modelling approach adopted in this paper—a mixed logit model—allows for accounting for unobserved heterogeneity, which could be coming from population dynamics.

Out of the 400 questionnaires distributed, only 265 were completed and returned, representing a 66.25% response rate. This response rate aligns with the literature, indicating that

a response rate of 40-75% is acceptable (Sataloff and Vontela 2021). While response rates are not consistently reported in most food choice studies in Ghana, Oppong-Yeboah and May (2014) reported a response rate of 67%, which is comparable to the study's 66.25%. This suggests the response rate aligns with typical returns observed in a similar Ghanaian consumer preference study.

Respondents were distributed as follows: 75 from Amamoma, 65 from Apewosika, 60 from Duakro, and 65 from Abura. Adult residents in the selected communities, aged 18-65, who can independently make purchase decisions and have experience with alternative protein source consumption, were included. The exclusion criteria were children, non-residents of the communities, non-consenting individuals, and those who had not consumed or used alternative protein sources in any form at home. This approach ensured that the sample included individuals with relevant knowledge and experience, generating robust data for analysis.

The survey used a structured questionnaire for data collection between February and March 2025, employing four trained enumerators from the University of Cape Coast. Four enumerators from the University of Cape Coast were trained on neutral question delivery, avoiding leading prompts, and adhering strictly to the questionnaire script in an 8-hour session to minimize interviewer bias. Mock interviews and role plays were conducted during training to ensure interview consistency. Respondents were given a consent form to complete, and based on their agreement, we proceeded with the survey. Under no circumstances were they compelled, and they were free to withdraw from responding to the questions at any time if they were uncomfortable. Ethical approval was obtained from the University of Cape Coast Institutional Review Board with approval number UCC/EXT/2025/002.

Prior to data collection, a pretest was conducted at the University of Cape Coast with a sample of 30 students. The students ranged between 18 and 25 years, with females comprising 27% depending on their availability and consent to participate in the pretest. While this group provided valuable feedback on survey structure and comprehension, a limitation is that university students may not fully reflect the demographic and socioeconomic diversity of the broader study population. As such, insights from the pretest may not capture all real-world comprehension challenges among less-educated or lower-income respondents. To mitigate this, enumerators were trained to provide neutral clarification during the actual fieldwork when necessary. The questionnaire included respondents' socioeconomic characteristics, such as age, gender, income status, educational level, and family size. Other questions addressed knowledge levels of alternative meat, including lab-cultured meat protein sources, as well as awareness and willingness to consume alternative meat, such as lab-cultured. Additional questions focused on preferences for alternative meat, including lab-cultured meat attributes, using a choice experiment with the following meat characteristics: type of meat (traditional animal-based, non-traditional animal-based, plant-based, or lab-cultured meat-based), origin (local or imported), eco-label (no eco-labeling or eco-labeling), price, and low carbon footprint. These attributes

were selected based on expert interviews and literature reviews (Ge et al. 2023; Profeta et al. 2021). The low carbon footprint and eco-labeling attributes reflect consumer preferences for environmental sustainability.

Choice experiment design

The choice experiment is based on Lancaster's characteristic theory of value, where a good (in this case, alternative meat) is defined by the attributes that compose it and the preferences of individuals (Díaz-Caro et al. 2023). It involves presenting alternative options for the same product with different attributes, and respondents were asked to select the option that best reflected their preferences.

The choice experiment design begins with identifying attributes and levels that compose the different products introduced to consumers. The following attributes were considered based on expert interviews and literature reviews (Profeta et al. 2021; Ge et al. 2023). Type of meat, defined as the source and production method, was measured on four levels: traditional animal-based (cattle, sheep, goat, poultry), non-traditional animal-based (snails, rabbits, grasscutter), plant-based (soy meat), and lab-cultured meat. The origin attribute, referring to where the meat is produced, was measured on two levels: local (Ghana) and imported. The low carbon footprint attribute, indicating meat produced with low greenhouse gas emissions, was measured as yes or no. The eco-labeling attribute, referring to the presence of an environmental certification label on the product, was measured as no eco-labeling or eco-labeling. Finally, the price attribute was calculated as the price per kilogram of meat on three levels: GHS 50, GHS 60, and GHS 70. We acknowledge that taste and texture attributes are essential for consumer preferences for meat choice. Still, in the context of this study, based on expert interviews and the need to reduce the cognitive burden on respondents with associated survey constraints, all these attributes could have been considered. This limitation is duly acknowledged and shall be regarded as in a follow-up sensory trial study. Regarding the price levels, we applied a 20-40% premium on the basic price of 50 GHS/kg of meat, the prevailing market price at the time of the study, for the meat alternatives. Table 1 shows the attributes and levels chosen for the study, which were based on a review of previous literature on consumer preferences for meat products and expert interviews.

The overall set of potential hypothetical products can be generated by combining the chosen attributes and levels, resulting in 96 ($4 \times 2 \times 2 \times 2 \times 3$) combinations, which would be too many for consumers to compare. Given that consumers are presented with choice sets composed of two alternative meat options (Options 1 and 2) and a no-choice option-Option 3 (representing an opt-out), there would be too many scenarios, which is impractical in terms of cost and time. Therefore, a fractional factorial design was implemented to reduce the total number of comparisons using Stata's "Dcreate" package. This package employs the modified Fedorov algorithm to produce an efficient design (Díaz-Caro et al. 2023). Ultimately, 10 choice sets were generated and used in the study, following previous studies

(Owusu et al. 2025). Table 2 provides an example of a choice set.

Data processing and coding

Before data analysis, the collected data were cleaned to handle issues of missing values and check consistency in variable coding in SPSS and later transferred to Stata and R software for more rigorous analysis. The change in the software was necessary because SPSS could not handle the complexity of the modelling required for the Bayesian mixed logit model, both in preference space and willingness to pay space. The quantitative attribute (price) was coded using the stated attribute levels in the choice set, and the categorical variable (type of meat) was dummy-coded, with traditional animal-based meat as the reference level. Origin, eco-labeling, and low carbon footprint were coded as dummies, where in the case of origin, local was coded as 0 and imported as 1; eco-labeling, no eco-labeling was coded as 0, and eco-labeling as 1; and low carbon footprint, no as 0, and yes as 1. Dummy coding, aligning with the study of (Owusu Coffie et al. 2016) for direct interpretation of baseline preferences.

