Journal of
Theoretical and Applied Electronic Commerce Research

MDPI

Article

From Field to Screen: How Live-Streaming Backgrounds and Product Processing Levels Shape Purchase Intentions for Agricultural Products

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Abstract

This research investigates the interactive influence of live-streaming background design and food processing levels on consumer behavior. Our findings reveal that for minimally processed agricultural products, an origin-based background (e.g., broadcasting directly from a farm) significantly enhances purchase intention compared to a standard studio background. We demonstrate that this effect is driven by a heightened perception of freshness. Conversely, for highly processed agricultural goods, the influence of background type is attenuated. Furthermore, we identify rural sentiment as a critical boundary condition, revealing that the positive effect of origin-based backgrounds is amplified among consumers with stronger emotional ties to rural life. These results offer nuanced insights into how digital broadcasting environments can be strategically aligned with product characteristics to optimize marketing outcomes.

Keywords: live-streaming background; agricultural food products; perceived freshness; rural sentiment

1. Introduction

Digital technologies and consumption patterns are increasingly converging. Consequently, live-streaming e-commerce has become a key catalyst for rural revitalization and transforming agricultural food sales models [1,2]. The 2024 Harvest Festival TikTok E-commerce Agricultural Aid Report [3] highlights this significant impact. Specifically, live-streaming facilitated over 7.1 billion agricultural transactions. This model boosts consumer understanding and trust in agricultural products. It offers real-time visualization of the entire production process, from cultivation to harvesting and processing [4,5]. Prior research has predominantly adopted a streamer-centric lens. Studies explore how streamer characteristics (e.g., influence, promotion tactics, and interactive style) [5] and technical features (e.g., visual guidance tools) [6] impact live-streaming effectiveness. However, the live-streaming background remains under-explored. As a significant visual element [7], it occupies substantial screen space and conveys critical contextual food-related information. Further, the literature has not addressed a key issue. It is unclear how to strategically link live-streaming backgrounds to specific agricultural products to optimize effectiveness. This research addresses this identified gap. We intend to explore optimizing live-streaming

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Academic Editors: Xianghui Peng, Chao Wen and Jiaming Fang

Received: 19 March 2026
Revised: 17 April 2026
Accepted: 27 April 2026
Published: 29 April 2026

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backgrounds to align with different levels of product processing. We also examine how this alignment influences consumer responses in agricultural e-commerce.

The live-streaming background serves as a visual cue [7,8]. It captures consumer attention and shapes purchase intentions by evoking cognitive or emotional responses [9]. This observation is particularly pertinent to agricultural products. Consumers inherently associate a product's origin with its production environment [10]. In online live-streaming, consumers lack a tangible consumption environment. They cannot directly interact physically with the products. Consequently, consumers rely heavily on visual and contextual live-stream cues to deduce product information. For agricultural goods, origin-based backgrounds signal freshness, authenticity, and traceability [11,12]. Based on this argument, we posit that the effectiveness of origin-based backgrounds depends on the product processing level. For minimally processed foods (e.g., live crabs, oranges), the core value is natural freshness and perceived authenticity [13]. Displaying authentic origin scenes during live-streams triggers associations with geographical indications. This visual display reinforces the perception of freshness. However, natural attributes often diminish as processing increases [14]. Structural changes in flavor, appearance, and texture may reduce the salience of origin cues [15,16]. Ultimately, this weakens the effectiveness of the live-streaming background. We further introduce rural sentiment as a moderator. This helps elucidate the mechanisms underlying consumers' differentiated responses to live-streaming backgrounds. Rural sentiment refers to individuals' emotional attachment to rural life, agricultural culture, and traditional farming practices [17,18]. Prior studies link rural sentiment to preferences for rural tourism [19], agricultural heritage products [20], and purchasing local foods [21]. However, its role in shaping consumer behavior within real-time live-streaming contexts remains unexamined. We propose that consumers with high rural sentiment are more sensitive to origin-based background cues. This sensitivity enhances their trust and emotional connection with minimally processed foods.

In this research, we adopt a broad definition of agricultural products. According to China's State Administration for Market Regulation official regulatory framework (https://www.gov.cn/gongbao/2024/issue_11266/202404/content_6944099.html, accessed on 17 April 2026), the term "agriculture" encompasses crop farming, forestry, animal husbandry, and fishery. Thus, aquatic (e.g., crabs), livestock (e.g., beef, milk), and crop products (e.g., oranges) are all considered agricultural products. This research contributes to the existing literature in the following ways. First, this research advances the understanding of live-streaming-based agricultural marketing. We shift the focus from streamer-centric factors to the visual design of live-streaming backgrounds. Previous research primarily adopted a streamer-centered perspective [5,22]. Instead, we highlight the cognitive function of live-streaming backgrounds as influential visual stimuli. This is especially true when aligned with product characteristics. We introduce the product processing level as a key boundary condition. We also identify perceived freshness as the underlying mechanism. This demonstrates how background–product congruence shapes consumer purchase intentions. Second, existing papers have identified various sensory cues (e.g., color, saturation, glossiness, and aroma) [23,24]. This research demonstrates that live-streaming backgrounds also serve as powerful non-sensory cues. We introduce perceived freshness as a cognitive mechanism. Consequently, this paper extends its application beyond traditional offline contexts into digital commerce environments. Third, this research introduces rural sentiment as a novel moderator in live-stream e-commerce. Consumers' emotional identification with rural culture significantly shapes their responses to origin-based backgrounds. This effect is particularly strong for minimally processed agricultural products. This finding enriches the emotional framework in consumer research by incorporating context-specific cultural sentiment [19,25].

