Introduction

In the updated Wasted Food Scale, the U.S. Environmental Protection Agency (EPA) lists "upcycling" as one of the most preferred food waste management pathways, as it prioritizes using food for its intended purpose: to nourish people (EPA, 2023). Upcycled food refers to value-added food products intended for human consumption, created by reintegrating ingredients that would otherwise be discarded into the food production chain (Aschemann-Witzel & Peschel, 2019; Aschemann-Witzel et al., 2023). With growing recognition of upcycling as a circular solution at the federal level, this emerging area holds significant potential to transform the agri-food system. One of the common challenges in introducing innovative agri-food products to the market is that consumers do not necessarily perceive these novel foods as positively as scientists do (Klerck & Sweeney, 2007; Siegrist & Hartmann, 2020). These discrepancies can be attributed to differences in evaluative approaches when assessing the risks of novel food products (Hansen et al., 2003; Ho et al., 2023). Consumers' risk assessments are typically complex and often lack scientific expertise, relying on simple cues and heuristics (Siegrist & Hartmann, 2020; Slovic et al., 2004). As a result, consumers may develop excessive apprehension, doubts, and skepticism, leading to a heightened sense of unease about food-related risks compared to experts (Bearth & Siegrist, 2019; Cattaneo et al., 2019). Studies across various novel food products confirmed that perceived risk negatively affects consumer attitudes (Bearth et al., 2014; Klerck & Sweeney, 2007). Thus, the purpose of present study is to understand how risk perception, as a key psychological determinant, shapes consumer attitudes toward upcycled food products.

A meta-analysis on innovative food technologies found considerable variability in the correlation between risk perception and acceptance (Bearth & Siegrist, 2016). The authors suggested that future research should focus on identifying proximal and peripheral factors contributing to this variability. Given the limited research on moderators of attitudes toward upcycled food, uncovering the variables that moderate the association between perceived risk and attitude is critically important. Such insights can explain the underlying cognitive mechanisms through which perceived risk influences consumer attitudes toward novel food and inform marketing and communication strategies and help predict consumer responses to innovative food products (Bearth & Siegrist, 2016).

To explore the moderators, the present study applies the Heuristic-Systematic Model (HSM; Chaiken et al., 1989) as a theoretical framework. The HSM proposes that attitude formation is influenced by the way individuals process information about an object and identifies two distinct modes of judgment: heuristic and systematic. Prior research confirms that both heuristic and systematic processing affect how individuals perceive risk (Trumbo, 2002), and these two processing modes also directly shape attitudes toward innovative foods (Kim & Paek, 2009). Thus, the interaction between risk perception and cognitive processing could influence attitudes toward upcycled food. On the one hand, due to knowledge deficits, lay consumers often rely on simple heuristics when evaluating emerging food products. This less cognitively

effortless approach can lead to reasonably accurate judgments in low-predictability scenarios (Gigerenzer & Gaissmaier, 2011; Slovic et al., 2004). On the other hand, systematic processing, which involves critical evaluation of information, is associated with greater knowledge and understanding (Kim & Paek, 2009). As consumers accumulate knowledge about novel food technologies, negative attitudes may diminish over time (Qin & Brown, 2006). Despite the relevance of the HSM, few studies have applied it to examine potential moderators in the relationship between perceived risk and consumer attitudes toward novel food technologies. To address this gap, the present study poses the following research questions:

1. How do perceived risks influence consumers' attitudes toward upcycled food?
2. How do heuristic and systematic cognitive factors moderate the relationship between perceived risk and attitudes toward upcycled food?