Data analysis

The data were analyzed using descriptive statistics, including standard deviations, frequencies, and choice experiment methods. The choice experiment approach is

rooted in Lancaster’s characteristic theory of value, with its econometric basis in the random utility theory of Manski (1977). The study applied the mixed logit model to account for unobserved preference heterogeneity (Lewbel and Pendakur 2017). The application of the choice experiment approach to examine consumer preferences for alternative protein sources is novel in Ghana. Random utility has two components: systematic and error components. The attributes of alternative *j* in choice occasion *t* faced by respondent *n* could be labeled as vector. The utility obtained by individual *n* from alternative *j* in choice occasion *t* is specified as:

$$U_{njt} = \beta_n X_{njt} + \varepsilon_{njt} \tag{1}$$

where β_n is defined as a coefficient vector of attributes and follows a multivariate normal distribution, $\beta_n \sim N(b, \Sigma)$, which consists of mean *b* and covariance matrix Σ , and ε_{njt} is the error term defined as a random disturbance and follows i.i.d extreme value distribution. If the error terms are independently and identically drawn from an extreme value distribution, we get the conditional logit model (McFadden 1974), which has the following closed form:

$$L_{nit}(\beta_n) = \frac{\exp(\beta_n' x_{nit})}{\sum_j \exp(\beta_n' x_{njt})} \tag{2}$$

Table 1. Attributes, descriptions, and levels used in the choice experiment

Attributes	Description	Levels	Coding	Literature reference
Type of meat	This attribute refers to the source and production process of meat product	Traditional meat (cattle, sheep, goat, poultry)	0	Ge et al. (2023)
		Non-traditional meat (snails, rabbits, grasscutter)	1	
		Plant-based meat (Soy)	2	
		Lab-cultured meat (grown from animal cells)	3	
Origin	This attribute refers to the origin of the meat offered for sale	Local (Ghana)	0	Ge et al. (2023)
		Imported	1	
Low carbon footprint	The attribute refers to producing meat with low greenhouse gas emissions	No	0	Profeta et al. (2021)
		Yes	1	
Eco-labeling	This attribute refers to the presence of environmental certification label on the product.	No eco-labeling	0	Brécard et al. (2009), Owusu et al. (2025)
		Eco-labeling	1	
Price/kg	This is the price per kg of meat offered for sale	GHS 50 GHS 60 GHS 70	Continuous	Profeta et al. (2021)

Table 2. Sample choice set

	Option 1	Option 2	Option 3
Type of meat	Plant-based meat	Non-traditional meat (snails, rabbits, grasscutter)	
Origin	Imported	Local	
Eco-labeling	No eco-labeling	Eco-labeling	
Low carbon footprint	Yes	No	
Price/kg	GHS 60	GHS 50	
I would buy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The unconditional probability is the integral of the conditional probability over all possible values of β_n , which is contingent on the distribution of β_n :

$$P_{nit}(\theta^*) = \int L_{nit}(\beta_n) f(\beta_n|\theta^*) d\beta_n \quad [3]$$

The unconditional probability in [3] is the mixed logit probability.

The models can be estimated using classical estimation methods, such as maximum simulated likelihood, or Bayesian inference. Bayesian inference analysis is based on the hypothesis that all model parameters are random variables and thus can incorporate prior information (Díaz-Caro et al. 2023). It is grounded in Bayes' rule, which formalizes the integration of new data with existing data. One advantage of this model estimation technique is that it provides a complete distribution of the parameters, offering a more robust approach to estimation. It relies on the prior distribution of the parameters, providing summaries of this distribution, including posterior means, associated Markov Chain Monte Carlo (MCMC) Standard Errors (MCSE), and credible intervals.

Building on previous studies (Choi et al. 2013; Gaspar et al. 2022), this study employs the Bayesian inference approach to estimate the preferences of sampled consumers for alternative meat, including lab-cultured meat, in Ghana. To determine willingness to pay for the meat attributes, the Bayesian mixed logit model was extended to a direct estimation technique in willingness to pay space (Train 2009; Owusu and Dadzie 2021; Owusu et al. 2025). The utility coefficients were allowed to be randomly distributed, and a full covariance matrix among them was estimated (Hoedemakers et al. 2022). Bayesian models were estimated using the brms package in R, which implements Hamiltonian Monte Carlo (HMC) via stan. This allows for full posterior inference and convergence diagnostics, including the potential scale reduction factor (R-hat), and MCSE. Weakly informative priors were specified for all parameters (e.g., normal (0, 2) for coefficients). An earlier model version was estimated using Stata's bayesmixedlogitwtp command; however, since that approach does not provide MCMC diagnostics or flexible prior control, we present only the R-based model in this paper. Convergence was achieved at 10,000 iterations with an R-hat value of 1.

RESULTS AND DISCUSSION

Results of the study

This section presents the study's results. First, the socioeconomic characteristics of respondents are presented, followed by an examination of awareness, knowledge levels, attitudes, barriers, and factors influencing the consumption of meat alternatives. This is followed by modeling consumer preferences for alternative protein sources. Finally, the mixed logit results are presented, covering both preference and willingness to pay space in the Bayesian framework.

Descriptive results

Table 3 presents the descriptive statistics of the respondents. The table shows that the average age of the sample is 39, indicating a youthful population. Additionally, the sample comprises 53% women and 47% men. Regarding education, the majority of the sample (61%) have a bachelor's degree, while 8.7% have no formal education. The average household size is six, and 62% of the sample is unemployed.

Sample demographic characteristics align with that of the Cape Coast Metropolis specifically, Cape Coast demographic dynamics show that there are more women than men. That is 51.1% women and 48.9% men (Owusu et al. 2025). However, the unemployment rate reported in this study is higher than that in Cape Coast 11.3% (Owusu et al. 2025). Similarly, the low percentage of formal education reported in this study is compared with the trend in Cape Coast Metropolis, where about 88.5% of the population is educated.

Consumers' awareness, knowledge, and attitudes toward meat alternatives

The awareness levels of respondents regarding alternative meat are reported in Table 4. According to the table, 88% of respondents are aware of non-traditional meat, 93% of plant-based meat, and 89% of lab-cultured meat (each $n = 265$). Accounting for the fact that the same respondents answered all three awareness items, Cochran's Q test indicated a significant difference in awareness across meat types, $\chi^2(2) = 10.30$, $p = 0.0058$. For completeness, a crude (unpaired) Pearson chi-square on the aggregated 3×2 table was not significant, $\chi^2(2) = 3.86$, $p = 0.145$, but this ignores within-person pairing.

However, knowledge levels vary, with 43, 35, and 12% of respondents having high knowledge about non-traditional, plant-based, and lab-cultured meats, respectively. These findings are consistent with Bryant (2022), who found that although awareness of alternative meat is increasing, knowledge levels among consumers remain limited. Consumers' willingness to consume alternative meat depends on their knowledge levels, which has implications for educational campaigns. Testing statistical significance, knowledge levels differed significantly by meat type ($\chi^2(4) = 87.22$, $p < .001$): non-traditional meat had the highest share reporting high knowledge, plant-based meat was intermediate, and lab-cultured meat showed a concentration in Medium knowledge (70.2%); pairwise Stuart-Maxwell tests confirmed all distributions differ (all $p \leq .005$).

