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Cross-country differences in consumer acceptance and advocacy of novel food technologies

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ABSTRACT

Novel food technologies can contribute to more sustainable and resilient food systems, but their success depends on public acceptance. This study examines cross-country and demographic differences in consumer responses to three novel food technologies, gene editing, cellular agriculture, and controlled-environment agriculture, using data from 14,617 participants across eight countries. Adoption readiness was assessed across four dimensions: perceived safety, willingness to buy, willingness to encourage others to buy, and support for government initiatives. Results show substantial variation across countries and demographic groups, underscoring the importance of national contexts and sociodemographic factors in shaping acceptance, social endorsement, and policy support. These findings offer a multi-dimensional understanding of how consumers evaluate novel food technologies and provide insights for industry, researchers, and policymakers advancing future food innovations.

1. Introduction

1.1. Global context and cross-country variation in novel food technologies

The global food system faces intensifying pressure from climate change, population growth, and resource scarcity, driving renewed interest in technological solutions that can increase resilience and efficiency. Agriculture remains a major contributor to greenhouse gas emissions, biodiversity loss, and freshwater depletion, and these impacts are expected to rise as the global population approaches 10 billion by 2050 (Tilman & Clark, 2014; Nations, 2019). In this context, novel food technologies, including gene editing (GE; i.e., the alteration of genetic material to improve organism traits), cellular agriculture (CA; i.e., the production of food from cell cultures), and controlled-environment agriculture (CEA; i.e., the optimization of farming through controlled settings), are widely viewed as potential pathways for producing food with lower burdens and greater predictability (Conroy & Errmann, 2023; McCartney & Lefsrud, 2018). Yet the societal benefits of these technologies depend not only on scientific advances but also on public acceptance (Frau et al., 2022; Siegrist & Hartmann, 2020). Because regulatory environments, economic conditions, and cultural attitudes differ across countries, consumers form distinct perceptions of safety, purchasing intentions, social advocacy, and support for government initiatives toward gene editing, cellular agriculture, and controlled-environment agriculture (Buchholzer & Frommer, 2022; Chodkowska et al., 2022; Failla et al., 2023).

Research shows substantial variation across countries, influenced by regulatory histories, cultural expectations around "naturalness," institutional trust, and national food-security priorities. Cross-national work documents significant international differences in GM-related risk perception and acceptance, while also highlighting the challenges of comparing countries with divergent regulatory and cultural contexts (Frewer et al., 2013). For example, acceptance of gene-edited or cultured foods is higher in some Asian contexts, where technological progress is closely linked to national development narratives (Xu et al., 2020; Tzompa-Soza et al., 2023). In contrast, consumers in countries with strong culinary traditions or longstanding debates about genetic technologies often express more caution, as seen in Australia and New Zealand (Giacalone & Jaeger, 2023; Siegrist & Hartmann, 2020b). Singapore, Japan, and South Korea have positioned themselves as innovation-forward economies, investing heavily in agri-food technologies and shaping public narratives that emphasise efficiency, modernity, and food resilience (Chong et al., 2022). Meanwhile, the United Arab Emirates faces acute food-security challenges and is rapidly

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adopting controlled-environment and alternative-protein technologies as part of national sustainability strategies (Khaleel et al., 2024).

These contextual differences suggest that acceptance of novel food technologies cannot be understood without considering how country-level cultural, institutional, and food-security environments shape consumer judgments. While demographic influences on food-technology acceptance are well documented in regions such as Europe, the United States, China, and Japan (Chen et al., 2023; Mohr et al., 2007; Rollin et al., 2011), far less is known about how these patterns operate in countries like Viet Nam or the United Arab Emirates, where existing studies focus on general acceptance rather than demographic variation (Tzompa-Soza et al., 2023; Khaleel et al., 2024). This gap underscores the need for a cross-country comparison that systematically examines demographic differences across distinct national contexts.

Demographic characteristics further influence adoption readiness. Younger and more educated consumers tend to be more open to novel technologies, though higher education can also heighten sensitivity to ethical concerns (Mohr et al., 2007). Gender differences also emerge, with women in several Western contexts exhibiting greater risk aversion toward food innovations (Cardello, 2003; Rollin et al., 2011). However, demographic factors rarely operate independently; their influence interacts with national values, developmental priorities, trust in governance, and exposure to technology. Recent cross-country work shows that attitudes toward lab-grown or gene-edited foods are strongly shaped by both personal traits and contextual factors such as religious norms, modernisation narratives, and trust in regulators (Ho et al., 2023; Siegrist & Hartmann, 2020b; Lin et al., 2019).

Despite the expanding literature, several gaps remain. Most studies examine acceptance within a single country or around a single technology, limiting understanding of how different novel food technologies are evaluated across culturally and institutionally diverse settings (Giacalone & Jaeger, 2023). Research also tends to focus on a single outcome, such as willingness to try or support for labelling, rather than recognising that adoption of novel food technologies requires alignment across multiple domains, including risk perceptions, behavioural intentions, social endorsement, and policy attitudes. These limitations restrict our ability to anticipate how novel food technologies will diffuse across societies with different technological priorities, food traditions, and governance systems.

To address this gap, we focus on a purposively selected set of eight countries that vary along regulatory stringency, food-security dependence, and technological orientation (spanning innovation-forward, food-import-dependent economies and more regulation-averse, agriculturally established contexts), allowing for comparative analysis rather than statistical representativeness. This study conducts a large-scale cross-country comparison of consumer responses to gene editing, cellular agriculture, and controlled-environment agriculture across eight countries: China, Viet Nam, Singapore, Japan, South Korea, Australia, New Zealand, and the United Arab Emirates. Using data from 14,617 participants, we examine four complementary dimensions of adoption readiness: perceived safety, willingness to buy, willingness to encourage others to buy, and support for government initiatives. These outcomes capture the risk-focused, behavioural, social, and institutional dimensions of how consumers evaluate novel food technologies. Prior research shows that perceived safety is central to risk and benefit evaluation (Bearth & Siegrist, 2016; Monaco et al., 2024), willingness to buy reflects personal adoption potential (Chen et al., 2023), encouraging others supports social diffusion (Hawkins et al., 2020), and support for government initiatives signals institutional trust and willingness to endorse systemic adoption (Hobbs & Goddard, 2015; Lindberg et al., 2023).

By examining various novel food technologies, multiple adoption outcomes, and multiple countries, this study makes three contributions. First, it explains how country-level contexts, such as regulatory histories, cultural norms, and national food-security priorities, shape responses to novel food technologies, extending recent cross-country work (Siegrist & Hartmann, 2020b; Tzompa-Soza et al., 2023; Chong et al., 2022). Second, it frames adoption readiness as a multi-dimensional construct, integrating four established outcome domains—risk/safety perceptions, behavioural intention, social endorsement, and policy support—consistent with emerging models that emphasise parallel judgments about risk, benefits, trust, and behavioural intentions (Albertsen et al., 2020; Monaco et al., 2024). Third, it examines how sociodemographic factors interact with country-level contexts to shape perceived safety, behavioural intention, advocacy, and policy support, contributing to a growing literature on demographic and institutional drivers of acceptance (Chen et al., 2023; Harrison & Liem, 2026; Lindberg et al., 2023). Together, these contributions offer a more comprehensive understanding of cross-country differences in public engagement with novel food technologies.

1.2. *Adoption readiness for novel food technologies*

Novel food technologies in this study include gene editing, cellular agriculture, and controlled-environment agriculture, three approaches that differ in technical mechanism but share the goal of producing food with greater efficiency, predictability, and sustainability. GE modifies an organism's existing DNA with high precision, offering potential improvements in resilience and nutritional content (Giacalone & Jaeger, 2023; Shew et al., 2018). CA produces foods from cultured cells, reducing environmental and ethical burdens while aiming to replicate conventional sensory attributes (Baum et al., 2021; Li et al., 2024). CEA, including vertical farming, uses optimised indoor systems to minimise land, water, and pesticide use (Jürkenbeck et al., 2019; McCartney & Lefsrud, 2018). These technologies vary in maturity and familiarity due to their distinct attributes. In addition, their adoption depends on how consumers evaluate their safety, behavioural relevance, social implications, and policy alignment: four dimensions that together form adoption readiness.

Adoption readiness reflects the extent to which consumers judge a novel food technology as safe, personally acceptable, socially endorsable, and deserving of institutional support. Prior research typically examines these outcomes separately (e.g., willingness to try, trust, or perceived risk). However, evidence shows that these judgments are interdependent: perceived safety shapes willingness to buy (Albertsen et al., 2020; Bearth & Siegrist, 2016), social endorsement emerges when technologies are seen as socially beneficial or normatively appropriate (Hawkins et al., 2020), and support for government action reflects both perceived societal benefits and institutional trust (Hobbs & Goddard, 2015; Lindberg et al., 2023). Examining these dimensions together provides a more holistic understanding of adoption readiness.