Literature Review

Perceived Risk and Attitude toward Novel Food

Perceived risk refers to individuals' general perception of potential hazards and is a crucial factor in shaping the acceptability of innovative foods (Siegrist and Hartmann, 2020; Sodano et al., 2016). Compared to other applications of emerging technologies for non-food purposes, food-related applications are typically perceived as riskier (Siegrist et al., 2008). Prior studies indicate that consumers' perceived risks, such as concerns about food safety, quality, and taste, reduce acceptance of innovative food products, including genetically modified foods (Klerck & Sweeney, 2007), artificial food additives (Bearth et al., 2014), irradiated foods (Bearth & Siegrist, 2019), and foods made with upcycled ingredients (Combest & Warren, 2022).

In the context of upcycled food, a study conducted across five European countries revealed that some consumers associate the term "upcycled food" with unfamiliarity, indifference, skepticism, and even aversion (Altintzoglou et al., 2021). For instance, the processing stages required to extract beneficial substances from byproducts or imperfect foods can evoke worries about over-processing and negative associations with "leftovers" or "waste," which may further heighten perceived risk (Moshtaghian et al., 2023). In addition, a lack of direct experience with consuming such products could be another source of risk perceptions in adopting upcycled food (Matthews, 2025). Accordingly, we propose the following hypothesis:

H1. Perceived risk has a negative effect on consumer attitudes toward upcycled food.

Perceived Benefit and Attitude toward Novel Food

Consumers' acceptance of innovative food products is often influenced by perceived benefits related to health, the environment, and the economy (Parrella et al., 2023; Siegrist & Hartmann, 2020). With regard to upcycled food, perceived benefits generally fall into two

categories: self-interested benefits, such as nutritional value and health improvements; and other-interested benefits, such as sustainability and food waste reduction (Asioli & Grasso, 2021; Grasso et al., 2023). Moshtaghian et al. (2023) found that ethical concern for ecological welfare was the most important factor motivating upcycled food choices. Studies on foods containing upcycled ingredients have shown that participants who are informed about the health and environmental benefits of these sustainable products report more positive attitudes than those who do not receive such information (Altintzoglou et al., 2021). Therefore, consumers are more likely to develop a preference for upcycled foods when they confidently perceive the value and benefits (Yilmaz & Kahveci, 2022). Accordingly, we propose the following hypothesis:

H2. Perceived benefit has a positive effect on the consumer attitudes toward upcycled food.

Systematic Processing Factor: Subjective Knowledge of Upcycled Food

Knowledge directly or indirectly shapes beliefs, values, and attitudes, enabling consumers to make informed decisions through systematic thinking (Chaihanchanchai & Anantachart, 2022). In consumer knowledge constructs, subjective knowledge refers to an individual's perception of the amount of information about a product category stored in memory (Park et al., 1994). This is generally easier to measure with reasonable accuracy than objective knowledge. It is typically what consumers think they know, rather than what they actually know, that guides their choices (Essiz et al., 2023). Higher levels of subjective knowledge are often associated with greater acceptance of new food products (Aertsens et al., 2011; Chaihanchanchai & Anantachart, 2022; Parrella et al., 2024). Providing information about the characteristics of upcycled ingredients can help reduce consumer wariness (Perito et al., 2019). In a study on food made with upcycled seafood byproducts, knowledge had a cumulative positive effect on participants' intent to try the product (Murillo et al., 2023). Accordingly, we propose the following hypothesis:

H3a. Subjective knowledge of upcycled food has a positive effect on the consumer attitudes toward upcycled food.

Consumers assess and take risks based on their knowledge, which can be either objective or subjective (Essiz et al., 2023; Saari et al., 2021). This distinction is important because objective knowledge and subjective knowledge influence information processing differently. Objective knowledge tends to reduce perceived risks, while subjective knowledge has not been shown to have a significant direct effect (Klerck & Sweeney, 2007). However, studies on green consumption found that consumers with higher levels of subjective knowledge often exhibit greater alignment between their values and behaviors, largely due to increased self-confidence in decision-making (Chaihanchanchai & Anantachart, 2022; Essiz et al., 2023). In other words, individuals with stronger subjective knowledge are better equipped to process risk-related information and are less susceptible to these messages. Based on this reasoning, subjective

knowledge may serve as a positive moderator in the relationship between perceived risk and attitude toward upcycled food. Accordingly, we propose the following hypothesis:

H3b. Subjective knowledge of upcycled food positively moderates the relationship between perceived risk and attitude toward upcycled food.