Regarding willingness to pay, 86% of the sampled consumers are willing to pay for plant-based meat, followed by non-traditional meat (77%). Despite relatively high awareness of lab-cultured meat (89%, Table 4), willingness to pay a premium is slightly low (63%, Table 4), probably due to the barriers in Table 6. This finding is consistent with Wilkes et al. (2019), who found that consumers accept plant-based meat more than lab-cultured meat. The majority of respondents (62-66%) agree to try alternative meat. Additionally, 45, 48, and 36% of respondents believe that non-traditional meat, plant-based meat, and lab-cultured meat alternatives, respectively, are healthier compared to traditional meat. Furthermore, 71% of respondents are willing to replace traditional meat with

non-traditional or plant-based meat, while 63% are willing to replace traditional meat with lab-cultured meat.

Factors that would make you consume the following meat alternatives

The results show that discounts and promotions, recommendations from friends and family, availability, and ethical concerns would improve the consumption of meat alternatives (93%)—Table 5. This is followed by improvements in taste and texture (92%), as well as information on health benefits (91%).

Table 5. Factors that would promote consumption

Factors	Response	Percentage
Discounts and promotions	Yes	93
Recommendations from friends and family	Yes	93
Information about health benefits	Yes	91
Availability	Yes	93
Improved taste and texture	Yes	92
Ethical concerns	Yes	93

Table 3. Descriptive statistics of respondents

Variable	Category	Mean	Standard deviation	Min.	Max.
Age		39	8.38	31	55
Household size		6	2.0	2	14
		Frequency	Percentage		
Gender	Man	125	47.17		
	Woman	140	52.83		
Education level	No formal education	23	8.7		
	Primary	9	3.4		
	JHS	17	6.4		
	SHS	33	12.5		
	Bachelor’s	162	61		
	Master’s	19	7.2		
Employment status	Unemployed	164	61.9		
	Employed	101	38.1		
	PhD	2	0.8		

Note: N= 265, JHS: Junior High School, SHS: Senior High School

Table 4. Consumer awareness, knowledge levels, and attitudes towards alternative meat

	Response	Non-traditional meat	Percentage (%)	Plant-based meat	Percentage (%)	Lab-cultured meat	Percentage (%)
Awareness	Yes	233	88	243	93	236	89
Knowledge levels	Low	44	17	71	27	48	18
	Medium	108	41	102	39	186	70
	High	113	43	92	35	31	12
Willingness to pay	Yes	204	77	228	86	167	63
I will be open to trying the following meat alternatives	SD	8	3	8	3	5	2
	D	8	3	11	4	5	2
	N	58	22	42	16	50	19
	A	167	63	175	66	164	62
	SA	24	9	32	12	40	15
I believe the meat from the following sources is healthier than traditional sources	Yes	119	45	127	48	95	36
I am willing to replace traditional meat with the following sources	Yes	188	71	188	71	167	63

Note: SD: Strongly disagree, D: Disagree, n: Neither, A: Agree, SA: Strongly agree, overall $\chi^2(4) = 87.22, p < .001$ (knowledge distributions differ across meat types), N= 265 for all percentages

Table 6. Barriers to the consumption of meat alternatives

	Response	Non-traditional meat	Plant-based meat	Lab-cultured meat	Average
High price	Yes	91	90	91	91
Lack of availability	Yes	91	93	93	92
Taste and preferences	Yes	88	90	86	88
Lack of knowledge or awareness	Yes	90	88	90	89
Unfamiliarity with preparation methods	Yes	84	85	83	84
Ethical concerns	Yes	86	86	82	85

Barriers to the consumption of the following meat alternatives

Concerning barriers to adoption, 90-91% of respondents perceive high prices as a barrier to consuming meat alternatives (Table 6), which is consistent with the findings of Slade (2018), who noted that cost is a significant deterrent for both plant-based and cultured meat. Similarly, 91-93% of respondents view a lack of availability as a barrier to consumption, a finding supported by Elzerman et al. (2021), who found that limited market access reduces adoption. Additionally, 86-90% of respondents perceive taste and preference as barriers to consumption, consistent with Apostolidis and McLeay (2019), who noted that sensory characteristics strongly influence consumer choices. Finally, 82-86% of respondents indicated that ethical concerns could be a barrier to adoption. This aligns with Bryant and Dillard (2019), who observed that ethical debates surrounding lab-grown meat impact its acceptance.

Chi-square tests revealed significant differences in the distribution of barriers across meat types (Table 7). Price was a significantly stronger barrier for non-traditional meat compared to plant-based meat ($\chi^2 = 116.44$, $p < 0.001$), non-traditional compared to lab-cultured meat ($\chi^2 = 106.58$, $p < 0.001$), and lab-cultured compared to plant-based meat ($\chi^2 = 96.45$, $p < 0.001$). Similarly, availability barriers were significantly different across all meat types, with especially strong differences between plant-based and lab-cultured meats ($\chi^2 = 136.05$, $p < 0.001$). Taste and preferences, knowledge/awareness, preparation, and ethical concerns also varied significantly across meat types, with all pairwise comparisons yielding p-values < 0.001 . Overall, these results demonstrate that while barriers such as price and availability dominate across all meat alternatives, their relative severity differs significantly by product type, underscoring the need for both broad systemic interventions and product-specific strategies.

Figure 1 ranks the top three barriers to consuming meat alternatives. Availability (92%) emerged as the most cited barrier, followed closely by price (91%) and lack of knowledge/awareness (89%). While the rank order of barriers was similar across non-traditional, plant-based, and lab-cultured meat, chi-square tests (Table 7) indicated statistically significant differences in their relative importance across meat types (all $p < 0.001$). This suggests that although

consumers broadly agree on the key barriers, the intensity of these concerns varies by product category.

Preference heterogeneity results

Before discussing the preference heterogeneity model estimates, model convergence and diagnostics are first presented. Model convergence was evaluated using posterior density plots, trace plots, and standard diagnostics. The posterior distributions for all parameters (Figures S1-S4) were smooth and unimodal, indicating stable estimation. Trace plots across four chains showed good mixing without visible trends or drifts, suggesting that the Markov chains properly explored the posterior distribution space. The potential scale reduction factor (Rhat) values were equal to 1.00 for all estimated parameters, which falls within the recommended threshold (< 1.01), confirming convergence. Monte Carlo Standard Errors (MCSE) were minimal, further supporting the stability of estimates. Regarding model fit, the Bayesian mixed logit model achieved a McFadden's pseudo R^2 of 0.65 in the preference-space specification and 0.66 in the willingness-to-pay specification, indicating a strong explanatory power. These diagnostics confirm that the Bayesian mixed logit models converged appropriately and produced reliable parameter estimates.