Because regulatory histories, food-security conditions, and public narratives differ across countries (Xu et al., 2020; Chong et al., 2022; Khaleel et al., 2024), we conceptualise countries as contextual environments that shape consumer expectations and experiences with food technologies. We do not treat these contextual features as measured constructs; rather, they provide the backdrop against which safety perceptions, behavioural intentions, and policy attitudes are formed. Below, we develop hypotheses for each adoption dimension.

1.3. *Hypotheses development*

1.3.1. *Perceived safety*

Perceived safety is central to consumer acceptance of any food innovation (Bearth & Siegrist, 2016; Monaco et al., 2024). Safety judgments reflect emotional reactions, perceptions of naturalness, familiarity, and trust in science and regulation (Frewer et al., 2011; Xu et al., 2020). Historical scepticism toward GMOs shows that negative safety perceptions can suppress acceptance even when technologies offer clear benefits (Wohlfender-Bühler et al., 2016). Across countries, perceived safety varies due to differing communication environments, regulatory philosophies, and public discourse (Siegrist & Hartmann, 2020; Tzompa-Soza et al., 2023).

H1a: Perceived safety of GE differs across countries.

H1b: Perceived safety of CA differs across countries.

H1c: Perceived safety of CEA differs across countries.

Safety perceptions also vary across demographic groups. Women and older consumers frequently display higher risk sensitivity (Rollin et al., 2011), and education may either reduce or heighten perceived risks depending on whether individuals emphasise scientific benefits or ethical concerns (Mohr et al., 2007).

H2a: Demographic characteristics (age, gender, education) influence perceived safety of GE, and these effects vary across countries.

H2b: Demographic characteristics (age, gender, education) influence perceived safety of CA, and these effects vary across countries.

H2c: Demographic characteristics (age, gender, education) influence perceived safety of CEA, and these effects vary across countries.

1.3.2. Willingness to buy

Willingness to buy reflects a consumer's readiness to adopt a novel food and serves as a strong behavioural predictor (Chen et al., 2023). Willingness to buy increases when technologies are framed in terms of personal benefits, such as nutrition or sustainability, and when consumers feel they understand the technology (Castellini et al., 2025; Parrella et al., 2024). Because safety and risk perceptions heavily influence willingness to buy (Albertsen et al., 2020; Bearth & Siegrist, 2016), countries with different safety concerns or regulatory climates often show distinct patterns.

H1d: Willingness to buy GE foods differs across countries.

H1e: Willingness to buy CA foods differs across countries.

H1f: Willingness to buy CEA foods differs across countries.

Age, gender, and education also influence purchasing intentions. Younger consumers tend to be more open (Monaco et al., 2024), men often show greater technological openness (Rollin et al., 2011), and the effects of education vary depending on whether ethical concerns or scientific optimism dominate (Mohr et al., 2007; Mattavelli et al., 2022).

H2d: Demographic characteristics (age, gender, education) influence willingness to buy GE foods, and these effects vary across countries.

H2e: Demographic characteristics (age, gender, education) influence willingness to buy CA foods, and these effects vary across countries.

H2f: Demographic characteristics (age, gender, education) influence willingness to buy CEA foods, and these effects vary across countries.

1.3.3. Advocacy behaviour (willingness to encourage others to buy)

Advocacy behaviour captures whether consumers would recommend or endorse a technology to others; a key mechanism for diffusion of unfamiliar products (Frewer et al., 2011). Advocacy is driven by social norms, perceived societal benefits, and internalisation of positive attitudes (Hawkins et al., 2020; Judge et al., 2022). Countries differ in the extent to which social influence, collective narratives, or innovation discourse support endorsement of food technologies (Tzompa-Soza et al., 2023).

H1g: Willingness to encourage others to buy GE foods differs across countries.

H1h: Willingness to encourage others to buy CA foods differs across countries.

H1i: Willingness to encourage others to buy CEA foods differs across countries.

Demographic effects mirror those of behavioural intention: younger and male consumers tend to show greater advocacy willingness, while education may amplify or attenuate endorsement depending on moral evaluation (Monaco et al., 2024; Rollin et al., 2011).

H2g: Demographic characteristics (age, gender, education) influence willingness to encourage others to buy GE foods, and these effects vary across countries.

H2h: Demographic characteristics (age, gender, education) influence willingness to encourage others to buy CA foods, and these effects vary across countries.

H2i: Demographic characteristics (age, gender, education) influence willingness to encourage others to buy CEA foods, and these effects vary across countries.

1.3.4. Support for government initiatives

Support for government initiatives reflects whether consumers believe that policy action, regulation, or institutional investment in novel technologies is appropriate. Policy support depends on trust in government, perceived societal benefits, and expectations around food security (Hobbs & Goddard, 2015; Lindberg et al., 2023). Because countries differ in regulatory philosophies and state involvement in agri-food innovation (Chong et al., 2022; Khaleel et al., 2024), responses to government-led actions are expected to vary.

H1j: Support for government initiatives related to GE foods differs across countries.

H1k: Support for government initiatives related to CA foods differs across countries.

H1l: Support for government initiatives related to CEA foods differs across countries.

Demographic differences also shape policy attitudes, with women and older individuals often expressing stronger preferences for precautionary oversight, and education influencing regulatory trust (Rollin et al., 2011; Vicente-Molina et al., 2013).

H2j: Demographic characteristics (age, gender, education) influence support for government initiatives related to GE foods, and these effects vary across countries.

H2k: Demographic characteristics (age, gender, education) influence support for government initiatives related to CA foods, and these effects vary across countries.

H2l: Demographic characteristics (age, gender, education) influence support for government initiatives related to CEA foods, and these effects vary across countries.

Overall, adoption readiness is best understood as a multidimensional construct rather than a single behavioural intention. Prior research shows that responses to novel food technologies cluster along four domains that jointly shape acceptance. Perceived safety reflects core risk assessments and strongly predicts whether consumers consider a product viable (Albertsen et al., 2020; Bearth & Siegrist, 2016). Willingness to buy captures personal adoption intention and translates safety and benefit perceptions into individual behaviour (Chen et al., 2023). Willingness to encourage others to buy represents a form of social endorsement that facilitates diffusion, particularly for unfamiliar or controversial foods (Frewer et al., 2011; Hawkins et al., 2020). Support for government initiatives reflects institutional trust and perceived societal value, signalling readiness for systemic implementation (Hobbs & Goddard, 2015; Lindberg et al., 2023). Although safety often precedes behavioural intention, and advocacy and policy support operate as parallel or downstream social responses, research consistently shows that these four dimensions co-occur and reinforce one another when consumers evaluate emerging food technologies. Thus, examining all four outcomes together provides a comprehensive and theoretically grounded framework for understanding adoption readiness across diverse country contexts.

2. Method

2.1. Participant recruitment

Participants were recruited through the market research agency Dynata across eight

countries: New Zealand, Australia, Viet Nam, Singapore, Japan, the United Arab Emirates (UAE), South Korea, and China, with quota sampling applied for age and gender within each country to achieve broadly representative samples. These countries were chosen to represent a diverse range of cultural, economic, and technological contexts, as well as a wide range of priorities such as the emphasis on technological novelty and innovation in Japan and South Korea (Li et al., 2023; Yoon et al., 2020); food supply concerns in Singapore and the UAE (Al Hamedi et al., 2023; Mok et al., 2020); and strong agricultural traditions in New Zealand and Australia (Pannell & Rogers, 2022), making them ideal for exploring cross-country variations in consumer adoption readiness for novel food technologies.

Responses that were invalid were excluded from the dataset (i.e., failing attention checks or showing unusually short completion times). The final dataset included 14,617 participants (New Zealand: $n = 1830$, Australia: $n = 1817$, Singapore: $n = 1800$, China: $n = 1812$, Japan: $n = 1801$, South Korea: $n = 1826$, Viet Nam: $n = 1813$, United Arab Emirates: $n = 1918$). The demographic information is outlined in Supplementary Table 1.