2. Literature Review

2.1. Live-Streaming for Agricultural Food Products

Live-streaming has transformed agricultural product marketing by integrating real-time audio and video. This allows consumers to directly observe production environments, satisfying their curiosity about natural landscapes and building trust through streamer commentary on local customs and farming practices [26]. During live-streaming, streamers often showcase agricultural products from multiple angles [1] while addressing real-time viewer questions. This interactive process mitigates information gaps and enhances consumers' comprehension and trust in product attributes [27,28]. For farmers, live-streaming provides a direct sales channel that bypasses intermediaries and facilitates efficient farm-to-consumer transactions [27]. This model is particularly effective for perishable products that require short supply chains. Compared with traditional retail or standard e-commerce models, live-streaming improves logistics efficiency, reduces inventory waste [29], and boosts farmer income [30].

From a marketing perspective, identifying strategies to enhance the effectiveness of agricultural live-streaming sales is essential. Prior research has identified several influencing factors, including brand identity [31], product familiarity [2], streamer influence [5], and live-streaming features (e.g., personalization, entertainment) [22]. Additionally, visual presentation of production processes can enhance transparency and consumer engagement [32]. Notably, live-streaming background—serving as a core visual cue—has been found to provide an immersive experience and enhance viewers' sense of presence, thereby strengthening consumer trust [33].

In this research, we distinguish between minimally processed and highly processed agricultural products. Minimally processed products retain most of their natural attributes and maintain a strong visual connection to their original raw state. Highly processed products undergo substantial industrial transformation and have weaker visual connections to their original raw materials. This classification is consistent with the NOVA food classification system [34] and follows the dichotomization approach adopted in prior research [35].

2.2. The Role of Live-Streaming Background

Marketing environment and shopping context exert a significant influence on consumers' purchase decisions. For instance, in physical retail, elements such as store layout, decoration, and lighting collectively shape consumers' initial impressions of a store [36,37]. A pleasant shopping atmosphere has been shown to increase consumer dwell time and incidental spending [38]. Similar principles apply in digital contexts. For instance, in mobile commerce, visually rich and relevant interfaces boost consumer engagement [39]. In online product displays, backgrounds that simulate consumption scenarios improve cognitive fluency and perceived product appeal [40,41].

The growing prevalence of live-streaming e-commerce has transformed background design into a dynamic and engaging element within the shopping environment. Unlike static visuals, live-streaming backgrounds provide real-time cues that influence attention, immersion, and social presence [8,42]. Moderate visual complexity enhances emotional arousal and viewer pleasure [7]. Moreover, background–product congruence is critical for creating immersive experiences. For instance, apparel live-streams often mimic fitting room settings to simulate offline experiences. Congruent background design enhances perceived product value and strengthens user engagement [8,43].

Despite these insights, few studies have examined how different live-streaming backgrounds influence consumer behavior regarding the sale of agricultural products. To address this issue, our research examines how background–product fit affects perceived product qualities and consumer decisions. In this research, an origin-based background

refers to a live-streaming scene that explicitly shows the product's natural production environment (e.g., farmland, orchard, fishing dock, pasture), while an ordinary background refers to a neutral studio setting (e.g., plain solid-color wall or simple indoor setup) without any origin-related cues.

2.3. Perceived Freshness

Freshness is a core determinant in consumer evaluations of agricultural products [44–46]. If a product appears less fresh, consumers tend to avoid it [47,48]. Perceived freshness arises from consumers' subjective interpretation, typically guided by sensory information linked to the product's appearance or condition. During live-streaming, where physical inspection is not possible, visual cues become particularly salient and influential [49]. Consumers judge freshness using multi-dimensional visual indicators. Vivid color is associated with ripeness and nutritional quality, while dullness suggests spoilage [50]. Glossy surfaces enhance freshness perceptions [51]. Packaging design also plays a role; for example, circular logos are perceived as fresher than angular ones [52]. In addition, animated visuals such as flowing juices can further boost perceived freshness and taste expectations [53].

To clarify the conceptual distinctiveness of perceived freshness, Table 1 compares it with related constructs.

Table 1. Comparison of perceived freshness with related constructs.

Construct	Definition	Source
Perceived freshness	Assessment of the product's temporal proximity to its original state	Péneau et al. (2009) [13]
Perceived quality	Overall judgment of product excellence or superiority	Petrescu et al. (2020) [46]
Perceived quality	Perceived genuineness of product's origin, production method, or cultural heritage	Kim et al. (2020) [54]
Trust	Willingness to rely on a seller or brand based on expectations of reliability	Yoon (2002) [55]

2.4. Signaling Theory

Signaling theory was introduced by Spence to explain how parties in a transaction can overcome information asymmetry [56]. The core idea is that when one party possesses private information that the other party cannot directly observe, the informed party can send observable signals to convey credible information. For a signal to be effective, it must be costly or difficult to imitate, thereby reliably distinguishing the sender's true type and helping receivers make better decisions [57].

In marketing contexts, signaling theory has been widely applied to explain how sellers use various marketing instruments to signal product quality to buyers. In e-commerce environments, where physical inspection is not possible, signaling becomes particularly critical. Studies have shown that online product descriptions [58], third-party certifications [59], and money-back guarantees [60] all serve as important quality signals. User-generated content such as online reviews and ratings also constitute powerful social consensus signals that significantly influence consumer trust and risk perception [61].

In the context of live-streaming e-commerce, the form and transmission of signals have fundamentally changed. Live-streaming not only conveys static product information but also constructs a multi-dimensional immersive experience in real time. This study draws on signaling theory to conceptualize live-streaming backgrounds—whether an actual farm or a well-decorated studio—as visual scene signals that convey information about product origin, authenticity, and freshness.