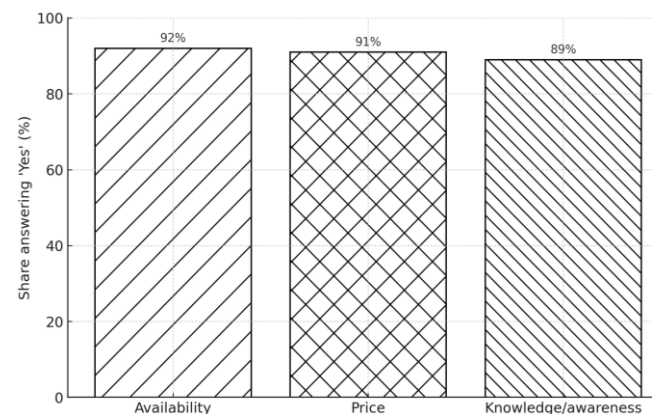


Figure 1. Ranked bar chart of the top three barriers affecting the consumption of meat alternatives based on “Yes” responses

Table 7. Chi-square test results of the barriers of consumption across meat types

	Non-traditional vs. plant-based meat	Plant-based meat vs. lab-cultured	Non-traditional vs Lab-cultured meat
High price	$\chi^2 = 116.44$, $p < 0.001$	$\chi^2 = 96.45$, $p < 0.001$	$\chi^2 = 106.58$, $p < 0.001$
Lack of Availability	$\chi^2 = 87.58$, $p < 0.001$	$\chi^2 = 136.05$, $p < 0.001$	$\chi^2 = 87.58$, $p < 0.001$
Taste and preferences	$\chi^2 = 37.28$, $p < 0.001$	$\chi^2 = 37.28$, $p < 0.001$	$\chi^2 = 37.66$, $p < 0.001$
Lack of knowledge or awareness	$\chi^2 = 27.87$, $p < 0.001$	$\chi^2 = 31.21$, $p < 0.001$	$\chi^2 = 13.97$, $p < 0.001$
Unfamiliarity with preparation methods	$\chi^2 = 39.61$, $p < 0.001$	$\chi^2 = 39.60$, $p < 0.001$	$\chi^2 = 37.66$, $p < 0.001$
Ethical concerns	$\chi^2 = 36.09$, $p < 0.001$	$\chi^2 = 76.50$, $p < 0.001$	$\chi^2 = 19.88$, $p < 0.001$

The preference space results are presented in Table 8, and the model with socioeconomic interactions are presented in Table 10. According to Table 8, the non-traditional meat attribute has a negative coefficient but it is not statistically significant (-0.24, P=0.16), indicating that consumers are indifferent towards this type of meat source, compared to the base category, traditional meat. Additionally, the plant-based meat attribute is positive but not significant (0.20, p = 0.32), indicating that sampled consumers are indifferent towards plant-based meat, compared with the reference, traditional meat. The lab-cultured meat attribute has a negative coefficient but is insignificant (-1.59, p = 0.43), suggesting that sampled consumers are indifferent about lab-cultured meat, compared to the reference category, traditional meat.

Regarding sustainability attributes, the low carbon footprint attribute has a positive coefficient and it is statistically significant (0.44, p = 0.04)—Table 8—indicating high concern about carbon footprint. Product origin has a negative and significant coefficient (-4.06, p = 0.00), suggesting that sampled consumers prefer locally produced meat alternatives over imported ones. This is because the attribute is a dummy variable, where 1 represents imported and 0 represents local (Ghana). The preference for local meat sources aligns with Feldmann and Hamm (2015), who found that local origin is a key factor in building trust and perceptions of food safety. Additionally, the eco-labeling attribute is insignificant in the preference model, implying it may not influence the choices of sampled consumers.

The negative and significant price attribute shows that sampled consumers are price-sensitive. This matches findings from Andreani et al. (2023), who noted that alternative protein meat need to have price parity with conventional meats to gain widespread acceptance. The alternative-specific constant (representing the opt-out option) is negative and significant, indicating that consumers prefer the presented

alternatives over opting out. The significant standard deviations confirm that consumer preferences for alternative meat sources vary, supporting Mancini and Antonioli (2020).

Table 9 summarizes marginal effects and odds ratios. Consumers are strongly influenced by origin, being ~50 times more likely to choose local over imported meat. Lab-cultured meat shows a large negative marginal effect (-1.23), while low-carbon footprint options are ~1.6 times more likely to be selected. Price significantly decreases selection odds (OR = 0.66), whereas eco-labeling and plant-based meat show only negligible effects, not credibly different from the baseline.

Socioeconomic interactions

Socioeconomic characteristics are noted in the literature to have effect on consumer preferences. In this regard, a model with socioeconomic interactions was estimated and the results are reported in Table 10. From the estimated results, lab-cultured meat is positive and significant (8.35, p = 0.00), indicating that sampled consumers prefer lab-cultured meat to the base category, traditional meat. Additionally, the origin attribute is negative and significant (-1.62, p = 0.00), suggesting that sampled consumers prefer locally produced meat to imported meat, as imported meat was coded as 1, and local meat, 0.

Table 9. Marginal effects results

Attributes	Odds ratio	Marginal effects
Non-traditional meat	0.790	-0.004
Plant-based meat	1.220	0.003
Lab-cultured meat	0.200	-1.230
Low carbon footprint	1.550	0.010
Origin	0.020	-0.350
Eco-labeling	1.130	0.002
Price	0.660	-0.010

Table 8. Estimates from the Bayesian mixed logit model in preference space

Random variables	Coefficient	MCSE	P> t	95% credible interval		Rhat
Non-traditional meat	-0.240	0.002	0.160	-0.580	0.090	1.00
Plant-based meat	0.200	0.002	0.320	-0.190	0.590	1.00
Lab-cultured meat	-1.590	0.010	0.430	-6.060	0.300	1.00
Low carbon footprint	0.440**	0.002	0.040	0.050	0.870	1.00
Origin (imported=1)	-4.060***	0.010	0.000	-5.050	-3.130	1.00
Eco-labeling	0.120	0.002	0.550	-0.270	0.520	1.00
Price	-0.420***	0.001	0.000	-0.580	-0.280	1.00
ASC (opt-out)	-7.790***	0.001	0.000	-9.850	-6.240	1.00
Random parameters standard deviations (SD)						
SD_Non-traditional meat	0.840***	0.001	0.000	0.470	1.210	1.00
SD_Plant-based meat	1.860***	0.001	0.000	1.490	2.250	1.00
SD_Lab-cultured meat	5.690	0.257	0.160	2.550	14.460	1.00
SD_Low carbon footprint	1.750***	0.001	0.000	1.370	2.200	1.00
SD_Origin	6.980***	0.004	0.000	6.040	8.020	1.00
SD_Eco-labeling	1.930***	0.001	0.000	1.580	2.340	1.00
SD_Price	0.460***	0.001	0.010	0.070	0.810	1.00
SD_ASC (opt-out)	6.390***	0.001	0.000	4.980	8.130	1.00
McFadden’s pseudo R-squared	0.650					

Note: ASC: Alternative specific constant, SD: Standard Deviation, “*”, “**”, “***” denote significance at the 10, 5, and 1% levels, respectively

The price attribute is also negative and significant, showing that sampled consumers prefer affordable meat to more expensive ones. The socioeconomic interactions were based on lab-cultured meat, because the aim was to explore the potential socioeconomic factors that could influence preference for that type of meat. This was also done to simplify the model, instead of having a more complex model that could take more computational time and affect convergence.