2.2. Study design and procedure

The study examined consumer perceptions across eight countries (Australia, New Zealand, Singapore, China, Japan, South Korea, Viet Nam, and the United Arab Emirates) for three novel food technologies: Gene editing, Cellular agriculture, and Controlled-environment agriculture. Respondents were randomly assigned to one of the three technology conditions, resulting in approximately equal sample sizes per condition. The sample sizes for each technology within each country were as follows: Australia (GE $n = 629$, CA $n = 594$, CEA $n = 607$), New Zealand (GE $n = 625$, CA $n = 587$, CEA $n = 605$), Singapore (GE $n = 600$, CA $n = 589$, CEA $n = 611$), China (GE $n = 637$, CA $n = 570$, CEA $n = 605$), Japan (GE $n = 601$, CA $n = 613$, CEA $n = 587$), South Korea (GE $n = 595$, CA $n = 630$, CEA $n = 601$), Viet Nam (GE $n = 613$, CA $n = 603$, CEA $n = 597$), and the United Arab Emirates (GE $n = 627$, CA $n = 647$, CEA $n = 644$).

The online survey created on SurveyMonkey was designed to examine whether consumers' adoption readiness for novel food technologies differ by country. The researchers initially designed the questionnaire in English, and the translation process was conducted carefully to align with the languages of each country. The market research agency Dynata assisted in translating the questionnaire, while bilingual individuals from the researchers' network reviewed the translations to ensure accuracy and consistency.

Participants in each country were informed that the study sought to understand their adoption readiness of novel food technologies. Each participant was then presented with information corresponding to one of the food technologies. An introductory explanation of the designated food technology (Supplementary Figs. 1, 2, and 3) was provided to give participants a clear understanding of the concept before they responded to any related questions. Following this, they were asked to indicate their perceptions of the assigned technology's safety, willingness to buy food produced using the technology, willingness to encourage others to buy such food, and support for government initiatives in the technology. The survey concluded with participants providing their demographic information, including age, gender, education, geographic location, living situation, and dietary habits.

2.3. Measurement

Perceived safety, willingness to buy, willingness to encourage others to buy, and support for government initiatives were assessed to understand consumer readiness to adopt novel food technologies. Consumer-perceived safety of the technology was measured by a single question: 'How would you evaluate the safety of the described technology?' on a sliding scale from very risky (−50) to not risky at all (+50). Willingness to buy was measured through two items based on a Likert scale from 1 (strongly disagree) to 7 (strongly agree). The two items ($\alpha = 0.90$) adapted from Zhang et al. (2018) were: "I am inclined to purchase foods made using the technology" and "I am willing to purchase food produced with the technology." Consumers' willingness to encourage others to buy sustainable foods was assessed with a single item: "How likely is it that you would encourage others to consider buying foods grown using the described technology?" on a sliding scale from 0% to 100% probability. Government support was evaluated by asking, "How likely is it that you would support government investment in research and development for the described food technology?" also on a sliding scale from 0% to 100% probability.

2.4. Analysis rationale

The analysis begins with country-level comparisons to examine external influences such as government policies, regulatory frameworks, economic conditions, and technological infrastructure that shape the broader environment for adoption of novel food technologies. These macro-level factors provide crucial context for understanding national differences in perceptions, willingness to adopt, and support for these technologies. Following this, individual micro-level demographic characteristics, including age, gender, education, are analysed to explore within-country variations. This two-step approach allows for a comprehensive understanding of both macro-level externalities and micro-level individual differences, offering a nuanced perspective on adoption readiness across and within countries.

3. Results

3.1. Consumer adoption readiness for novel food Technologies in Cross-Country Contexts

This section reports the results of cross-country differences in consumer adoption readiness for three novel food technologies and evaluates Hypotheses 1a–1 l. Bivariate correlations among the adoption readiness measures were first examined. All variables were positively and significantly correlated, with coefficients ranging from $r = 0.49$ to $r = 0.79$ (Table 1). Although the correlation between encourage others to buy and support for government initiatives was relatively high, the variables represent theoretically distinct dimensions of adoption readiness (Tabachnick & Fidell, 2007).

Given that the adoption readiness outcomes are theoretically distinct but empirically correlated, one-way Multivariate Analysis of Variance (MANOVA) tests were then conducted for each novel food technology, with country as the independent variable and multiple indicators of consumer adoption readiness as dependent variables. This multivariate approach allows for the detection of overall country-level differences in adoption readiness while controlling for Type I error inflation (Kim, 2017). When a significant multivariate effect was observed, tests of between-subjects effects (univariate ANOVAs) were examined to identify which specific readiness measures differed across countries.

The magnitude of effects was evaluated using Eta-squared (η^2), following Cohen's (1988) benchmarks: $\eta^2 < 0.01$ = negligible, $0.01 \leq \eta^2 < 0.06$ = small, $0.06 \leq \eta^2 < 0.14$ = medium, and $\eta^2 \geq 0.14$ = large. Statistical significance was evaluated at $p < .05$ (Gaur & Gaur, 2006). For dependent variables showing significant univariate effects, Tukey's HSD post hoc tests were conducted to assess pairwise differences among countries using estimated marginal means (Tabachnick & Fidell, 2007).

3.1.1. Multivariate effects of country in consumer adopt readiness

The MANOVA results revealed statistically significant multivariate

Table 1
Correlation matrix of outcome variables.

Variables	1	2	3	4
1. Perceived safety	1			
2. Willingness to buy	0.49***	1		
3. Willingness to encourage others to buy	0.53***	0.62***	1	
4. Support for government initiatives	0.52***	0.57***	0.79***	1

Notes: *** $p < .001$, **$p < .01$, *$p < .05$.

effects of country for all three food technologies:

GE: *Wilks*' $\lambda = 0.85$, $F(28, 17726.31) = 29.51$, $p < .001$, $\eta^2 = 0.04$.

CA: *Wilks*' $\lambda = 0.85$, $F(28, 17387.39) = 27.74$, $p < .001$, $\eta^2 = 0.04$.

CEA): *Wilks*' $\lambda = 0.86$, $F(28, 17473.92) = 27.32$, $p < .001$, $\eta^2 = 0.04$.

Across all three technologies, the effect sizes indicate small but meaningful country-level differences in consumer adoption readiness. The following sections present the tests of between-subjects effects, followed by post hoc pairwise comparisons to identify country-level differences on the four dependent variables: perceived safety, willingness to buy, willingness to encourage others to buy, and support for government initiatives.

3.1.1.1. Perceived safety. The tests of between-subjects effects indicated that country had a significant effect on consumers' perceived safety for each novel food technology: GE, $F(7, 4919) = 57.97$, $p < .001$, $\eta^2 = 0.08$; CA, $F(7, 4825) = 47.69$, $p < .001$, $\eta^2 = 0.07$; and CEA, $F(7, 4849) = 20.15$, $p < .001$, $\eta^2 = 0.03$. These findings support H1a-1c, indicating that safety perceptions of these food technologies vary significantly across countries. Medium effect sizes for both GE and CA suggest that country context explains a meaningful proportion of the variance in safety perceptions, whereas the small effect for CEA indicates that national context has a relatively weaker influence. Figure 1 illustrates the estimated marginal means for perceived safety of each technology across the eight countries. Descriptive statistics, including means and standard deviations, as well as post hoc pairwise comparisons, are reported in Supplementary Table 2.

Cross-country differences in the perceived safety of GE food were identified. Participants from China ($M = 14.18$) and Viet Nam ($M = 14.11$) reported the two highest safety perceptions. Singapore ($M = 7.73$) and South Korea ($M = 8.10$) reported moderate levels of perceived safety, while participants from Australia ($M = -1.16$), New Zealand ($M = -1.86$), and Japan ($M = -4.53$) indicated lower levels of perceived safety, positioning them at the lower end of the spectrum.

Regarding the perceived safety of CA, notable cross-country variations were observed. China ($M = 12.60$) and Viet Nam ($M = 14.43$) once again reported the highest safety perceptions for this technology. South Korea ($M = 8.65$) showed a moderate level of perceived safety. In contrast, Australia ($M = -1.70$), New Zealand ($M = -4.67$), and Japan ($M = -0.33$) all indicated lower levels of perceived safety, with New Zealand showing the lowest mean.

Cross-country differences were evident in the perceived safety of CEA technology. Viet Nam ($M = 20.17$) and China ($M = 18.08$) again reported the highest perceived safety levels. Singapore ($M = 16.4$), New Zealand ($M = 14.43$), and Australia ($M = 12.85$) also demonstrated relatively high and moderate levels of perceived safety for CEA. In contrast, Japan ($M = 7.73$), and the UAE ($M = 10.62$) reported comparatively lower, but still positive, levels of perceived safety for CEA technology.

3.1.1.2. Willingness to buy. Significant differences across countries were found in 'willingness to buy' for each novel food technology: GE, $F(7, 4919) = 69.90$, $\eta^2 = 0.09$, $p < .001$; CA, $F(7, 4825) = 75.16$, $p < .001$, $\eta^2 = 0.10$; and CEA, $F(7, 4849) = 62.56$, $p < .001$, $\eta^2 = 0.08$. These findings provide support for Hypotheses 1d – 1f, suggesting that consumers' willingness to buy novel food technologies varies significantly across countries. In addition, the effect sizes for all three technologies fall within the medium range, suggesting that country context accounts for a meaningful and practically important proportion of the variance in willingness-to-buy responses. Figure 2 depicts the estimated marginal means for each technology's willingness-to-buy ratings across the eight countries. Supplementary Table 3 reports the corresponding descriptive statistics (means and standard deviations) and post hoc pairwise comparisons.