Systematic Cognitive Factor: Subjective Knowledge of Food Waste

In contrast to subjective knowledge of upcycled food, which reflects consumers' perceived familiarity and understanding of the product itself, subjective knowledge of food waste concerns individual's self-assessed understanding of the broader environmental problems underlying such innovations. Sufficient knowledge of environmental issues enables consumers to recognize the urgency for action and fosters more positive attitudes toward innovative sustainable food alternatives (Altintzoglou et al., 2021). Such knowledge has also been shown to promote sustainable consumption behavior (Saari et al., 2021). Individuals with greater knowledge of food waste are also more likely to engage in waste reduction behaviors (Principato et al., 2015). Similarly, as a promising solution to reducing food waste in the production and processing stages, upcycled food is more likely to be valued by individuals who perceive themselves as knowledgeable about the current food waste challenges in the sector (Hellali & Korai, 2023). Accordingly, we propose the following hypothesis:

H4a. Subjective knowledge of food waste has a positive effect on the consumer attitudes toward upcycled food.

Individuals with higher levels of subjective knowledge are more inclined toward systematic processing and tend to form risk-related perceptions, attitudes, and behaviors that are more stable and consistent over time (Griffin et al., 1999). Prior research further shows that subjective knowledge of environmental issues can strengthen the effect of green purchase attitudes on behavior, serving as a positive cognitive moderator (Chaihanchanchai & Anantachart, 2022). Given that individuals with greater subjective knowledge of food waste issues are more aware of the contribution of upcycled food to waste reduction and are therefore better equipped to contextualize risk-related information, the negative effect of perceived risk on attitudes toward upcycled food is expected to be weaker among consumers who are more knowledgeable about food waste. Accordingly, we propose the following hypothesis:

H4b. Subjective knowledge of food waste positively moderates the relationship between perceived risk and attitude toward upcycled food.

Heuristic Cognitive Factor: Social Consumption Motivation

Social consumption motivation refers to a type of purchase motivation driven by consumers' perceptions of the image associated with a food product and the image of those who consume it (Fitzmaurice & Comegys, 2006). Individuals with high social consumption

motivation pay greater attention to the symbolic social meanings attached to their purchases (Moschis, 1981). As consumers have become increasingly aware of the ethical and environmental implications of their private consumption (Prendergast & Tsang, 2019; Webster, 1975), social consumption motivation has emerged as a key driver for establishing a pro-environmental or sustainable self-identity through sustainable consumption choices (Dermody et al., 2015; Lavuri et al., 2023). Consequently, sustainable products are likely to elicit positive evaluations among socially motivated consumers (Lavuri et al., 2023). Moreover, with limited knowledge about an emerging food product like upcycled food, consumers are more likely to rely on social consumption motivation as a heuristic processing factor in forming initial attitudes. Accordingly, we propose the following hypothesis:

H5a. Social consumption motivation has a positive effect on the consumer attitudes toward upcycled food.

Attitudes toward pro-environmental food consumption may involve a tension between social normative motivations and perceived risk, as individuals' desire to signal socially valued pro-environmental commitment usually coexist with concerns about potential personal risks. Prior research has documented similar tensions. For example, Visschers et al. (2016) found in consumer attitudes toward food waste: personal norms opposing food waste often conflicted with concerns about the health risks of consuming leftovers. This tension implies that social consumption motivation may serve as a countervailing driver, mitigating the negative effect of perceived risk on attitudes. In other words, in acceptance of upcycled food, consumers with strong social consumption motivation may be more inclined to tolerate or downplay perceived risks to uphold a desirable social image or moral identity, resulting in more favorable attitudes. However, research examining this moderating effect remains limited. To address this gap, we propose the following hypothesis:

H5b. Social consumption motivation positively moderates the relationship between perceived risk and attitude toward upcycled food.