The model interaction results show younger consumers prefer lab-cultured meat over older consumers, as revealed in the negative and significant coefficient on the interaction term (-1.43, $p=0.00$). Additionally, high-income earners prefer lab-cultured meat to low-income earners, as shown in the positive and significant coefficient (0.5, $P=0.00$). Gender differences were explored in interaction models. While the coefficient for women suggested a higher relative valuation of lab-cultured meat than for men, the effect was not statistically significant (Table 10).

Willingness to pay results

This study employed hierarchical Bayesian techniques to estimate consumers' willingness to pay for alternative poultry meat attributes using the direct approach, where price is normalized so that the coefficients are direct WTP values. The willingness to pay estimates are presented in Table 11. The results show that sampled consumers attach a positive value to lab-cultured meat, as revealed by the positive but not significant coefficient (GHS 1.020, $p = 0.740$). This is consistent with the preference space model estimate, where the lab-cultured meat coefficient was insignificant, implying that sampled consumers are indifferent towards lab-cultured meat compared with the base category, traditional meat. However, plant-based meat alternatives

are positive and significant (1.240, $p = 0.050$) and are indifferent towards non-traditional meat alternatives (0.590, $p = 0.230$). Specifically, this implies that sampled consumers are willing to pay an additional GHS 1.24 per kilogram of plant-based meat compared to the traditional meat alternative. Regarding sustainability attributes, consumers are willing to pay extra for a product with a lower carbon footprint (GHS 1.650 per kilogram, $p = 0.010$), over a traditional meat alternative. This finding is consistent with Hoek et al. (2021), who found that sampled consumers are climate-conscious and value sustainability attributes. Product origin is also significant and negative, indicating that sampled consumers are willing to pay GHS 6.640 more for locally produced meat alternatives than imported ones, where they require a discount of GHS 6.640 to buy. The eco-labeling attribute is positive but not significant (0.950, $p = 0.110$), suggesting that although sampled consumers potentially place a higher perceived cost-associated value with eco-labeled meat, this is not statistically significant. This is supported by Grunert et al. (2024), who found mixed effects on consumer choices concerning eco-labeling.

In the WTP specification, none of the socioeconomic interaction terms (age×lab-cultured meat attribute, gender×lab-cultured meat attribute, education×lab-cultured meat attribute, income×lab-cultured meat attribute) were credibly different from zero; all 95% credible intervals overlapped zero, and the posterior probabilities of a positive (or negative) effect were < 0.95 . Main-effect WTP estimates were stable to including these interactions, so we focus on the parsimonious model in the text. Full interaction results are provided in Table S1. The lack of statistically credible moderation by socioeconomic variables suggests that, within our sample, WTP patterns are broadly similar across subgroups once product attributes are controlled.

Table 10. Estimates from the Bayesian mixed logit model in preference space with observed heterogeneity

Random variables	Coefficient	MCSE	P> t	95% Credible interval		Rhat
Non-traditional meat	-0.080	0.001	0.250	-0.210	0.050	1.00
Plant-based meat	0.050	0.001	0.620	-0.140	0.240	1.00
Lab-cultured meat	8.360***	0.001	0.000	7.530	9.260	1.00
Low carbon footprint	0.130	0.012	0.150	-0.030	0.310	1.00
Origin (imported=1)	-1.620***	0.002	0.000	-2.080	-1.180	1.00
Eco-labeling	0.010	0.002	0.910	-0.170	0.200	1.00
Price	-0.540***	0.002	0.000	-0.930	-0.170	1.00
ASC (opt-out)	-2.290***	0.005	0.000	-2.770	-1.810	1.00
Lab-cultured meat *Age	-1.430***	0.001	0.000	-1.840	-1.110	1.00
Lab-cultured meat *gender	0.140	0.009	0.990	-1.750	2.070	1.00
Lab-cultured meat* employment	-0.430	0.010	0.880	-2.350	1.440	1.00
Lab-cultured meat*income	0.500***	0.001	0.000	0.300	0.700	1.00
Random parameters standard deviations (SD)						
SD Non-traditional meat	0.350***	0.001	0.000	0.210	0.490	1.00
SD Plant-based meat	0.870***	0.001	0.000	0.700	1.060	1.00
SD Lab-cultured meat	9.810***	0.012	0.000	5.840	16.100	1.00
SD Low carbon footprint	0.810***	0.001	0.000	0.630	1.020	1.00
SD Origin		0.002				1.00
SD Eco-labeling	3.310***	0.001	0.000	2.870	3.800	1.00
SD Price	0.550*	0.001	0.090	0.030	1.190	1.00
SD ASC (opt-out)	2.560***	0.004	0.000	2.110	3.070	1.00
McFadden's pseudo R-squared	0.670					

Note: ASC: Alternative specific constant, MCSE: Monte Carlo Standard Error, “*”, “***”, “****” denote significance at the 10, 5, and 1% levels, respectively

Table 11. Estimates from the Bayesian mixed logit model in the willingness to pay space

Random variables	Coefficient	MCSE	P> t	95% Credible interval		Rhat
Non-traditional meat	0.590	0.010	0.230	-0.340	1.590	1.00
Plant-based meat	1.240**	0.010	0.050	0.060	2.490	1.00
Lab-cultured meat	1.020	0.090	0.740	-5.470	4.660	1.00
Low carbon footprint	1.650***	0.010	0.010	0.500	2.890	1.00
Origin (imported=1)	-6.640***	0.020	0.000	-9.120	-4.300	1.00
Eco-labeling	0.950	0.010	0.110	-0.200	2.140	1.00
Price	-	-	-	-	-	1.00
ASC (opt-out)	-6.880***	0.010	0.000	-8.670	-5.53	1.00
Random parameters standard deviations (SD)						
SD Non-traditional meat	3.030***	0.003	0.000	2.510	3.610	1.00
SD Plant-based meat	2.980***	0.004	0.000	1.840	4.140	1.00
SD Lab-cultured meat	6.470***	0.369	0.000	5.200	7.860	1.00
SD Low carbon footprint	16.870	0.003	0.130	8.210	40.920	1.00
SD Origin	6.110***	0.008	0.000	4.730	7.760	1.00
SD Eco-labeling	24.770***	0.004	0.000	21.480	28.580	1.00
SD ASC (opt-out)	6.600***	0.006	0.000	5.340	8.210	1.00
McFadden's pseudo R-squared	0.660					