Cross-country differences were observed in the willingness to buy GE food. China ($M = 5.30$) and Viet Nam ($M = 5.16$) reported the highest willingness to buy. Singapore ($M = 4.91$) and South Korea ($M = 4.73$) showed moderately high levels of willingness to buy. In contrast, Australia ($M = 4.31$), New Zealand ($M = 4.37$), and the UAE ($M = 4.41$) reported slightly lower, but still positive, willingness to buy. Japan ($M = 3.93$) demonstrated the lowest willingness to buy GE food among the surveyed countries.

Regarding the CA, variations across countries were evident. China ($M = 5.26$) and Viet Nam ($M = 5.27$) again showed the highest willingness to purchase products utilizing this technology. Singapore ($M = 4.94$) and South Korea ($M = 4.76$) exhibited moderate levels of willingness to buy. Australia ($M = 4.25$), New Zealand ($M = 4.10$), and the UAE ($M = 4.22$) reported somewhat lower willingness to buy. Japan ($M = 4.05$) indicated the lowest willingness to buy CA products among the countries surveyed.

Significant cross-country differences were also present in the willingness to buy CEA technology. China ($M = 5.44$) and Viet Nam ($M = 5.44$) consistently showed the highest willingness to buy. New Zealand ($M = 5.03$), and Singapore ($M = 5.18$) all reported strong, yet slightly lower, willingness to buy. South Korea ($M = 4.97$), Australia ($M = 4.81$), Japan ($M = 4.30$), and the UAE ($M = 4.57$) indicated comparatively lower, but still positive, levels of willingness to buy CEA products.

3.1.1.3. Willingness to encourage others to buy. A significant effect of country on willingness to encourage others to buy was identified for each novel food technology: GE, $F(7, 4919) = 97.51$, $p < .001$, $\eta^2 = 0.12$; CA, $F(7, 4825) = 88.93$, $p < .001$, $\eta^2 = 0.11$; and CEA, $F(7, 4849) = 88.55$, $p < .001$, $\eta^2 = 0.11$. These results support Hypotheses 1 g – 1i, indicating that participants' willingness to encourage others to buy these sustainable foods varied significantly across countries. These effect sizes fall within the medium range, indicating that country context accounts for a substantial and practically meaningful proportion of the variance in consumers' willingness to encourage others to buy across all three

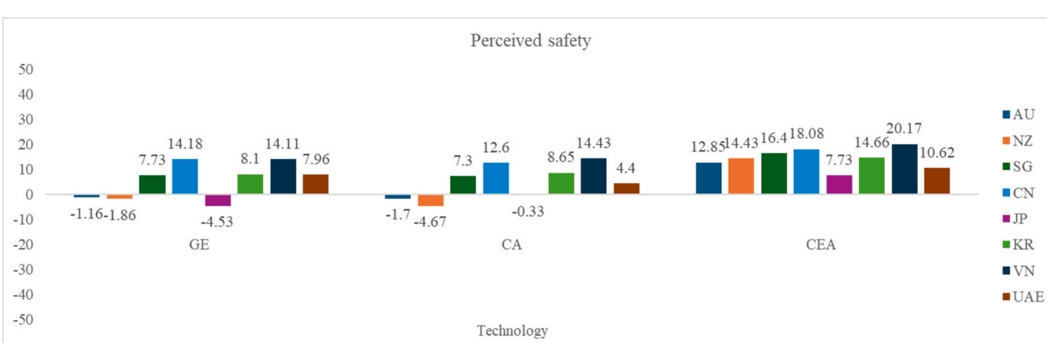

Fig. 1. Perceived safety of novel food technologies across countries.

Note: GE = Gene-editing, CA = Cellular agriculture, CEA = Controlled environment agriculture, AU = Australia, NZ = New Zealand, SG = Singapore, CN=China, JP = Japan, KR = Korea, VN=Viet Nam. UAE = United Arab Emirates; Sliding scale: −50 very risky to not risky 50.

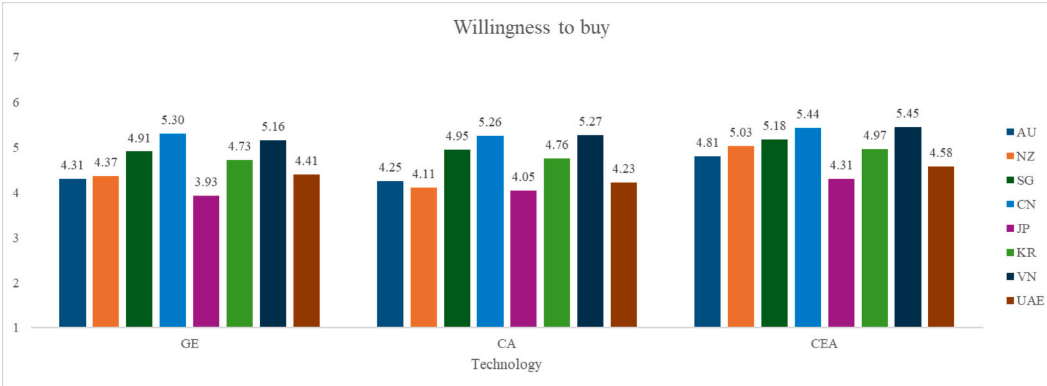

Fig. 2. Willingness to buy novel food technologies across countries.
Note: GE = Gene-editing, CA = Cellular agriculture, CEA = Controlled environment agriculture, AU = Australia, NZ = New Zealand, SG = Singapore, CN=China, JP = Japan, KR = Korea, VN=Viet Nam. UAE = United Arab Emirates; 7-point Likert scale: 1 = Strongly disagree to 7 = Strongly agree.

technologies. The estimated marginal means for willingness to encourage others to buy each technology across the eight countries are shown in Fig. 3. Supplementary Table 4 presents the descriptive statistics, including means and standard deviations, along with the results of post hoc pairwise comparisons.

Cross-country differences were observed in the willingness to encourage others to buy GE food. China (*M* = 69.06) and Viet Nam (*M* = 69.23) demonstrated the highest willingness to encourage others to buy. Singapore (*M* = 63.13) showed moderately high levels of willingness to encourage. In contrast, Australia (*M* = 49.84), New Zealand (*M* = 48.27), South Korea (*M* = 57.43) and the UAE (*M* = 57.45) reported comparatively lower, yet still substantial, levels of willingness to encourage others to buy. Japan (*M* = 40.27) exhibited the lowest willingness to encourage the consumption of GE food.

Regarding the willingness to encourage others to buy CA foods, notable variations were apparent across countries. China (*M* = 68.16) and Viet Nam (*M* = 70.36) again presented the highest willingness to encourage. Singapore (*M* = 63.45) and South Korea (*M* = 59.32) also showed strong, though slightly lower, levels of willingness to encourage. The UAE (*M* = 54.05) reported more moderate levels of willingness to encourage. Australia (*M* = 48.47), New Zealand (*M* = 46.52), and Japan (*M* = 42.64) indicated the lowest willingness to encourage others to buy to adopt CA products.

Significant cross-country differences were also identified in the willingness to encourage others to buy CEA products. Viet Nam (*M* = 74.66), China (*M* = 71.77), and Singapore (*M* = 70.44) showed the highest willingness to encourage, indicating a very positive attitude toward advocating for CEA. Australia (*M* = 61.16), New Zealand (*M* = 60.16), South Korea (*M* = 62.00), and the UAE (*M* = 60.34) also demonstrated strong willingness to encourage others to buy. Japan (*M* = 45.89) exhibited the lowest willingness to encourage others to buy CEA products among the surveyed countries.

3.1.1.4. Support for government initiatives. A significant effect of country on support for government initiatives was observed across all three novel food technologies: GE, $F(7, 4919) = 88.14$, $p < .001$, $\eta^2 = 0.11$; CA, $F(7, 4825) = 78.15$, $p < .001$, $\eta^2 = 0.10$; and CEA, $F(7, 4849) = 72.81$, $p < .001$, $\eta^2 = 0.10$. The effect sizes all fall within the medium range. Hypotheses 1j-11 were thus supported. Figure 4 illustrates the estimated marginal means for support for government initiatives across countries for each novel food technology. Descriptive statistics (means and standard deviations) and post hoc pairwise comparisons are reported in Supplementary Table 5.