2.5. Cue Utilization Theory

Cue utilization theory posits that products consist of multiple cues that convey quality information to consumers. When evaluating products, consumers do not attend to all cues equally; instead, they selectively use cues based on their predictive value (the perceived strength of association between a cue and product quality) and confidence value (the consumer's certainty in correctly judging that cue) [62].

A key distinction in cue utilization theory is between intrinsic and extrinsic cues [63]. Intrinsic cues are directly related to the product's physical attributes, such as color, shape, texture, and taste. Extrinsic cues are product-related but not part of its physical composition, such as price, brand, packaging, and origin. Generally, when intrinsic cues are readily available and highly diagnostic, consumers rely on them for quality judgments. When intrinsic cues are difficult to obtain or have low diagnosticity, consumers rely more on extrinsic cues [64].

In food consumption contexts, cue utilization theory has been widely applied. Consumers actively use various available cues to judge product quality in both offline and online channels [65–67]. In live-streaming commerce, where consumers cannot physically inspect products, live-streaming backgrounds serve as an important extrinsic cue. This study draws on cue utilization theory to examine how live-streaming backgrounds interact with product processing levels to influence consumers' perceived freshness and purchase intentions.

3. Hypothesis Development

3.1. Interactive Influence of Live-Streaming Background and Product Processing Level

According to cue utilization theory, consumers rely on both intrinsic cues and extrinsic cues to infer product quality when information is incomplete. In live-streaming contexts, where direct product examination is impossible, background settings serve as a salient extrinsic cue. Signaling theory further suggests that effective signals must be costly or difficult to fake. Origin-based backgrounds are difficult for non-local sellers to replicate in real-time, thereby serving as a credible signal of product authenticity and freshness.

Consumers process information more efficiently when environmental cues in the live-streaming setting align with product characteristics, thereby reducing cognitive load and enhancing decision-making quality [68]. As a key visual stimulus, the live-streaming background not only enhances immersion but also conveys implicit product information, which fosters consumer trust and reduces psychological distance [42]. A compelling background is therefore essential for capturing and sustaining consumer attention [69], particularly in agricultural contexts where origin cues signify product authenticity and traceability [70].

We propose that this effect is primarily driven by cue diagnosticity. For minimally processed products, origin-based backgrounds are expected to be highly diagnostic because consumers perceive a strong logical link between the production environment and product freshness. For highly processed products, this diagnosticity is expected to diminish, as processing weakens the link between origin cues and product attributes. Cue congruence plays a secondary role in this process. Recent research confirms that consumers actively use perceived processing level as a cue for evaluating food healthiness [71,72].

For minimally processed products, origin-based backgrounds may trigger sensory associations and perceived experiential value, leading to higher purchase intentions [73–75]. These contextual cues help consumers infer freshness and naturalness, which are central to their expectations of such products. For highly processed products, industrial production obscures natural attributes, making consumers rely more on brand, certification, and ingredient transparency [76], thereby reducing the relevance of background cues. Based on the above analysis, we propose the following:

H1. *Live-streaming background and product processing level jointly affect consumer purchase intention.*

H1a. *For minimally processed products, origin-based backgrounds (vs. ordinary backgrounds) significantly enhance purchase intention.*

H1b. *For highly processed products, the type of background has no significant effect on purchase intention.*

3.2. Mediating Effect of Perceived Freshness

Perceived freshness can be understood as an inferred quality signal. According to signaling theory, origin-based backgrounds serve as observable cues from which consumers infer product freshness. Freshness is a core dimension by which consumers evaluate food safety, nutrition, and the consumption experience [45,77]. For fresh produce and meats, consumers prioritize perceived freshness over brand reputation or price [44,78,79]. In live-streaming contexts, where sensory inspection is limited, consumers increasingly depend on visual cues to assess freshness. For minimally processed agricultural products, origin-based live-streaming scenes (e.g., orchard harvesting, aquaculture ponds) offer visual transparency into production stages, satisfying consumers' desire for supply chain visibility [80]. Additionally, natural environmental features (e.g., clear water, moist soil) suggest unprocessed and naturally fresh conditions. These intuitive visual cues are readily interpreted by consumers and help establish trust in product quality. By contrast, ordinary backgrounds lack contextual cues beyond the product itself, making it difficult for consumers to assess freshness and quality. Thus, for minimally processed agricultural products, we posit that origin-based live-streaming enhances perceived freshness compared to ordinary backgrounds.

Conversely, for highly processed agricultural products (e.g., fruit juices, pickled foods), freshness is less visually inferable due to the transformation of the raw material. Instead, consumers tend to focus on processing standards, nutritional labeling, or storage life [81], which limits the influence of live-streaming backgrounds on freshness perception.

Notably, perceived freshness is particularly salient in this context because it is the dominant criterion for agricultural products, especially minimally processed ones [13]. Unlike more general constructs such as trust or authenticity, freshness directly captures the perishability and current condition of the product [80]. Moreover, live-streaming backgrounds signal freshness more directly—origin-based cues provide immediate visual transparency about the product's source and condition—whereas trust or authenticity typically requires additional information such as seller reputation or certification [52]. Therefore, perceived freshness serves as the most proximal mechanism linking live-streaming backgrounds to purchase intentions for agricultural products.