Note: ASC: Alternative specific constant, MCSE: Monte Carlo Standard Error, “*”, “**”, “***” denote significance at the 10, 5, and 1% levels, respectively

Discussion

Africa's population is projected to reach approximately 2.5 billion by 2050, positioning the continent as one of the fastest-growing regions globally. Within this context, Ghana's population is expected to nearly double, amplifying concerns about food security, particularly the rising demand for protein-rich diets. Though culturally ingrained and economically significant, conventional livestock production poses major sustainability challenges, including deforestation, greenhouse gas emissions, water resource depletion, and biodiversity loss. Consequently, the development and acceptance of alternative protein sources represent both an environmental imperative and a socioeconomic opportunity for sustainable growth in Ghana and sub-Saharan Africa.

Alternative protein innovations—such as non-traditional meat (e.g., snails, rabbits, grasscutters), plant-based meat analogs, and lab-cultured meat—offer a viable path toward reducing the environmental burden of food systems while meeting nutritional needs. These options vary in technological maturity, cultural acceptance, and production scalability. Plant-based meat substitutes, typically derived from cereals and legumes, aim to emulate conventional meats' taste, texture, and protein content. Lab-cultured meat, produced from animal cells under controlled laboratory conditions, promises to deliver the full sensory experience of meat while significantly reducing the ecological footprint of production. Globally, these alternatives attract investment and consumer interest, but empirical insights remain sparse in African contexts—where cultural and economic dynamics differ significantly.

This study contributes to the limited literature on alternative proteins in West Africa by exploring consumer perceptions and preferences for lab-cultured meat in the Cape Coast Metropolis of Ghana. Through a choice experiment involving 265 respondents and a Bayesian estimation approach applied in preference and willingness to pay spaces, the research sheds light on how consumers evaluate

lab-cultured meat relative to traditional meat. The analysis focused on key attributes, including price, country of origin, and environmental impact.

The findings provide a deeper understanding of Ghanaian consumers' preferences for alternative meat, including lab-cultured meat, regarding taste, price sensitivity, preferred meat origin, and sustainability concerns. The mixed logit model reveals that consumers prefer traditional meat but also find plant-based versions attractive. Lab-cultured meat elicited a heterogeneous response; its positive coefficient is not statistically distinguishable from zero (Table 11). This suggests consumers are skeptical about its naturalness, taste, and safety.

A key finding is that origin significantly predicts consumer preference, with a strong preference for locally produced meat over imported meat. This is echoed in the literature, which identifies trust in local food systems as a key driver of food choice (Feldmann and Hamm 2015). While Grasso et al. (2022) reported that European consumers associate local meat with quality and freshness, Ghanaian respondents in this study were more concerned with food safety and traceability. Unlike European consumers who prioritize local meat for quality, Ghanaian consumers linked local origin to food safety (Isanovic et al. 2023)—a critical concern given recent scandals in informal meat markets, such as the sale of expired imported meat, unregulated slaughtering, and poor cold-chain infrastructure. This indicates that “local” in the Ghanaian context reflects trust in domestic food systems, more than quality concerns. Such insights emphasize the need for locally tailored messaging connecting lab-cultured meat with Ghanaian safety standards and transparency in domestic production. In Ghana, where food safety is a priority, this preference for local meat suggests that lab-cultured meat could gain traction if marketed as locally produced.

The strong preference for locally produced meat in this study also reflects deeper cultural values tied to identity,

trust, and tradition in Ghanaian society. Beyond concerns about food safety or freshness, meat carries symbolic and ritual significance—often associated with status, hospitality, and communal ceremonies. In many Ghanaian communities, livestock such as goats or chickens are central to rites of passage, funerals, and traditional festivals, where slaughtering and sharing meat reinforce social bonds. Lab-cultured meat, which lacks this visible, ritualistic production process, may therefore face skepticism if seen as disconnected from these practices. As such, adoption will likely require not just consumer education, but cultural framing. Engaging traditional leaders, local chiefs, and religious figures could help position lab-cultured meat not as a replacement for sacred practices, but as a complementary food source for everyday consumption—preserving ritual slaughter for symbolic occasions while promoting sustainability in daily meals. This dual framing aligns with the Ghanaian value of balance between tradition and modernity, and may help lab-cultured meat gain cultural legitimacy in both urban and rural settings.

The findings also show that price sensitivity is a primary barrier to adopting alternative proteins. The significant and negative price coefficient for lab-cultured meat indicates that high prices discourage its adoption, confirming previous research that alternative proteins must achieve price parity for widespread acceptance (Yasri et al. 2020). This aligns with Siegrist and Hartmann (2020), who concluded that high prices limit consumers' adoption of new food technologies. Competitive pricing and affordability will be critical for lab-cultured meat's success in Ghana.

Interestingly, despite growing global concern for environmental sustainability, low-carbon footprint and eco-labeling have mixed impacts. Although the eco-labeling attribute was not statistically significant in the overall preference or WTP models (Tables 8 and 11), low carbon footprint was positive and significant. While sustainability ranked low overall, 17 and 23.1% of educated respondents selected eco-labeled meat alternatives, and low carbon footprint, respectively compared to just 5.2 and 10.1% among those with lower educational attainment. This suggests that sustainability messaging may resonate more with educated consumers—a niche market for premium positioning in urban areas and among the educated. Specifically, educated respondents were willing to pay a premium for eco-labeled meat alternatives and meat produced with a low carbon footprint. This suggests that eco-consciousness is emerging within a niche subgroup, particularly among educated urban youth and middle-income professionals. For this demographic, eco-labels and low carbon footprint may signal not only environmental responsibility but also modernity, health consciousness, and global alignment. These findings highlight a small but meaningful market segment for premium-positioned sustainable meat products, particularly in urban retail settings, universities, or digital marketplaces where these consumers are concentrated. In developed nations, sustainability is a significant driver of consumer decision-making (Hoek et al. 2021). However, in developing economies like Ghana, consumers prioritize short-term considerations such as price and familiarity over long-term environmental issues (Mancini

and Antonioli 2020). While appreciated, sustainability factors such as eco-labels and carbon footprint information, although they have been seen as secondary in decision-making, are becoming more relevant, as revealed in the positive coefficient of the low carbon footprint attribute. Therefore, while sustainability messages should not be abandoned, they must be strategically balanced with themes of familiarity, affordability, taste, and safety to drive behavioral change.