Heuristic Cognitive Factor: Trust in Food Producers

In situations where individuals lack the knowledge needed to assess the benefits and risks of food innovations and where the complexity of novel technologies hinders information processing, the trust heuristic becomes especially important (Lusk et al., 2014; Siegrist et al., 2007; Siegrist & Hartmann, 2020). Numerous studies have confirmed the direct influence of various forms of social trust (e.g., farmers, agricultural companies, public research and institution, the agri-food industry, and food retailers) on consumers' acceptance of novel food products (Parrella et al., 2024; Siegrist et al., 2008; Sodano et al., 2016). Among these, trust in food producers has been frequently investigated. It reflects the degree to which individuals trust the food producers, which are key actors in the food production system. Consumers form overall trust based on perceptions of producers' competence, reliability, and integrity. A study on food

products made with upcycled seafood byproducts found that consumers who trust food producers are less skeptical of such novel products (Altintzoglou et al., 2021). Accordingly, we propose the following hypothesis:

H6a. Trust in food producers has a positive effect on the consumer attitudes toward upcycled food.

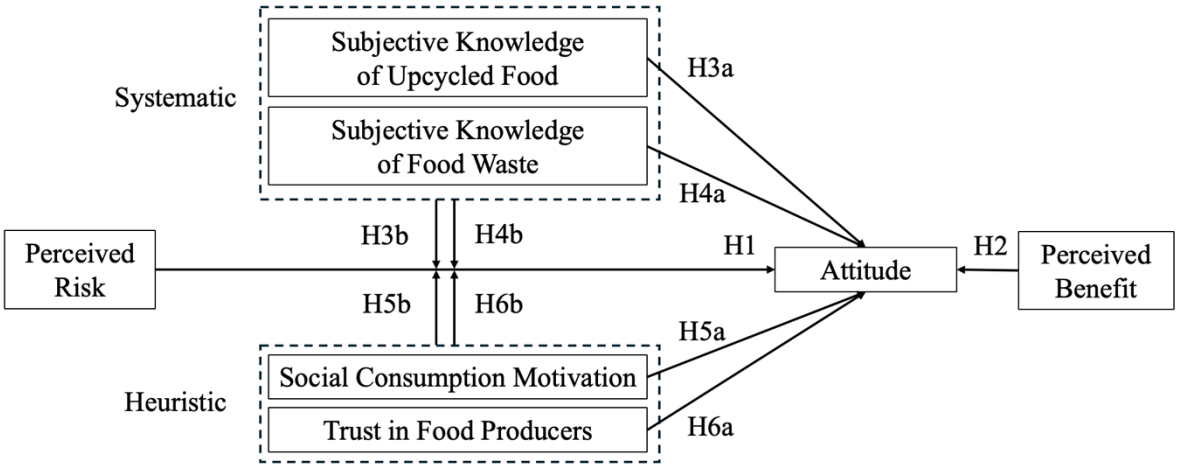
Trust influences risk perceptions of novel food technologies, particularly when consumers lack relevant information about potential hazards and have limited direct experience (Banovic & Grunert, 2023; Siegrist & Cvetkovich, 2000; Siegrist & Hartmann, 2020). A recent study on precision fermentation technology found that trust in food manufacturers negatively affects consumer skepticism toward this novel technology (Banovic & Grunert, 2023). Thus, consumers who exhibit a high level of trust in food producers may be less influenced by perceived risk when forming attitudes toward upcycled food. Accordingly, we propose the following hypothesis:

H6b. Trust in food producers positively moderates the relationship between perceived risk and attitude toward upcycled food.

Based on the hypotheses above, a conceptual framework was developed (see Figure 1).