Cross-country differences were evident in the support for government initiatives related to GE. China (*M* = 70.86) and Viet Nam (*M* = 70.62) displayed the strongest support for government initiatives concerning GE technology. Singapore (*M* = 65.22) and South Korea (*M* = 58.86) also showed substantial support. In contrast, Australia (*M* = 52.38), New Zealand (*M* = 51.28), and the UAE (*M* = 59.28) reported moderate levels of support. Japan (*M* = 43.54) exhibited the lowest level of support for government initiatives of GE.

Regarding CA, variations were observed across the countries. Viet Nam (*M* = 72.14) and China (*M* = 69.47) again showed the highest levels of support for government initiatives. Singapore (*M* = 66.42) and South Korea (*M* = 61.41) demonstrated strong, though slightly lower, support. Australia (*M* = 52.21), and the UAE (*M* = 55.47) reported more moderate levels of support for government involvement in CA. New Zealand (*M* = 49.90, and Japan (*M* = 46.25) indicated lower support

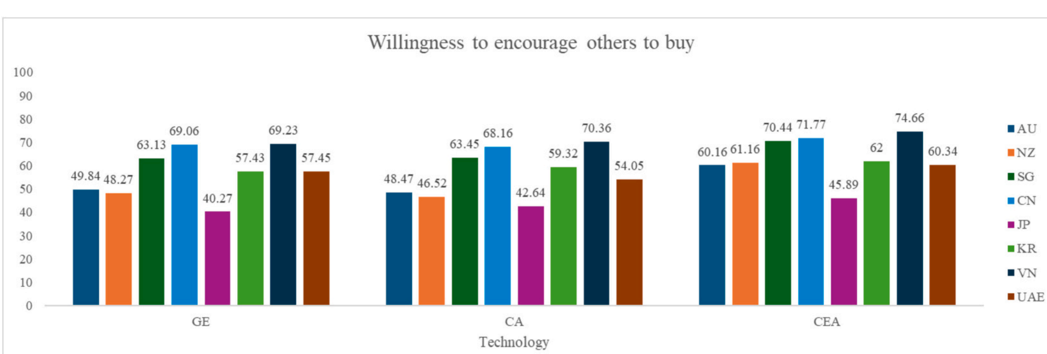

Fig. 3. Willingness to encourage others to buy novel food technologies across countries. Note: GE = Gene-editing, CA = Cellular agriculture, CEA = Controlled environment agriculture, AU = Australia, NZ = New Zealand, SG = Singapore, CN=China, JP = Japan, KR = Korea, VN=Viet Nam. UAE = United Arab Emirates; Sliding scale: 0% probability to a 100% probability.

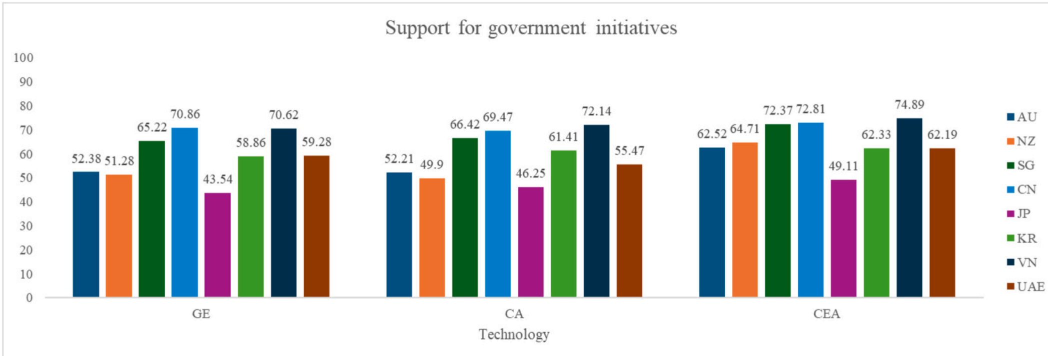

Fig. 4. Support for government initiatives in novel food technologies across countries. Note: GE = Gene-editing, CA = Cellular agriculture, CEA = Controlled environment agriculture, AU = Australia, NZ = New Zealand, SG = Singapore, CN=China, JP = Japan, KR = Korea, VN=Viet Nam. UAE = United Arab Emirates; Sliding scale: 0% probability to a 100% probability.

among the surveyed nations.

Cross-country differences were also present in the support for government initiatives related to CEA technology. Viet Nam ($M = 74.89$), China ($M = 72.81$) and Singapore ($M = 72.37$) showed the highest support for government initiatives concerning CEA. New Zealand ($M = 64.71$), Australia ($M = 62.52$), UAE ($M = 62.19$), and South Korea ($M = 62.33$) also demonstrated high levels of support. Japan ($M = 49.11$) exhibited the lowest support for government initiatives in CEA.

3.2. Consumer demographics and adoption readiness for novel food Technologies in Cross-Country Contexts

This section provides results on demographic differences (i.e., Gender, Age and Education) in consumer adoption readiness for novel food technologies, and whether these differences vary across countries. To ensure the precision and reliability of the results, participants who selected "gender diverse" for gender or "other" for education were excluded from the analysis due to small and unrepresentative sample sizes in these categories. Country was treated as a categorical variable and entered into the models using numeric codes for identification purposes (1 = Australia; 2 = New Zealand; 3 = Singapore; 4 = China; 5 = Japan; 6 = South Korea; 7 = Viet Nam; 8 = United Arab Emirates). In addition, for gender, dummy coding was applied, with male coded as 0 and female as 1, while age and education level were treated as continuous variables and mean-cantered to reduce multicollinearity. Although other demographics such as geography and living situation were measured, these variables were not included in the analyses due to low representation in some categories.

To evaluate Hypotheses 2a–2 l, a series of two-way MANOVAs were conducted to examine the interaction effects between demographic variables and country on multiple measures of consumer adoption readiness, with models including both main effects of demographics and country, as well as the demographic × country interaction term. Each focal demographic variable (Age, Gender, Education) was included as an interaction term with Country, with the various adoption readiness measures serving as dependent variables. When significant multivariate interaction effects were observed, tests of between-subjects effects (univariate ANOVAs) were conducted to identify which specific adoption readiness dimensions were influenced by the demographic × country interactions.

Following the identification of a significant univariate interaction, Hayes' PROCESS macro (Model 1; 5000 bootstrap samples) was employed to examine the conditional effects of the focal predictors to identify the specific countries in which demographic variables significantly influenced each dimension of consumer adoption readiness (Hayes, 2012). In these analyses, consumer demographics served as the independent variables, country as the moderator, and the various measures of consumer adoption readiness as the dependent variables.

3.2.1. Gender × country interaction effects

Significant multivariate interactions between gender and country for all three food technologies were identified:

GE: *Wilks'* $\lambda = 0.98$, $F(28, 17484.74) = 2.82$, $p < .001$, $\eta^2 = 0.004$.

CA: *Wilks'* $\lambda = 0.98$, $F(28, 17156.64) = 3.15$, $p < .001$, $\eta^2 = 0.01$.

CEA: *Wilks'* $\lambda = 0.99$, $F(28, 17174.66) = 1.59$, $p < .05$, $\eta^2 = 0.002$.

These findings indicate that gender and country jointly influence consumers' readiness to adopt novel food technologies. The follow-up univariate ANOVAs further identify which specific readiness measures were affected by the Gender × Country interaction for each food technology.

For GE, the interaction was significant for perceived safety, $F(7, 4852) = 6.27, p < .001, \eta^2 = 0.01$; willingness to buy, $F(7, 4852) = 3.63$, $p < .001$, $\eta^2 = 0.01$; willingness to encourage others to buy, $F(7, 4852) = 5.05, p < .001, \eta^2 = 0.01$; and support for government initiatives, $F(7, 4852) = 4.37$, $p < .001$, $\eta^2 = 0.01$. Conditional effects analyses further clarified these interactions by identifying the specific countries in which gender significantly influenced each adoption readiness dimension (Table 2). Female consumers reported lower perceived safety than males in Australia, New Zealand, Korea, and the UAE, whereas the pattern was reversed in China, where women reported higher perceived safety than men. Gender differences in willingness to buy GE foods were observed in Australia, New Zealand, and Korea, with women reporting lower intentions than men, while no significant differences emerged in Singapore, China, Viet Nam, or the UAE. Similarly, women in Australia, New Zealand, and Korea were less likely than men to encourage others to buy GE foods, whereas women in China showed a more positive effect. Finally, women in Australia, New Zealand, Korea, and the UAE expressed substantially lower support for government engagement compared to men.