While the willingness to pay (WTP) space model produced a positive coefficient for lab-cultured meat—suggesting some perceived value relative to traditional alternatives such as cattle, beef, and poultry—this result was not statistically significant (Table 11). Similarly, the main preference space model indicated no significant preference for lab-cultured meat, with a negative but insignificant coefficient (Table 8). However, when socioeconomic interactions were included in the preference model, lab-cultured meat emerged as strongly and significantly preferred (coefficient = 8.36, $p < 0.001$; Table 10), particularly among younger and higher-income consumers. This pattern highlights an important nuance: while average effects may suggest consumer hesitation or neutrality, certain demographic groups exhibit strong positive preferences. These findings imply that lab-cultured meat may gain broader acceptance if barriers such as high prices, limited availability, and low consumer knowledge (Table 6) are addressed—especially through targeted awareness campaigns and strategic pricing. This aligns with Bryant and Barnett (2020), who found that consumer acceptance of lab-grown meat increases with greater transparency, familiarity, and understanding of production processes.

The extended preference space model with socioeconomic interactions revealed that younger consumers (ages 18-35) exhibited significantly greater openness to lab-cultured meat compared to older age groups ($p = 0.000$; Table 10). This is further supported by the negative and significant interaction between lab-cultured meat and age (-1.43 , $p = 0.000$), indicating that preference decreases as age increases. These younger respondents are likely more receptive due to higher levels of education, urban residency, and greater exposure to global food trends, including sustainability and ethical consumption. In contrast, older participants expressed more skepticism, often citing concerns about safety, “unnaturalness,” and unfamiliar production methods. Similarly, higher-income earners showed a statistically significant positive preference for lab-cultured meat ($p = 0.000$; Table 10), suggesting affordability and lifestyle alignment as influencing factors. These demographic insights align with broader trends in Africa, where youth populations are increasingly embracing food innovation and technology-driven solutions to sustainability challenges (Sumberg and Hunt 2019). These findings point to the potential of targeted interventions—such as awareness campaigns, university-based sampling, and urban marketing strategies—aimed at younger, educated, and higher-income consumers to accelerate early adoption.

Overall, the study has important policy and marketing implications. To facilitate consumer acceptance of lab-cultured meat in Ghana, raising awareness of its safety and

aligning it with traditional food culture are essential. Additionally, pricing strategies that position lab-cultured meat competitively with traditional meat will be crucial. The findings underscore the importance of conducting follow-up consumer perception studies over time, as repeated exposure to lab-cultured meat will likely shift attitudes and increase acceptance.

The implications of these findings are significant for policymakers and food innovators. Policymakers should support regulatory frameworks that ensure the safety and labeling of novel food products while promoting public awareness. For industry players and entrepreneurs, success will hinge on blending innovation with cultural insight—designing products and campaigns that resonate with local values, economic realities, and evolving consumption patterns.

In conclusion, the transition to sustainable protein sources in Ghana and Africa must be grounded in scientific innovation and social acceptability. Lab-cultured meat holds promise as part of this future. However, its acceptance will depend on more than technological feasibility—To facilitate broader consumer acceptance of lab-cultured meat in Ghana, policymakers and industry leaders must move beyond generic strategies and adopt concrete, contextually grounded actions. For example, government support could include targeted subsidies or tax incentives for local R&D initiatives focused on lab-cultured meat, particularly at technical universities and food science departments. This approach would mirror Kenya’s public support for insect-based protein innovation, which successfully catalyzed domestic startups and reduced dependence on imported protein (Tanga et al. 2021). Furthermore, branding and marketing strategies should emphasize “Ghanaian-grown” lab meat, framing it as a modern yet culturally resonant product. One potential approach is to position lab meat as a future-forward ingredient in beloved national dishes—such as jollof rice or waakye—thereby tying technological innovation to culinary heritage. This strategy leverages food’s symbolic role in Ghanaian identity and could help normalize lab-cultured meat through familiar formats. Collaborations with chefs, food influencers, and local food bloggers can further boost credibility and appeal, particularly among younger urban consumers. Finally, including lab-cultured meat in public procurement policies—such as school feeding programs or institutional canteens—could establish early exposure and trust, while supporting local production scale-up, consumer education, and policy support. As the population continues to grow and food systems face mounting pressure, the findings of this study provide a valuable foundation for understanding how alternative proteins can be integrated into Ghana’s evolving food landscape in a way that is both sustainable and socially inclusive.

Although this research provides valuable insights into consumer preferences for alternative meat, several limitations must be acknowledged. First, while the study provides valuable insights into urban consumer preferences in Cape Coast Metropolis, its geographic scope limits the generalizability of the findings to the rest of Ghana. Cape Coast is a mid-sized city with unique socioeconomic and cultural characteristics, including high unemployment and

moderate income. In contrast, cities like Accra, Ghana’s capital, are more cosmopolitan, with a more diverse, higher-income, and globally exposed population. As a result, consumers in Accra may exhibit greater openness to novel food technologies, including lab-cultured and plant-based meats, due to higher levels of education, exposure to international trends, and greater access to alternative proteins. Future research should include comparative samples from major urban centers like Accra, Kumasi, and Takoradi, as well as rural areas, to capture a more representative national perspective and better inform policy and marketing strategies.

Despite the limitations, the findings present a valuable roadmap for developing sustainable protein sources in Ghana and other emerging economies. Specifically, the findings reveal a nuanced consumer landscape. While traditional meat continues to dominate preferences, there is measurable openness to lab-cultured meat, provided certain conditions are met. Price remains a central barrier—lab-cultured meat is perceived as relatively expensive, affecting its competitiveness in a market where affordability is paramount. Trust also emerged as a significant determinant; many consumers expressed skepticism about the safety and authenticity of lab-cultured meat, highlighting the need for targeted public education and certification mechanisms to reassure potential buyers.

Cultural context plays a pivotal role in shaping consumer acceptance. The study suggests that aligning lab-cultured meat marketing with Ghanaian identity, values, and local consumption narratives could enhance receptivity. Strategies that frame lab-cultured meat as a Ghanaian-led innovation—emphasizing national pride, self-sufficiency, and local economic development—may be more effective than those relying solely on health or sustainability arguments. This approach resonates particularly well in an environment where consumers strongly prefer locally sourced, culturally familiar protein sources.

Future studies should extend the research to other regions of Ghana and other emerging economies. An integrated framework should be developed to encompass socioeconomic and psychological factors within a hybrid discrete choice framework to examine the drivers of consumer preferences. Research should also extend to rural areas to explore differences in acceptability by demographics. Furthermore, longitudinal studies should investigate shifts in consumer attitudes resulting from increased exposure and familiarity with lab-cultured meat and experiments with taste, texture, and sensory attributes to elucidate potential market acceptability.