Figure 1

The Proposed Theoretical Model



Method

Stimulus Product

The specific characteristics of a novel food product play a critical role in determining its eventual market acceptance (Bryant & Barnett, 2020). Therefore, the present study specifically examines an emerging upcycled food product: milk enriched with peanut skins. The U.S. peanut industry discards an estimated 40 to 70 million pounds annually (USDA, 2022), while peanut skins are rich in polyphenols, a type of antioxidant known for various health benefits, such as improved gut health, reduced risk of heart disease, and protecting against oxidative stress and inflammation (Çiftçi & Suna, 2022). Recently, food scientists have applied a cost-effective, pH-driven extraction approach to obtain bioactive compounds from peanut skins and encapsulate them into milk (Csuti et al., 2023; Gong et al., 2024). This food product not only offers consumers added-nutrition in their daily dairy intake but also contributes to a circular economy by reducing food loss in the agri-food production system.

Data Collection

This study received approval for data collection from the Institutional Review Board at the University of Georgia (PROJECT00009202), and all participants consented to participate. Data was collected between April 26, 2024, and May 7, 2024, using Qualtrics, a data collection company. We employed a quota sampling approach to match the U.S. Census population in terms of age, gender, and region (U.S. Census Bureau, n.d.). We conducted standard quality control measures in Qualtrics to ensure data reliability. In total, 1,488 responses were collected. Participants who reported allergies to dairy products were excluded, as they were not the target population for milk consumption. The final sample included 1,261 participants. Participants ranged in age from 18 to 34 (27.36%), 35 to 54 (32.43%), and 55 or above (40.21%). The sample comprised 51.47% female participants. Geographically, respondents were distributed across the Northeast (16.02%), Midwest (21.17%), South (39.49%), and West (23.31%).

Measurement

Given the novelty of the upcycled food concept, we provided a 150-word introduction explaining upcycled food and milk enriched with upcycled peanut skins at the beginning of the questionnaire to establish a clear context for the subsequent items. We developed the measurement based on prior published studies and adapted it to fit the context of our research. To ensure content validity, a panel of experts in the field of consumer acceptance of upcycled foods reviewed the questionnaire. According to their feedback, a few revisions were made. All items were measured on a 7-point Likert scale or 7-point semantic differential scale. We calculated Cronbach's alpha coefficients of each scale, all of which exceeded 0.80, indicating strong internal consistency.

Attitude Toward Upcycled Food

Adapted from McCroskey (2006), respondents were asked to select the option that best describes their attitudes toward using milk with upcycled peanut skins: Bad (1) to Good (7), Wrong (1) to Right (7), Harmful (1) to Beneficial (7), Foolish (1) to Wise (7), and Negative (1) to Positive (7) (Cronbach's α = 0.89). Higher value indicates more positive attitude.

Perceived Risk

We constructed a three-item scale: "I have concerns about the safety of such milk product," "I worry that such milk product has lower quality than milk without upcycled ingredients," and "I am concerned that such milk product might have an unusual taste" (α = 0.81).

Perceived Benefit

We constructed a five-item scale: "Milk with upcycled peanut skins is a sustainable choice," "Milk with upcycled peanut skins can help reduce food waste," "Milk with upcycled peanut skins is nutritious," "Milk with upcycled peanut skins can lower my carbon footprint," and "Milk with upcycled peanut skins can reduce food insecurity" (α = 0.92).

Subjective Knowledge about Upcycled Food

This measure was adapted from Altintzoglou et al. (2021) and consisted of a three-item scale: "I feel that I know a lot about upcycled food," "Compared to my friends, I know a lot about upcycled food," and "Compared to experts, I know a lot about upcycled food" (α = 0.84).

Subjective Knowledge about Food Waste

Similarly, this measure consisted of the adapted three-item scale (Altintzoglou et al, 2021). Sample items included "I feel that I know a lot about food waste reduction" (α = 0.83).