A similar pattern was observed for CA, with significant Gender × Country interactions for perceived safety, $F(7, 4761) = 4.08$, $p < .001$, $\eta^2 = 0.01$; willingness to buy, $F(7, 4761) = 7.04$, $p < .001$, $\eta^2 = 0.01$; willingness to encourage others to buy, $F(7, 4761) = 7.34, p < .001, \eta^2 = 0.01$; and support for government initiatives, $F(7, 4761) = 6.93$, $p < .001$, $\eta^2 = 0.01$. Follow-up conditional effects analyses determine the countries in which gender had a significant impact on the adoption readiness of CA (Table 2). Female consumers in Australia and New Zealand reported lower perceived safety compared to males. Gender differences in willingness to buy CA products were observed in New Zealand, Australia, Japan, Korea, and Viet Nam, with women reporting lower intentions than men, whereas no significant differences emerged in Singapore, China, or the UAE. Similarly, women were less likely to encourage others to buy CA products in Australia, New Zealand, Japan, Korea, and Viet Nam, with the strongest negative effect observed in New Zealand. Finally, women in Australia, New Zealand, Japan, and Korea expressed lower support for government engagement than men.

CEA showed a more limited pattern, with significant interactions for

Table 2
Conditional interaction effects of gender and country on consumer adoption readiness of novel food technologies across countries (unstandardised *b*).

	AU	NZ	SG	CN	JP	KR	VN	UAE
GE								
Perceived safety	−7.04***	−5.75**	0.28	6.0**	−0.21	−5.80**	2.66	−5.13**
Willingness to buy	−0.30**	−0.42***	0.07	0.18	−0.04	−0.38***	−0.19	−0.12
Willingness to encourage others to buy	−7.56***	−8.68***	−0.42	4.03*	−1.34	−6.54**	1.13	−6.40**
Support for government initiatives	−8.19***	−8.36***	−3.85	3.76	−4.72*	−8.87***	−1.16	−5.01*
CA								
Perceived safety	−7.34***	−11.49***	0.16	0.03	−1.25	−1.62	−2.28	−2.23
Willingness to buy	−0.26*	−0.90***	0.04	0.08	−0.30*	−0.26*	−0.33**	0.02
Willingness to encourage others to buy	−7.18**	−17.44***	1.03	0.80	−4.97*	−5.00*	−4.2*	−0.51
Support for government initiatives	−7.24**	−17.61***	−0.99	−0.10	−9.48***	−6.23**	−2.85	−1.27
CEA								
Willingness to encourage others to buy	1.96	−4.18*	1.73	0.15	−8.12***	−3.83*	−0.63	−4.05*
Support for government initiatives	−2.41	−7.02**	−0.79	−1.31	−8.73***	−6.89***	−1.35	−5.84**

Notes: GE = Gene-editing, CA = Cellular agriculture, CEA = Controlled environment agriculture, AU = Australia, NZ = New Zealand, SG = Singapore, CN=China, JP = Japan, KR = Korea, VN=Viet Nam. UAE = United Arab Emirates; *$p < .05$, **$p < .01$, *** $p < .001$; Gender: 0 = Male, 1 = Female.

willingness to encourage others to buy, $F(7, 4766) = 3.25, p < .01, \eta^2 = 0.005$, and support for government initiatives, $F(7, 4766) = 2.60, p < .05, \eta^2 = 0.004$. Interactions were not significant for perceived safety, $F(7, 4766) = 1.50, p = .16, \eta^2 = 0.002$, and willingness to buy, $F(7, 4766) = 1.62, p = .12, \eta^2 = 0.002$. The conditional effects analyses identified the specific countries in which gender significantly influenced the adoption readiness of CEA (Table 2). Women were less likely than men to encourage others to buy CEA in New Zealand, Japan, Korea, and the UAE. Similarly, gender differences in support for government initiatives were observed in New Zealand, Japan, Korea, and the UAE, with women reporting lower support than men.

3.2.2. *Age × country interaction effects*

Multivariate analyses revealed significant interactions between age and country across all three food technologies.

GE: *Wilks*' $\lambda = 0.98$, $F(28, 17484.74) = 3.32, p < .001, \eta^2 = 0.01$.

CA: *Wilks*' $\lambda = 0.97$, $F(28, 17156.64) = 6.16, p < .001, \eta^2 = 0.01$.

CEA: *Wilks*' $\lambda = 0.99$, $F(28, 17174.66) = 2.79, p < .001, \eta^2 = 0.004$.

These findings suggest that consumers' readiness to adopt novel food technologies is jointly affected by age and country.

Follow-up univariate ANOVAs identify which specific adoption-readiness outcomes were influenced by the Age × Country interaction for each technology. For GE, the interaction reached significance for perceived safety, $F(7, 4852) = 5.74, p < .001, \eta^2 = 0.01$; willingness to buy, $F(7, 4852) = 3.96, p < .001, \eta^2 = 0.01$; willingness to encourage others to buy, $F(7, 4852) = 2.96, p < .01, \eta^2 = 0.004$; and support for government initiatives, $F(7, 4852) = 2.64, p < .05, \eta^2 = 0.004$. Conditional effects analyses clarified the countries in which age significantly influenced GE adoption readiness (Table 3). Older consumers generally reported lower perceived safety in countries, including Australia, Singapore, Japan, and Korea, whereas older consumers in Viet Nam expressed higher confidence in GE safety. Age was also a negative predictor of willingness to buy GE products, particularly in Australia, Singapore, Japan, and Korea, while no significant age differences were observed in China and the UAE. Similarly, older consumers were less likely to encourage others to buy GE products in Australia, Singapore, and Korea. The effect of age on support for government initiatives was more limited, with older individuals expressing lower support only in Australia and Korea.

For CA, significant Age × Country interactions were observed for perceived safety, $F(7, 4761) = 14.13, p < .001, \eta^2 = 0.02$; willingness to buy, $F(7, 4761) = 12.82, p < .001, \eta^2 = 0.02$; willingness to encourage others to buy, $F(7, 4761) = 10.97, p < .001, \eta^2 = 0.02$; and support for government initiatives, $F(7, 4761) = 8.82, p < .001, \eta^2 = 0.01$. In Table 3, conditional effects analyses revealed that older consumers tended to perceive CA as less safe in Australia, New Zealand, Singapore, Japan, Korea, and the UAE. China and Viet Nam were notable exceptions, where older consumers reported higher perceived safety. Age was a negative predictor of willingness to buy CA products in Australia, New Zealand, Singapore, Japan, and Korea, whereas older consumers in China were more willing to purchase these products. Age effects on willingness to encourage others to buy mirrored this pattern: older individuals in Australia, New Zealand, and Singapore were less likely to promote CA, while older respondents in China showed a positive effect. Finally, age was generally associated with lower support for government engagement in Australia, New Zealand, Singapore, and Korea, whereas in China, older individuals expressed greater support for government action.

Table 3
Conditional interaction effects of age and country on consumer adoption readiness of novel food technologies across countries (unstandardised *b*).

	AU	NZ	SG	CN	JP	KR	VN	UAE
GE								
Perceived safety	−2.0**	0.43	−2.16**	1.34	−1.44*	−1.65*	2.73***	−1.25
Willingness to buy	−0.20***	−0.10*	−0.18***	−0.03	−0.17***	−0.16***	−0.07	0.10
Willingness to encourage others to buy	−3.23***	−0.91	−1.64*	0.39	−0.89	−2.40**	0.93	−0.46
Support for government initiatives	−3.04***	0.24	−1.16	0.14	−0.19	−2.21**	−0.02	0.68
CA								
Perceived safety	−2.31**	−2.63***	−2.94***	4.42***	−1.56*	−2.76***	3.43***	−2.50*
Willingness to buy	−0.30***	−0.32***	−0.29***	0.14**	−0.10*	−0.21***	0.01	−0.08
Willingness to encourage others to buy	−4.30***	−4.05***	−3.72***	3.47***	0.87	−1.99*	1.02	−1.96
Support for government initiatives	−4.15**	−3.15***	−3.30***	2.43***	1.54	−1.92*	1.22	−0.68
CEA								
Perceived safety	3.21***	1.10	0.24	3.26***	0.27	−1.66*	3.36***	−0.18
Willingness to buy	−0.00	−0.05	−0.11**	0.06	0.03	−0.06	0.10*	−0.04
Willingness to encourage others to buy	1.27	0.27	0.14	2.96***	1.74*	−0.41	2.74***	−0.34
Support for government initiatives	1.52*	0.08	0.66	2.73***	2.70**	0.10	3.10***	0.44

Notes: GE = Gene-editing, CA = Cellular agriculture, CEA = Controlled environment agriculture, AU = Australia, NZ = New Zealand, SG = Singapore, CN=China, JP = Japan, KR = Korea, VN=Viet Nam. UAE = United Arab Emirates; *$p < .05$, **$p < .01$, *** $p < .001$.