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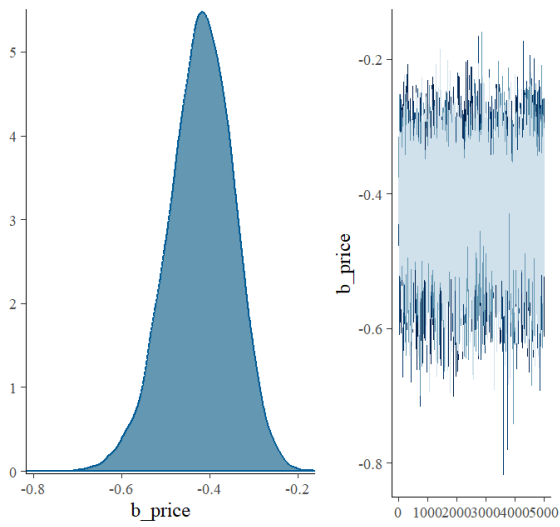


Figure S1. Posterior distribution and trace plots for the price parameter

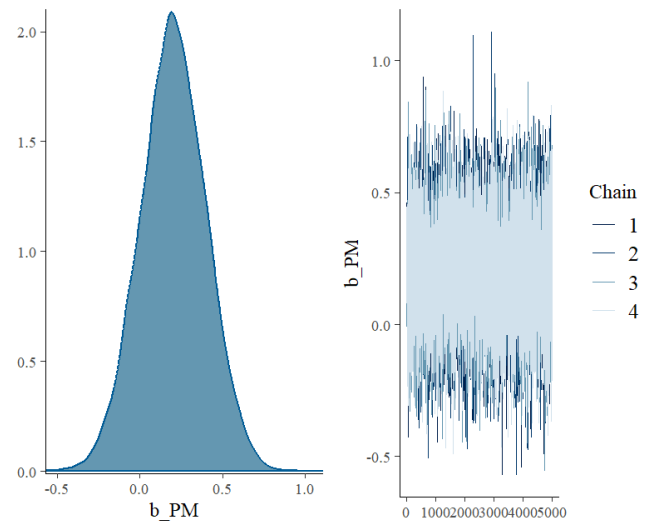


Figure S2. Posterior distribution and trace plots for the plant-based meat parameter

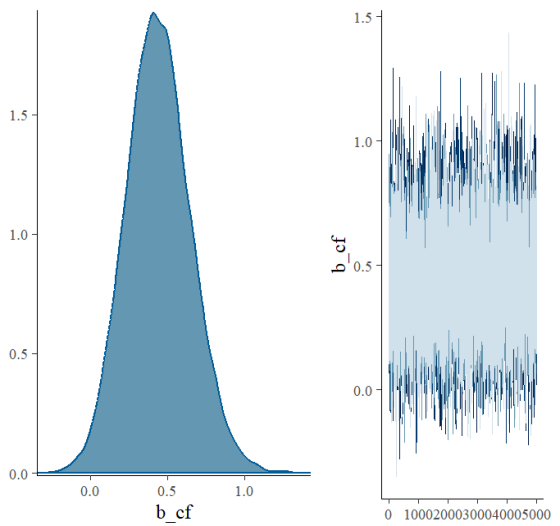


Figure S3. Posterior distribution and trace plots for the low carbon footprint parameter

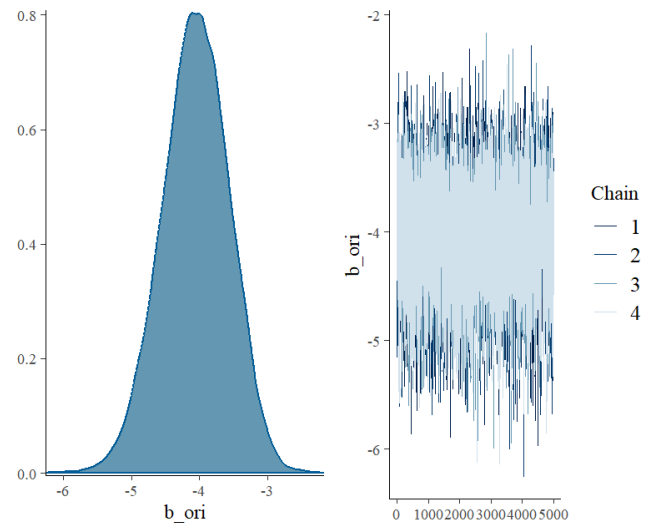


Figure S4. Posterior distribution and trace plots for the origin parameter

Table S1. WTP space model with observed heterogeneity

Items	Coefficient	MCSE	P> t	95% Credible interval		Rhat
Random variables						
Price (+1)	-	-	-	-		-
Non-traditional meat	-0.060	0.004	0.391	-0.200	0.070	1.01
Plant-based meat	0.020	0.001	0.842	-0.180	0.210	1.00
Lab-cultured meat	-1.040	0.013	0.221	-2.730	0.610	1.00
Low carbon footprint	0.210**	0.001	0.036	0.020	0.410	1.00
Origin (imported = 1)	-2.000***	0.003	0.000	-2.490	-1.550	1.00
Eco-labeling	0.030	0.010	0.881	-0.350	0.420	1.00
ASC (opt-out)	-8.770***	0.002	0.000	-10.950	-7.000	1.00
Lab-cultured meat × Age	-0.100	0.001	0.532	-0.470	0.160	1.00
Lab-cultured meat × Gender	3.860	0.011	0.311	-2.500	12.810	1.00
Lab-cultured meat × Employment	-0.960	0.001	0.784	-9.050	5.120	1.00
Lab-cultured meat × Income	0.002	0.001	0.550	-0.002	0.002	1.00
Random parameter SDs						
SD - Price	-	-	-	-		-
SD - Non-traditional meat	0.340***	0.003	0.001	0.210	0.480	1.00
SD - Plant-based meat	0.870***	0.004	0.001	0.700	1.060	1.00
SD - Lab-cultured meat (scaled)	4.310**	0.014	0.028	1.360	8.850	1.01
SD - Low carbon footprint	0.820***	0.003	0.001	0.640	1.030	1.00
SD - Origin	3.360***	0.007	0.001	2.910	3.870	1.00
SD - Eco-labeling	1.880***	0.004	0.001	1.540	2.280	1.00
SD - ASC (opt-out)	6.950***	0.015	0.001	5.580	8.670	1.00

Note: Model fit: McFadden's pseudo R-squared = 0.32, SD: Standard Deviation, MCSE: Monte Carlo Standard Error, ***, **, ****, *****, denote significance at the 10, 5, and 1% levels, respectively