Social Consumption Motivation

Adapted from Altintzoglou et al. (2021), we asked respondents with a four-item scale to indicate what is important for them to know before buy a food product. Example items read: "What others think about the different products," and "What kinds of people buy these products" (α = 0.91).

Trust in Food Producers

We modified a six-item scale (Altintzoglou et al., 2021). Example items included, "Food producers can generally be trusted," and "I have great confidence in food producers" (α = 0.97).

Data Analysis

To answer hypotheses of direct effect, we conducted the linear regression analysis using SPSS 27, with attitude toward milk enriched with peanut skins as the dependent variable. This approach allowed for the examination of the individual and combined contributions of independent variables, while controlling for demographic variables. In addition, we conducted moderation analyses using the PROCESS macro (version 4.2, Model 1) in SPSS, with 5,000 bootstrap samples and 95% confidence intervals to test whether key cognitive factors moderate the effect of perceived risk on attitudes toward upcycled food.

Results

Descriptive Results

Participants held a slightly positive attitude toward milk with upcycled peanut skins (M = 4.74, SD = 1.52). Their perception of risk (M = 4.46, SD = 1.37) and benefit (M = 4.89, SD = 1.24) were both at a moderate level. Participants reported low levels of subjective knowledge of upcycled foods (M = 2.79, SD = 1.48) and food waste issues (M = 3.30, SD = 1.45). They were less likely to be motivated by social symbolic role of food consumption (M = 3.05, SD = 1.16) and had a neutral level of trust in food producers (M = 4.01, SD = 1.35).

Multiple Linear Regression Analysis

Table 1 presents the results of the linear regression analysis. Perceived risk negatively predicted attitude (β = –.33, p < .001), supporting H1. Perceived benefit positively predicted attitude (β = .68, p < .001), supporting H2. Subjective knowledge of upcycled food also positively predicted attitude (β = .06, p = .036), supporting H3a. In addition, age had a significant negative effect on attitude as well (β = –.01, p = .001). However, the association between subjective knowledge of food waste and attitude was not significant (β = .02, p = .50); therefore, H4a was not supported. Similarly, neither social consumption motivation (β = .01, p = .83) nor trust in food producers (β = .04, p = .076) predicted attitude, and thus, H5a and H6a were not supported.

Moderation Effect Analysis

Results indicated that the association between perceived risk and attitude was significantly positively moderated by subjective knowledge of upcycled food (b = .10, p < .001, LLCI = .07, ULCI = .14), supporting H3b. Similarly, subjective knowledge of food waste significantly moderated this relationship (b = .08, p < .001, LLCI = .04, ULCI = .12), supporting H4b. Social consumption motivation also played a positive moderating role (b = .14, p < .001,

LLCI = .10, ULCI = .18), supporting H5b. Finally, trust in food producers was a significant positive moderator (b = .05, p = .003, LLCI = .02, ULCI = .08), supporting H6b.

Table 1

Coefficients from the Regression Models (Predictors of Attitude)

	Attitude Toward Upcycled Food		
Predictors	*B*	*t*	*p*
Intercept	2.94	12.58	< .001
Age	-.01	-3.22	.001
Male (dummy-coded)	-.15	-1.56	.12
Others (dummy-coded)	.29	1.53	.13
Education (dummy-coded)	.03	.95	.34
Perceived Risk	-.33	-14.59	< .001
Perceived Benefit	.68	25.98	< .001
Subjective Knowledge about Upcycled Food	.06	2.10	.04
Subjective Knowledge about Food Waste	.02	.67	.50
Social Consumption Motivation	.01	.211	.83
Trust in food producers	.043	1.77	.08
R^2		.52	
F Change		135.83***	

Note. Categorical variables were dummy coded. The reference group for gender was female and education was some college. *** $p < .001$.