Based on the above, we propose the following:

H2. *For minimally processed products, origin-based backgrounds enhance purchase intention by increasing perceived freshness; this mediating effect is not observed for highly processed products.*

3.3. Moderating Effect of Rural Sentiment

Rural sentiment refers to individuals' emotional attachment and identification with rural environments, cultural traditions, and lifestyles [18]. It is important to distinguish rural sentiment from several related but distinct constructs. Nostalgia involves a sentimental longing for the past that one personally experienced [82], whereas rural sentiment does not require personal rural experience; it can be formed through cultural transmission and social narratives. Rural identity is a cognitive self-categorization (e.g., identifying oneself as a rural person) [83], while rural sentiment is primarily affective rather than cognitive. Moral values concern normative beliefs about right and wrong [84], whereas

rural sentiment carries no inherent moral judgment. Thus, rural sentiment offers a unique emotional lens—rooted in cultural memory and affective attachment—for understanding consumer responses to origin-based cues in live-streaming contexts. Consumers with high rural sentiment often experience strong emotional resonance when exposed to rural imagery or settings. These emotional responses can amplify trust and preference toward products that are closely associated with rural authenticity, particularly when such cues are embedded in live-streaming backgrounds.

Prior studies show that emotional resonance can increase purchase intention by evoking nostalgic or pleasurable feelings [85,86]. Thus, when minimally processed agricultural foods are presented against an origin-based backdrop, consumers with strong rural sentiment may form deeper psychological and cultural connections, strengthening their purchase intention. In contrast, consumers with low rural sentiment lack emotional resonance with rural symbols and instead rely on functional attributes such as price and brand, limiting the influence of origin-based backgrounds on their purchase intention.

For highly processed foods, the effects of rural sentiment are likely attenuated, as the product's connection to its origin is less visible or meaningful. Thus, whether consumers have high or low rural sentiment, the background type may not significantly influence their purchase intention. Based on this reasoning, the following hypotheses are proposed:

H3a. *For minimally processed agricultural products, consumers with high rural sentiment will report significantly higher purchase intentions under origin-based backgrounds than under ordinary ones. For those with low rural sentiment, background type will have no significant effect.*

H3b. *For highly processed agricultural products, background type will not significantly affect purchase intention, regardless of rural sentiment level.*

The conceptual framework for this research is shown in Figure 1.

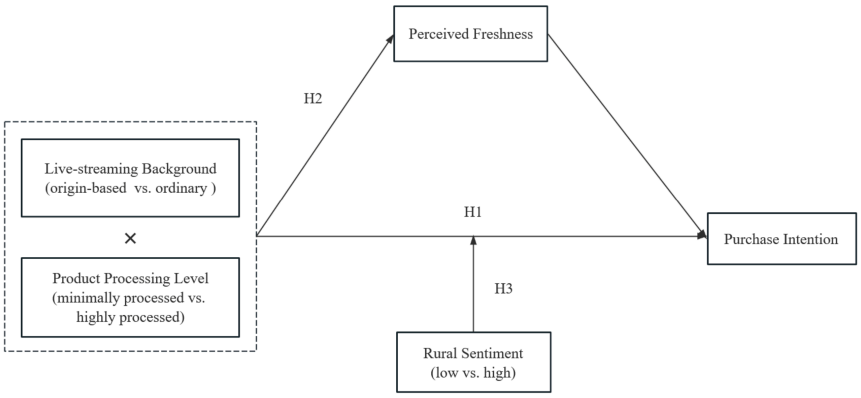


Figure 1. Theoretical Framework.

4. Overview of Studies

This research tests the hypotheses through four experiments, all of which were preregistered. The experimental stimuli (minimally processed and highly processed agricultural products) were carefully selected based on prior research [53] to ensure representativeness. The live-streaming backgrounds were designed to clearly contrast origin-based cues (e.g., farmland, orchards, fishing docks) with non-origin cues (plain solid-color studios). A power analysis conducted using G*Power 3.1 indicated that the target sample sizes for all studies were sufficient to detect medium effects [87].

All participants were recruited via Credamo, an online survey platform widely used for academic research in China [88,89]. Credamo was chosen because it provides access to

a large and diverse participant pool and allows for random assignment to experimental conditions. Participants were recruited through the platform's panel service. To ensure data quality, respondents with excessively short completion times were excluded from the final sample.

The use of 17 s video clips as experimental stimuli in Studies 2–4 is consistent with established methodological paradigms in recent live-streaming research [90,91]. This duration is considered sufficient to capture consumers' immediate psychological and behavioral responses to the visual environment while maintaining high internal validity by standardizing the informational load across different experimental conditions.

The experimental stimuli were selected such that minimally processed and highly processed products within each pair share the same raw material origin (e.g., live crabs vs. drunken crabs; fresh oranges vs. orange juice; raw beef vs. cooked beef; fresh milk vs. yogurt). This within-category design isolates the effect of processing level, which directly affects consumers' freshness perceptions and information needs. These four product pairs span diverse agricultural categories—aquatic, fruit, meat, and dairy—enhancing the generalizability of our findings.

Study 1 explored the interaction between the type of live-streaming background and product characteristics. It was found that when agricultural products were minimally processed, consumers were more likely to intend to purchase them if the live-streaming featured an origin-based background instead of an ordinary one. For highly processed agricultural products, purchase intention did not differ significantly between the two backgrounds. Studies 2 and 3 used bootstrap mediation tests and found that for minimally processed products, origin-based backgrounds enhanced purchase intention indirectly by increasing perceived freshness, while this mediating effect was not significant for highly processed products. Study 4 introduced rural sentiment as a moderator and confirmed that consumers with high rural sentiment were more likely to exhibit stronger purchase intentions when exposed to origin-based live-streaming backgrounds featuring farmland or orchards.