For CEA, significant interactions were also found for perceived safety, $F(7, 4766) = 7.16$, $p < .001$, $\eta^2 = 0.01$; willingness to buy, $F(7, 4766) = 3.01$, $p < .01$, $\eta^2 = 0.004$; willingness to encourage others to buy, $F(7, 4766) = 2.93$, $p < .01$, $\eta^2 = 0.004$; and support for government initiatives, $F(7, 4766) = 2.73$, $p < .01$, $\eta^2 = 0.004$. Conditional effects analyses showed that older consumers in Australia, China, and Viet Nam reported higher perceived safety for CEA compared with younger consumers. Age effects on willingness to buy were small and varied across markets, with Singapore showing a negative association and Viet Nam a slight positive association. Older individuals in China, Japan, and Viet Nam were more likely to encourage others to buy CEA products. Similarly, support for government involvement was higher among older consumers in Australia, China, Japan, and Viet Nam.

3.2.3. Education × country interaction effects

The multivariate results demonstrated significant Education × Country interactions across each of the three food technologies.

GE: *Wilks*' $\lambda = 0.97$, $F(28, 17484.74) = 6.10$, $p < .001$, $\eta^2 = 0.01$.

CA: *Wilks*' $\lambda = 0.97$, $F(28, 17156.64) = 4.73$, $p < .001$, $\eta^2 = 0.01$.

CEA: *Wilks*' $\lambda = 0.97$, $F(28, 17174.66) = 5.28$, $p < .001$, $\eta^2 = 0.01$.

The findings imply that consumers' readiness to adopt novel food technologies is influenced by the combined effects of education and country.

Subsequent univariate ANOVAs clarify which particular adoption-readiness outcomes were affected by the Education × Country interaction across the different technologies. For GE, the interaction reached significance for perceived safety, $F(7, 4852) = 5.58$, $p < .001$, $\eta^2 = 0.01$; willingness to buy, $F(7, 4852) = 7.24$, $p < .001$, $\eta^2 = 0.01$; willingness to encourage others to buy, $F(7, 4852) = 5.67$, $p < .001$, $\eta^2 = 0.01$; and support for government initiatives, $F(7, 4852) = 5.12$, $p < .001$, $\eta^2 = 0.01$. Conditional effects analyses (Table 4) further revealed that the influence of education varied across countries. Higher educational attainment was associated with decreased perceived safety in Singapore and Korea but increased perceived safety in Viet Nam. Education effects on willingness to buy were mixed: higher education predicted greater willingness in New Zealand, Viet Nam, and the UAE, but lower willingness in Korea. Similarly, higher education increased the likelihood of encouraging others to buy GE in New Zealand and Viet Nam, while reducing it in Korea and the UAE. Finally, higher education predicted stronger support for government involvement in New Zealand and Viet Nam, but lower support in the UAE.

In terms of CA, Education × Country interactions were significant for perceived safety, $F(7, 4761) = 4.22$, $p < .001$, $\eta^2 = 0.01$; willingness to buy, $F(7, 4761) = 5.56$, $p < .001$, $\eta^2 = 0.01$; willingness to encourage others to buy, $F(7, 4761) = 3.97$, $p < .01$, $\eta^2 = 0.01$; and support for government initiatives, $F(7, 4761) = 3.63$, $p < .01$, $\eta^2 = 0.004$. In addition, conditional effects analyses showed that the influence of education varied across countries (Table 4). Higher education was associated with greater perceived safety in New Zealand but lower perceived safety in Singapore, Korea, and the UAE. Education effects on willingness to buy were positive in New Zealand, Singapore, Viet Nam, and the UAE, but negative in Korea. Higher education increased the likelihood of encouraging others to buy CA food in New Zealand and Singapore but decreased it in Korea. Finally, education positively influenced support for government involvement in New Zealand and Singapore, but higher education predicted lower support in the UAE.

CEA analyses revealed significant Education × Country interactions for perceived safety, $F(7, 4766) = 2.15$, $p < .05$, $\eta^2 = 0.003$; willingness to buy, $F(7, 4766) = 7.01$, $p < .001$, $\eta^2 = 0.01$; and willingness to encourage others to buy, $F(7, 4766) = 2.80$, $p < .01$, $\eta^2 = 0.004$. In contrast, the interaction for support for government initiatives did not reach significance, $F(7, 4766) = 1.86$, $p = .07$, $\eta^2 = 0.003$. Conditional effects analyses showed that education had varying impacts across countries (Table 4). Higher education was associated with greater perceived safety in Australia but lower perceived safety in Korea. In addition, higher education levels increase willingness to buy CEA products in Australia, New Zealand, Singapore, Viet Nam, and the UAE, while no significant effects were observed in China, Japan, or Korea. Higher education also increased the likelihood of encouraging others to buy CEA food, particularly in Australia and New Zealand. Finally, higher education generally bolstered support for government-led CEA initiatives across countries, including Australia, New Zealand, Singapore, Japan, and Korea.

Overall, these findings support hypotheses H2a–H2l, indicating that age, gender, and education consistently influenced adoption readiness across GE, CA, and CEA, with the strength and direction of these effects varying across countries.

4. Discussion

Without consumer acceptance, novel food technologies aimed at addressing critical challenges such as food security and environmental sustainability are unlikely to succeed (Siegrist & Hartmann, 2020; Van Bussel et al., 2022). This study provides a large-scale, cross-country assessment of consumer readiness for three novel food technologies including gene editing, cellular agriculture, and controlled-environment agriculture across eight countries (New Zealand, Australia, Singapore, China, Japan, South Korea, Viet Nam, and the UAE). The findings underscore that consumer readiness for novel food technologies is not a monolithic response to innovation but is instead a complex negotiation between cultural values, national priorities, and demographic identity.

Table 4

Conditional interaction effects of education and country on consumer adoption readiness of novel food technologies across countries (unstandardised *b*).

	AU	NZ	SG	CN	JP	KR	VN	UAE
GE								
Perceived safety	0.81	1.37	−4.08***	−1.33	−0.47	−3.15**	3.27**	−1.37
Willingness to buy	0.08	0.19***	0.03	0.02	−0.03	−0.14*	0.26***	0.31***
Willingness to encourage others to buy	1.83	3.08***	−0.42	−1.21	0.82	−2.67*	4.24***	−2.42*
Support for government initiatives	1.40	3.92***	0.25	−1.11	1.87	−1.93	3.58*	−1.97*
CA								
Perceived safety	0.03	2.55**	−2.22*	0.67	−0.00	−3.61***	0.44	−2.48**
Willingness to buy	0.03	0.20***	0.24***	0.09	−0.03	−0.15*	0.15*	0.23***
Willingness to encourage others to buy	1.73	3.41***	2.80*	2.12	0.86	−3.09**	1.20	−1.34
Support for government initiatives	1.52	3.29**	3.37**	0.83	1.31	−2.14	1.20	−1.81
CEA								
Perceived safety	1.92*	0.08	−1.75	0.63	−0.54	−2.31*	0.24	−0.28
Willingness to buy	0.13**	0.17***	0.29***	0.05	0.02	−0.06	0.18***	0.33***
Willingness to encourage others to buy	3.37***	2.39**	0.42	0.25	0.82	−0.23	1.66	−1.33

Notes: GE = Gene-editing, CA = Cellular agriculture, CEA = Controlled environment agriculture, AU = Australia, NZ = New Zealand, SG = Singapore, CN=China, JP = Japan, KR = Korea, VN=Viet Nam. UAE = United Arab Emirates; *$p < .05$, **$p < .01$, *** $p < .001$.

4.1. Research implications

Our findings support Hypotheses 1a–1 l, demonstrating that cultural context plays a central role in shaping consumer readiness to adopt novel food technologies. Participants in China and Viet Nam exhibited significantly higher readiness than those in the other countries studied. This heightened acceptance appears to stem from the intersection of strong government prioritisation of food technologies and hierarchical cultural structures. In both countries, novel food technologies are framed as strategic tools for enhancing food quality, production capacity, and national resilience, as reflected in China's substantial investment in GM research and Viet Nam's Master Plan for agricultural biotechnology (Cui & Shoemaker, 2018; Stone, 2008; USDA, 2022). Within these societies, decision-making tends to be centralised and authority is highly respected (Hofstede Insights, 2024; Yang & Hobbs, 2020), fostering consumer trust in government-led technological initiatives. As a result, adoption of novel food technologies is often perceived not only as a personal choice but also as a contribution to the collective good. These insights may be transferable to other hierarchical and collectivist societies, such as India and Malaysia, where trust in state-led modernisation may similarly facilitate higher consumer readiness for novel food technologies (Hofstede Insights, 2024; Kahan, 2008).