Discussion

Participants in the study expressed slightly positive attitudes toward upcycled food, aligning with previous findings of general receptivity but persistent uncertainty surrounding this emerging category (Altintzoglou et al., 2021; Cattaneo et al., 2019; Grasso et al., 2023). The negative predictor role of age is consistent with previous research that younger consumers tend to exhibit lower levels of food neophobia, express more positive attitudes, and are more open to consuming upcycled foods (Aschemann-Witzel et al., 2022; Yilmaz & Kahveci, 2022). Therefore, early marketing efforts should prioritize younger segments to foster adoption of upcycled food. In line with previous research on novel circular food products (Sodano et al., 2016; Bearth & Siegrist, 2019; Banovic & Grunert, 2023), perceived benefit enhanced attitudes toward upcycled food whereas perceived risk hindered them. Regarding milk with added nutrients from peanut skins, food safety may be a primary concern, as peanuts are a common allergen. However, it is typically specific proteins that trigger allergic reactions (Çiftçi & Suna, 2022), rather than the polyphenols extracted from peanut skins, which should be noted in communication strategies to address consumers' potential concerns.

For novel food products and technologies, consumers often "perceive the benefits as accruing to society, but the risks accruing to themselves" (Bryant & Barnett, 2020). It is noteworthy that perceived benefit of upcycled food outweighs perceived risk in both the mean scores and effect sizes on attitude. This pattern aligns with previous qualitative studies showing that positive themes dominate in consumers' mixed associations with the term "upcycled food" (Altintzoglou et al., 2021; Aschemann-Witzel et al., 2023; Grasso et al., 2023) and with broader evidence that benefit perceptions generally exert greater influence than risk perceptions on acceptance of novel foods (Bearth & Siegrist, 2016; Siegrist et al., 2007). The present findings highlight the comparatively favorable benefit–risk profile of upcycled food. This benefit-dominant structure presents a strategic opportunity: communication emphasizing the environmental and resource-efficiency advantages of upcycling may resonate more strongly with consumers than messages attempting to mitigate concerns alone.

A central contribution of this study lies in demonstrating the multifaceted role of subjective knowledge. Subjective knowledge of upcycled food had both a direct effect on attitude and a moderating effect that reduced the influence of perceived risk. In contrast to the mixed relationship between knowledge and attitudes observed in the context of genetically modified foods (Christoph et al., 2008), the positive effect identified in this study suggests a clearer pattern for upcycled foods. This moderating effect may be attributed to differences in information processing styles of risk perception (Hansen et al., 2003; Ho et al., 2023; Siegrist & Hartmann, 2020). Lay consumers, who often lack scientific information, tend to rely on heuristics and are more sensitive to potential risks. In contrast, well-informed individuals are more likely to engage in systematic processing and accept known risks as reasonable trade-offs for recognized benefits. Taken together, given the novelty of the term "upcycling technology" among consumers (Grasso et al., 2023), educational communication is essential for fostering broader market acceptance and to prevent the escalation of fears or rejection of this food technology resulting from a lack of understanding (Bearth & Siegrist, 2016; Sodano et al., 2016).

In contrast, subjective knowledge of food waste did not directly predict attitudes toward upcycled food. This non-effect aligns with previous studies indicating that environmental concern does not consistently predict consumers' attitudes toward sustainable foods in some cases (Parrella et al., 2023; Vega-Zamora et al., 2014). Food waste remains an undervalued issue for many consumers who have limited knowledge of it and a lack of perceived urgency surrounding the issue (Richter, 2017). Consequently, mere knowledge of food waste may not translate into positive evaluations of upcycled solutions. However, this knowledge dimension moderated the negative effect of perceived risk. Individuals who perceived themselves as well-informed about food waste were less negatively affected by risk perceptions. This finding suggests that contextual understanding of food waste challenges can stabilize attitudes when faced with risks associated with upcycled foods. This moderating role underscores the value of broader education efforts around food waste led by Extension services and nonprofits in buffering the effect of perceived risk.