Finally, prior to conducting the primary analyses, we performed systematic diagnostic checks across all four studies to evaluate the core assumptions of ANOVA. While Shapiro–Wilk tests indicated minor deviations from normality—a common occurrence with bounded Likert-scale data—our substantial sample sizes (all Ns > 200) ensure the robustness of the ANOVA models in accordance with the central limit theorem. Visual inspections of Q-Q plots further supported the assumption of approximate normality (see Appendix A for detailed plots). Additionally, Levene's tests confirmed the homogeneity of variances for Studies 2 and 4. For Studies 1 and 3, where partial violations of this assumption were observed, we conducted Welch's *t*-tests as an additional robustness check. Across all instances, these alternative analyses yielded consistent, highly significant results (all *p*s < 0.001), demonstrating that our main findings are robust and reliable.

5. Study 1: Pilot Study

Before proceeding to the main experimental series, we present Study 1 as an exploratory pilot study to provide a preliminary test of the proposed mechanism. This initial study establishes a baseline understanding of the relationship between origin-based backgrounds and consumer intentions, laying the foundation for the more rigorous and definitive tests conducted in Studies 2 through 4.

5.1. Method

Study 1 employed a 2 (Live-streaming Background: origin-based vs. ordinary) × 2 (Product Processing Level: minimally processed vs. highly processed) between-subjects design.

Participants were randomly exposed to one of four experimental setups. A sample of 221 qualified respondents was obtained through Credamo (www.credamo.com; accessed on 18 January 2025), a China-based online data collection platform comparable to MTurk. The study was preregistered on AsPredicted (https://aspredicted.org/7vws-httw.pdf; accessed on 18 January 2025). The sample included 95 males, with an average age of 30.10 years (SD = 8.26). Participants came from 29 provinces across China, with the largest shares from Guangdong (12.22%), Henan (11.31%), and Shandong (11.31%). A statistical power analysis was conducted using G*Power 3.1 [87], based on an F-test for fixed and interaction effects in ANOVA. With an alpha level of 0.05 and a medium effect size estimate (f = 0.25), the achieved sample of 221 participants resulted in a power level of 0.95, sufficient for detecting the predicted effects.

The experimental scenario was set as follows: "Suppose you are shopping online for live crabs (drunken crabs) and enter a live-streaming room while browsing a shopping app, where the streamer is introducing the product". Participants were then shown a screenshot of the live-stream room along with the streamer's product description (see Appendix B for details).

After viewing the screenshot and reading the streamer's description, participants completed measures for core variables. Purchase intention was measured first, followed by perceived freshness and other variables (the same as below). Perceived freshness was measured using two items (i.e., "The product sold in this live-streaming room was harvested or caught. . ."; 1 = a long time ago, 7 = very recently; $\alpha = 0.82$; AVE = 0.72; adapted from Gvili et al. [53]). Purchase intention was assessed using four items (i.e., "I would like to recommend the product from this live-streaming room to my friends."; 1 = strongly disagree, 7 = strongly agree; $\alpha = 0.93$; AVE = 0.77; adapted from Moon et al. [92]). To ensure experimental validity, manipulation checks were conducted. Participants were asked to recall whether the live-streaming background reflected origin information (1 = strongly disagree, 7 = strongly agree) and to rate the processing degree of the product after being provided with a definition of processing level (1 = unprocessed, 7 = highly processed). Finally, participants provided their demographic information, including gender and age. Upon completing the questionnaire, each participant received a small monetary incentive as compensation (see Appendix C for full measurements).

5.2. Manipulation Test

Participants exposed to the origin-based background reported significantly greater recognition scores compared to those in the ordinary background condition ($M_{origin} = 5.68$, SD = 0.99; $M_{ordinary} = 2.73$, SD = 1.45; $|t| = 17.62$, $p < 0.001$), confirming the success of the background manipulation. Also, participants in the highly processed condition perceived a significantly greater level of processing compared to those in the minimally processed group ($M_{highly} = 4.25$, SD = 1.30; $M_{minimally} = 3.03$, SD = 1.53; $|t| = 6.42$, $p < 0.001$).

5.3. Hypothesis Testing

In this and all subsequent studies, following standard experimental procedures, we included age and gender as control variables to account for potential individual differences (e.g., [87]). Preliminary analyses confirmed that these covariates did not exert any significant effects on the dependent variables (all ps > 0.05), nor did they alter the direction or significance of the primary results. A 2 × 2 factorial ANOVA was conducted. Results indicated that live-streaming background significantly influenced purchase intention ($F(1, 183) = 11.08$, $p < 0.01$), whereas product processing level had no statistically significant impact ($F(1, 183) = 0.27$, $p > 0.05$). However, the interaction between the two variables was significant ($F(1, 183) = 4.75$, $p < 0.05$). To unpack this interaction, simple effect analysis was performed (see Figure 2). Simple slope results showed that origin-based live-streaming

background had a higher influence on purchase intention for minimally processed agricultural goods (M_{origin} = 5.74, SD = 0.17; $M_{ordinary}$ = 4.66, SD = 0.17; F(1, 217) =19.75, $p < 0.001$; $\eta^2 = 0.083$), with no significant difference for highly processed agricultural goods (M_{origin} = 5.25, SD = 0.17; $M_{ordinary}$ = 4.89, SD = 0.17; F(1, 217) = 2.17, $p > 0.05$; $\eta^2 = 0.010$). Thus, H1, H1a, and H1b were supported.