In Singapore and the United Arab Emirates, where novel food technologies are framed as a matter of national resilience, consumer readiness may be driven by strategic responses to food security constraints. For example, Singapore has positioned novel food technologies, particularly cellular agriculture, as essential solutions to limited land availability and heavy reliance on food imports (Mok et al., 2020). Similarly, the UAE's National Food Security Strategy 2051 prioritises sustainable agricultural innovation to ensure year-round access to safe and nutritious food (UAE Government Portal, 2023). These cases provide a useful proxy for other technologically advanced yet resource-constrained nations, such as Israel and Qatar, underscoring that necessity and clearly articulated national objectives are powerful drivers of consumer acceptance of novel food technologies (Cheikh Ismail et al., 2023; Kaitibie et al.).

In contrast, lower levels of readiness were observed in New Zealand and Australia, where strong agricultural traditions shape consumer perceptions. Participants in these countries demonstrated greater hesitancy toward GE and CA, likely reflecting deeply embedded cultural values that emphasise naturalness and conventional farming practices (Malavalli et al., 2021). CEA represents a notable exception, as it is often viewed as an extension of existing agricultural practices rather than a disruptive alternative (Benke & Tomkins, 2017; Gan et al., 2022). This pattern offers insight into other Western nations with influential agricultural sectors, such as Canada and France, where novel food technologies may be perceived as threats to cultural heritage and established food purity standards, resulting in lower trust and acceptance (Juhasz et al., 2024; Laureati et al., 2024).

Japan exhibited the lowest overall readiness, which can be attributed to its high level of uncertainty avoidance (Hofstede, 1983, 2024). Cultural preferences for stability, predictability, and clearly defined rules mean that substantial reassurance is required before new technologies gain public acceptance (Minkov & Hofstede, 2012; Tuorila & Hartmann, 2020). This finding has broader implications for other high uncertainty-avoidance societies, such as Greece, highlighting the importance of comprehensive, evidence-based public education and regulatory clarity prior to market introduction (Tsimitri et al., 2021).

Hypotheses 2a–2 l were also supported, revealing that consumer readiness is shaped by demographic factors, particularly gender, age, and education, in ways that vary considerably across countries. Significant gender differences emerged in Australia, New Zealand, and South Korea, where females generally reported lower perceived safety and willingness to purchase GE and CA products. This aligns with social role theory, which suggests that women tend to be more risk-averse and more attentive to health and environmental risks (Eagly et al., 2000; Rollin et al., 2011). These findings underscore the importance of targeted communication strategies in Western markets that explicitly address safety, regulation, and long-term health impacts.

Age effects were evident. In Australia, Singapore, and Japan, younger consumers generally perceived GE and CA technologies as safer. By contrast, an age inversion was observed in China and Viet Nam, where older consumers expressed higher safety perceptions and stronger support. This pattern may reflect historical experience: older cohorts in these countries have witnessed rapid technological advancement that has contributed directly to national development and food security, often following periods of scarcity (Malesky & London, 2014; Wang et al., 2023). Grounded in risk perception theory, previous studies have shown that individuals from different age groups perceive risks differently based on their life experiences and socialization (Lobb et al., 2007; Nolte & Hanoch, 2024; Slovic, 1987). These novel findings suggest that the relationship between age and novel food technology readiness is culturally contingent and shaped by collective technological trajectories rather than age alone.

Education also played a differentiated role. Higher educational attainment was associated with more favourable perceptions of GE and CA in New Zealand and Viet Nam, potentially due to greater scientific literacy (Mohr et al., 2007). In contrast, in South Korea, more highly educated respondents reported lower safety perceptions, suggesting that increased knowledge may heighten awareness of potential risks and foster scepticism (Siddiqui et al., 2022). These divergent patterns indicate that the influence of education is strongly moderated by national contexts, including public discourse, media framing, and institutional trust.

4.2. Practical implications

This study provides valuable, context-specific guidance for policymakers and marketers. In countries characterised by strong government leadership and high public trust in state institutions, such as China and Viet Nam, policymakers can embed novel food technologies within official national strategies, explicitly linking them to food safety and sustainability, thereby building upon the high existing institutional trust. Marketing efforts can frame technological advancement as a source of national progress, highlighting local success stories that demonstrate positive outcomes (Cui & Shoemaker, 2018; Zhang et al., 2020).

In resource-constrained countries, such as the UAE and Singapore, as well as comparable nations like Israel, a solution-oriented approach is likely to be most effective. Policymakers should maintain a clear and visible link between novel food technologies adoption and national resilience, while marketing communications emphasise the capacity of these technologies to support high-quality local production, reduce import dependence, and enhance sustainability (Basarir & Dayan, 2022).

For markets characterised by scepticism, strong agricultural heritage, or high-risk aversion, including Australia, New Zealand, and Japan, an incremental and transparency-focused strategy is essential. In high uncertainty-avoidance societies (e.g., Japan and Greece), clear, stringent, and long-term regulatory oversight is critical to building consumer confidence. Educational initiatives delivered through trusted independent institutions should directly address misconceptions using robust evidence (Shigi & Seo, 2023). In countries with strong agricultural identities (e.g., Australia, New Zealand, and Canada), messaging should shift from notions of disruption toward “precision agriculture,” emphasising how technologies such as GE can complement and protect traditional farming systems in the face of climate risks rather than replace them (Benke & Tomkins, 2017).

Finally, demographic differences necessitate tailored engagement strategies. The higher levels of risk aversion observed among females in countries such as Australia and New Zealand underscore the importance of communication that directly addresses health, safety, and regulatory assurances (Rollin et al., 2011). In addition, variation in age-related acceptance highlights the need for segmented outreach. Clear, accessible, and benefit-focused messaging may be more effective for engaging older consumers in countries such as Australia and Singapore, whereas digital platforms and social media are better suited to reaching younger audiences, particularly in China and Viet Nam (Torri et al., 2020; Wang et al., 2023). Education also warrants attention, as higher education is linked to greater scepticism in South Korea. Public awareness campaigns should aim to address misconceptions to build trust and acceptance (Mohr et al., 2007). However, lower education corresponds with lower acceptance of CEA in countries such as New Zealand and Australia, highlighting the need to understand the factors underlying their hesitation.

4.3. Limitations

Whilst comprehensive, this study has several limitations. First, the countries included were purposively selected to capture variation in regulatory environments, food-security contexts, and technological development rather than to provide a statistically representative global sample. Accordingly, findings should not be generalized beyond the countries examined, nor do they capture within-country heterogeneity in attitudes toward novel food technologies.

Relatedly, because the country set was purposively selected rather than randomly sampled and shaped in part by pragmatic considerations such as data availability and comparability, hypotheses regarding cross-country differences should be interpreted as comparative expectations within this theoretically motivated set of contexts rather than as universal claims, rendering the analyses partially exploratory rather than fully confirmatory.

Second, participants identifying as 'gender-diverse' or selecting 'other' for education were excluded due to small, unrepresentative sample sizes. While necessary for statistical validity, this limits generalizability, and future research should include larger samples of these groups to better capture their perspectives.

Third, although the study focuses on key demographic characteristics, future research could incorporate additional micro- and macro-level factors (e.g., values, institutional trust, media exposure), with cultural context treated as a boundary condition.

Fourth, while the large-scale quantitative design enables systematic cross-country comparison, it cannot fully explain why consumers accept or reject novel food technologies; qualitative approaches could provide deeper insight into underlying motivations.

5. Conclusion

This study underscores the importance of both cultural and demographic factors in shaping consumer readiness for novel food technologies across diverse global contexts. The findings demonstrate that consumer acceptance is a dynamic process influenced by macro-level cultural values such as such as societal norms, trust in institutions, and collective attitudes toward innovation as well as micro-level individual characteristics such as age and gender. Enhancing adoption thus requires a clear understanding of these differences, rather than relying on a universal approach. By addressing the distinct perceptions and concerns of different groups within each cultural setting, policymakers, industry leaders, and communicators can develop more targeted, relevant, and effective engagement strategies.

CRediT authorship contribution statement

Brian Lin: Writing – original draft, Validation, Project administration, Investigation, Formal analysis, Data curation. **Denise Conroy:** Writing – original draft, Validation, Project administration, Conceptualization. **Amy Errmann:** Writing – original draft, Formal analysis, Data curation, Conceptualization. **Hugo Fahn:** Writing – original draft, Project administration.

Ethics statement

This research was conducted in accordance with ethical guidelines and was approved by the Plant and Food Research Human Ethics Committee. All participants provided informed consent prior to their involvement in the study.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodqual.2026.105897.

Data availability

The authors do not have permission to share data.

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