The association between social consumption motivation and attitude was not statistically significant, indicating that a strong motivation to signal social identity does not directly translate into more positive evaluations of upcycled food. This may reflect the current ambiguity of social symbolic value and associated norms surrounding upcycled food. Prior studies have found significant associations between social consumption motivation and positive attitudes in the context of the more established general sustainability concept (Lavuri et al., 2023). These better-known domains carry clearer and more widely recognized symbolic meanings, while the social function of upcycled food in expressing a pro-environmental identity has not yet been firmly established in the U.S. market. Notwithstanding the absence of a direct effect, social consumption motivation demonstrated the strongest moderating effect among all moderators examined in this study. For consumers who place a high value on social image, perceived risk exerted a substantially weaker negative influence on attitude. This finding has important implications for communication strategies that market messages highlighting the environmental and socially responsible image of upcycled food may be particularly persuasive for individuals motivated by identity signaling (Fernandes & Saraiva, 2022). In addition, this finding suggests that beyond the widely studied construct of subjective norms, which reflects the influence of important others on individual behavior (Parrella et al., 2023), social consumption motivation is another important social-contextual variable that shapes attitudes toward novel food technologies.

Although trust in food producers did not directly predict attitudes, which is contrary to previous research in other food domains (Banovic & Grunert, 2023; Siegrist et al., 2008), it significantly moderated the effect of perceived risk. Participants present a neutral level of trust in food producers. Such undecided trust may be psychologically insufficient to directly shape favorable attitudes. Another possible explanation is the perceived distance between producers and consumers, with consumers tending to place more trust in food retailers than in food producers whom they know less (Ladwein & Sánchez Romero, 2021). Nevertheless, trust in food producers served as an important heuristic cue that reduced the negative effects of perceived risk and facilitated acceptance of upcycled food products. This finding supports the idea that trust in food producer, as a risk-attenuating factor, may play a more regulatory than generative role in shaping consumer evaluations.

Limitations and Future Research

This study has several limitations. First, although the sample reflects U.S. census demographics, the findings may not be generalizable to global consumer attitudes. For instance, social consumption motivation differs across cultural contexts. Prior research has shown that levels of motivation for socially symbolic food choices vary between developed and emerging economies (Dermody et al., 2015). Future studies should examine cultural differences more closely to better inform context-specific communication strategies about upcycled food. Second,

we introduced upcycled food to participants solely through a written description, without exposure to visual or taste cues. Because of limited firsthand experience of upcycled food products among consumers, the attitudes assessed in this study were largely based on abstract perceptions. Trial consumption is critical in shaping final attitudes, as it offers a more comprehensive sensory experience (Combest & Warren, 2022). Future research should include sensory evaluations to provide more robust conclusions on consumer attitudes. Third, as the upcycled food market is still in the early stages of consumer familiarity, the cross-sectional design of this study captures consumer attitudes only at a single point in time. It is essential to explore how attitudes evolve as the market develops. Future research should adopt a longitudinal approach to better capture the dynamics of consumer attitudes and provide understandings that reflect temporal changes and market progression.

Conclusion

The present study advances understanding of consumer attitudes toward upcycled food by demonstrating that the negative impact of perceived risk is not uniform but can be attenuated through distinct cognitive processing routes. Drawing on the Heuristic–Systematic Model, the findings show that both systematic cognitive factors (subjective knowledge of upcycled food and food waste) and heuristic cues (social consumption motivation and trust in food producers) serve as moderating mechanisms that buffer the adverse effect of perceived risk on attitudes. By explicitly distinguishing between heuristic and systematic mechanisms, this study highlights how different forms of information processing shape consumers' responses to risk. These insights provide a more nuanced understanding of attitude formation and offer actionable guidance for communication strategies aimed at reducing perceived risk and supporting the development of the upcycled food market.

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