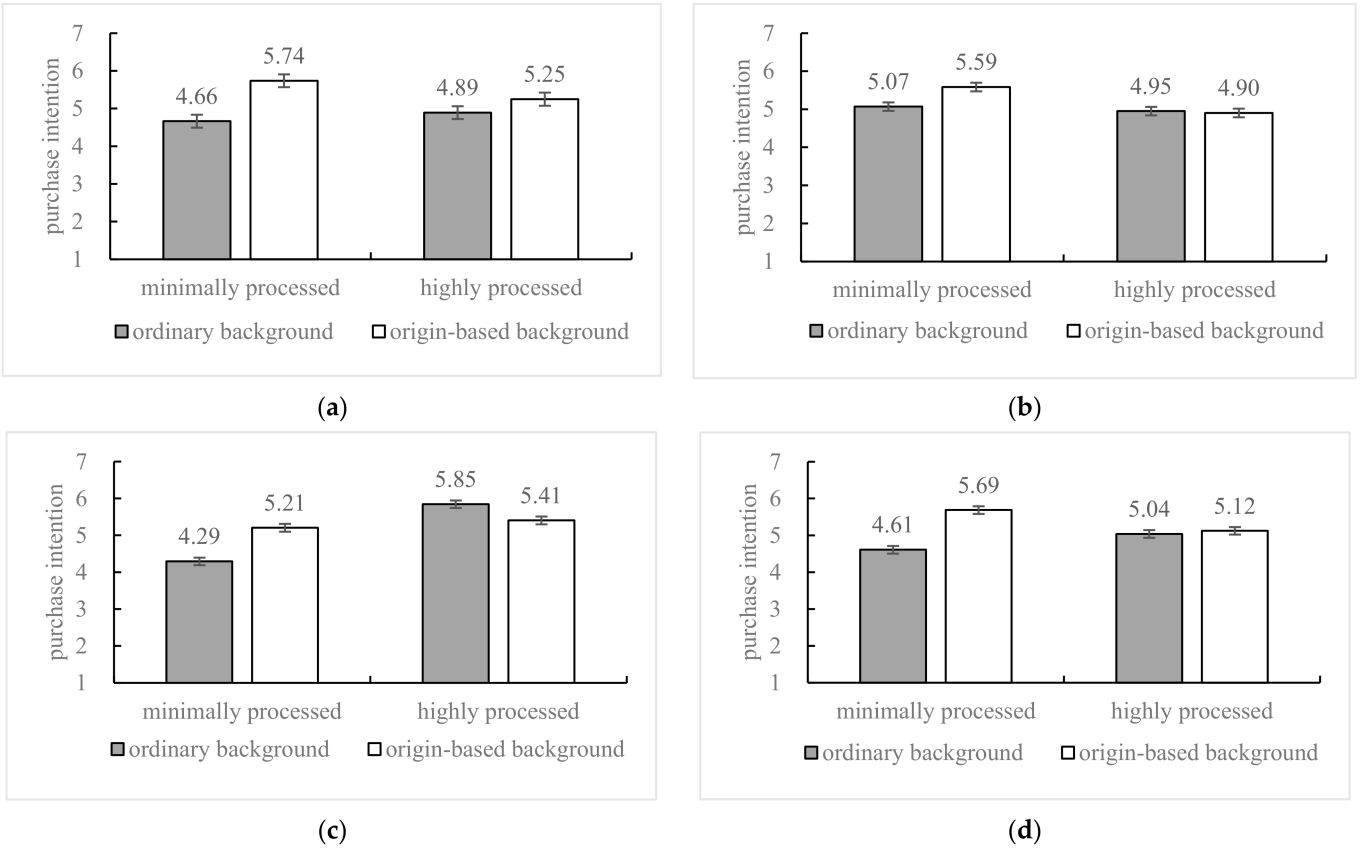


Figure 2. The interaction effect of live-streaming background and product processing level on purchase intention. Note(s): Panel (**a**)—Study 1; Panel (**b**)—Study 2; Panel (**c**)—Study 3; Panel (**d**)—Study 4.

A separate ANOVA was conducted using perceived freshness as the dependent variable. Results showed significant effects of both live-streaming background (F(1, 183) = 10.36, $p < 0.01$) and product processing level (F(1, 183) = 9.04, $p < 0.01$), as well as a significant interaction (F(1, 183) = 4.13, $p < 0.05$). Subsequent analysis of the simple effects is illustrated in Figure 3. Results revealed that origin-based live-streaming background had a higher influence on perceived freshness for minimally processed agricultural products compared to the ordinary live-streaming background (M_{origin} = 6.42, SD = 0.14; $M_{ordinary}$ = 5.57, SD = 0.15; F(1, 217) = 17.08, $p < 0.001$; $\eta^2 = 0.073$), with no significant difference for highly processed agricultural products (M_{origin} = 5.58, SD = 0.15; $M_{ordinary}$ = 5.45, SD = 0.14; F(1, 217) = 0.44, $p > 0.05$; $\eta^2 = 0.002$).

Using PROCESS Model 8 in SPSS 26.0, we tested whether perceived freshness acted as a mediator and whether this effect varied with product processing level. The conditional indirect effect was significant for the minimally processed group (Effect = 0.67, CI = [0.40, 0.96]) but not for highly processed agricultural products (Effect = 0.15, CI = [−0.12, 0.42]). Thus, H2 was supported.

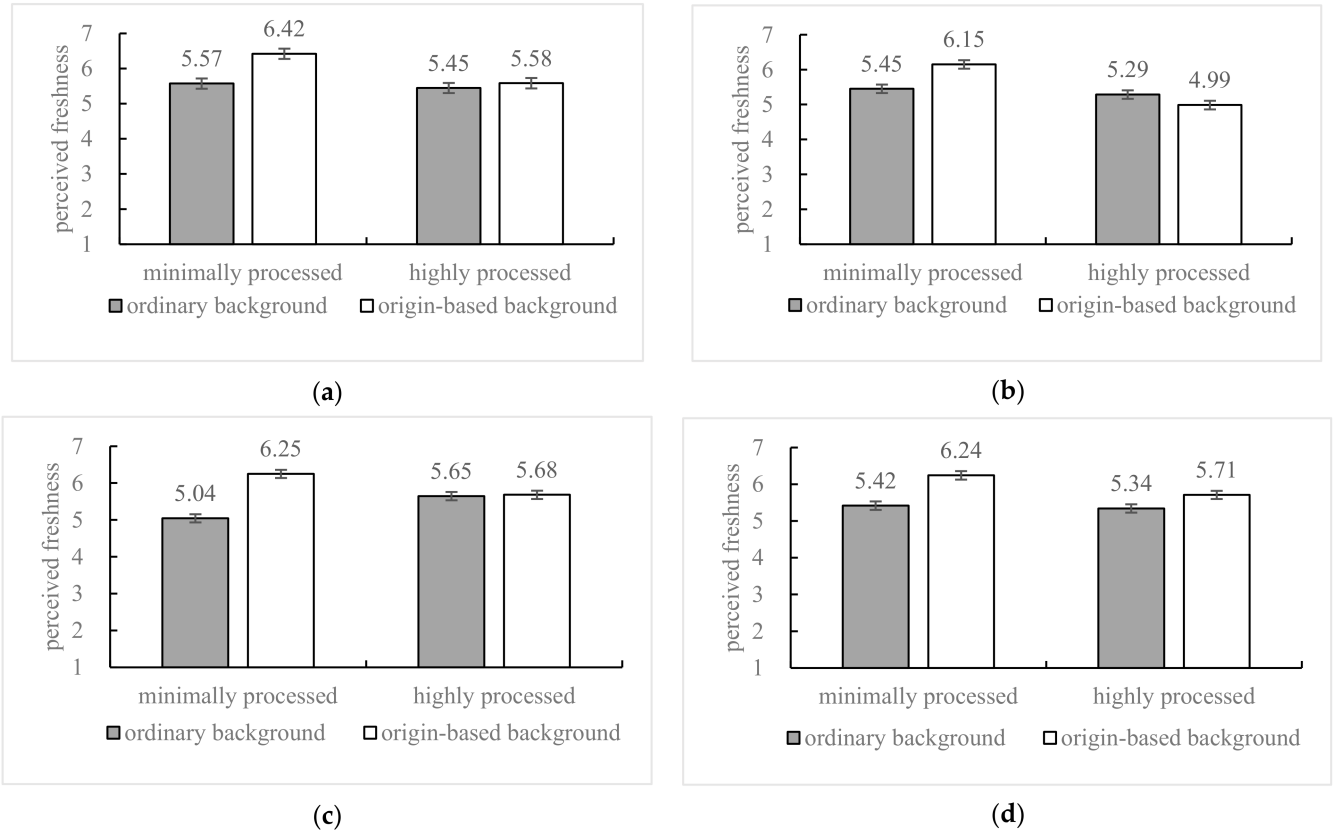


Figure 3. The interaction effect of live-streaming background and product processing level on perceived freshness. Note(s): Panel (**a**)—Study 1; Panel (**b**)—Study 2; Panel (**c**)—Study 3; Panel (**d**)—Study 4.

5.4. Discussion

Study 1 found that origin-based (vs. ordinary) live-streaming backgrounds are more effective in promoting minimally processed agricultural products, while making no difference in increasing the purchase intention of highly processed agricultural products. Moreover, perceived freshness mediates the influence of origin-based live-streaming backgrounds on purchase intention for minimally processed agricultural products.

We acknowledge that the contrast between live crabs and drunken crabs may not represent a definitive minimally versus highly processed manipulation, as drunken crab is produced through traditional preservation methods rather than heavy industrial processing. Therefore, this study should be viewed as a pilot study providing initial evidence for the interaction effect. The subsequent studies (Studies 2–4) employ clearer and more rigorous manipulations (e.g., fresh oranges vs. orange juice; raw beef vs. cooked beef; fresh milk vs. yogurt) to definitively test our hypotheses.

6. Study 2: Replication of Study 1 and Rule out Alternative Explanations

To further validate our findings, we introduced several modifications in the following study. First, we substituted the initial stimuli from Study 1 (live crab and drunken crab) with oranges and orange juice to examine if similar effects would emerge for other types of agricultural products in the live-streaming. Second, to better simulate a realistic shopping environment, the static screenshot used in Study 1 was replaced with a 17 s live-streaming video clip. Additionally, to ensure our findings are not an artifact of a specific streamer's characteristics and to test the generalizability of the effects, we intentionally changed the female streamer used in Study 1 to a male streamer in Study 2. Finally, we incorporated additional variables to rule out several alternative explanations.

6.1. Method

In Study 2, a sample of 289 qualified respondents was obtained through Credamo (https://aspredicted.org/gt54-bzqb.pdf; accessed on 28 January 2025). The sample included 109 males, with an average age of 29.58 years (SD = 9.58). Geographically, participants spanned 29 provinces, led by Guangdong (9.00%), Henan (7.61%), and Guangxi (6.92%). A 2 (Live-streaming Background: origin-based vs. ordinary) × 2 (Product Processing Level: minimally processed vs. highly processed) between-subjects design was adopted. Participants were randomly exposed to one of four experimental setups. A statistical power analysis was conducted using G*Power 3.1 [87], based on an F-test for fixed and interaction effects in ANOVA. With an alpha level of 0.01 and a medium effect size estimate (f = 0.25), the achieved sample of 289 participants resulted in a power level of 0.95, sufficient for detecting the predicted effects.

We created a fictional agricultural product brand, "Chengxiaoxian". The experimental scenario was framed as "You are watching a live stream while shopping for oranges (or orange juice)." The background setting varied between an orchard (origin-based) and an ordinary background. The streamer's script was customized according to product attributes (see Appendix D for details).

The core variables were measured identically to Study 1, with purchase intention (AVE = 0.64; α = 0.87) measured before perceived freshness (AVE = 0.78; α = 0.86) and other variables. In addition, we included alternative mediating variables: Mental vividness was measured using three items (i.e., "In this live stream, the product felt as if it were physically in front of me." 1 = strongly disagree, 7 = strongly agree; AVE = 0.69; α = 0.86; adapted from Peng et al. [93]). Positive emotions were measured with five items (i.e., "I felt relaxed during this live stream." AVE = 0.65; α = 0.90; adapted from Huang et al. [94]). Social presence was measured using five items (i.e., "I felt as if I were in the same space as others in this live stream." AVE = 0.67; α = 0.91; adapted from Shi et al. [42]). Immersion was measured with three items (i.e., "I was fully engaged while watching the stream." AVE = 0.73; α = 0.89; adapted from Sun et al. [6]). Emotional attachment was measured using three items (i.e., "I would like to know more about this streamer." AVE = 0.74; α = 0.89; adapted from Li and Peng [95]). At the survey's end, participants gave their gender and age and were compensated with a small monetary incentive.

6.2. Manipulation Test

Participants in the origin-based background condition considered the background more reflective of product origin than those in the ordinary background condition (M_{origin} = 4.38, SD = 1.57; $M_{ordinary}$ = 3.83, SD = 1.55; $|t|$ = 3.03, $p < 0.01$, Cohen's d = 0.35). Also, participants in the highly processed condition perceived a significantly greater level of processing compared to those in the minimally processed group (M_{highly} = 3.56, SD = 1.63; $M_{minimally}$ = 2.79, SD = 1.23; $|t|$ = 4.55, $p < 0.001$).

6.3. Hypothesis Testing

A 2 × 2 factorial ANOVA was conducted, with gender and age included as covariates. Results indicated that product processing level significantly influenced purchase intention ($F(1, 245) = 8.27$, $p < 0.01$), whereas live-streaming background had no statistically significant impact ($F(1, 245) = 1.82$, $p > 0.05$). However, the interaction between the two variables was significant ($F(1, 245) = 6.77$, $p < 0.01$). To unpack this interaction, a simple effect analysis was performed (see Figure 2). Simple slope results showed that the origin-based live-streaming background had a higher influence on purchase intention for minimally processed agricultural goods (M_{origin} =5.58, SD = 0.11; $M_{ordinary}$ = 5.07, SD = 0.11; $F(1, 285) = 10.539$, $p < 0.01$), with no significant difference for highly processed agricultural

goods (M_{origin} = 4.90, SD = 0.11; $M_{ordinary}$ = 4.95, SD = 0.11; F(1, 285) = 0.092, $p > 0.05$), supporting H1 again.

A separate ANOVA was conducted using perceived freshness as the dependent variable. Results indicated that product processing level significantly influenced perceived freshness (F(1, 245) = 21.68, $p < 0.001$), whereas live-streaming background had no statistically significant impact (F(1, 245) = 0.25, $p > 0.05$). However, the interaction between the two variables was significant (F(1, 245) = 12.98, $p < 0.001$). Subsequent analysis of the simple effects is illustrated in Figure 3. Simple slope results revealed that origin-based live-streaming background had a stronger influence on perceived freshness for minimally processed agricultural goods compared to the ordinary live-streaming background (M_{origin} = 6.15, SD = 0.12; $M_{ordinary}$ = 5.45, SD = 0.12; F(1, 285) = 16.52, $p < 0.001$), with no significant difference for highly processed agricultural goods (M_{origin} = 4.99, SD = 0.12; $M_{ordinary}$ = 5.29, SD = 0.12; F(1, 285) = 3.02, $p > 0.05$).

The analysis revealed that the indirect effect via perceived freshness was statistically significant for minimally processed goods (Effect = 0.18, CI = [0.08, 0.30]), whereas this effect did not reach significance for highly processed ones (Effect = −0.09, CI = [−0.22, 0.01]). These findings provide further support for H2.

6.4. Discussion

Study 2 successfully replicated the main effects observed in Study 1, demonstrating that origin-based live-streaming backgrounds significantly enhance consumers' perceptions of freshness of minimally processed agricultural products, thereby increasing purchase intentions. Moreover, by incorporating a series of control variables, Study 2 effectively ruled out alternative explanations such as mental vividness, positive emotions, social presence, immersion, and emotional attachment as primary drivers of the observed effects. We note that the manipulation check for background in this study showed a smaller difference compared to other studies, likely because the orchard scene was visually less distinctive. Nevertheless, the difference remained statistically significant ($p < 0.01$), confirming the validity of the manipulation.

7. Study 3: Further Replication

Although Study 2 confirmed the robustness of our findings using oranges and orange juice as stimuli, these two products differ substantially in their visual appearance. In Study 3, we introduced a new set of stimuli to minimize potential confounds arising from discrepancies in visual appearance.

7.1. Method

This study employed a 2 (Live-streaming Background: origin-based vs. ordinary) × 2 (Product Processing Level: minimally processed vs. highly processed) between-subjects design. Participants were randomly exposed to one of four experimental setups. A sample of 225 qualified respondents was obtained through Credamo (https://aspredicted.org/78zg-bjkn.pdf; accessed on 20 February 2025). Among the participants, 68 were male, and their average age was 29.53 years (SD = 7.60). In terms of geographic distribution, the sample covered 26 provinces, with the highest proportions coming from Guangdong (12.89%), Sichuan (9.78%), and Hebei (8.89%). We selected visually similar products—raw beef and cooked beef—as stimuli. The experimental scenario was framed as "You are shopping for raw (or cooked) beef and enter a live-stream room". A 17 s live-stream video clip was presented (see Appendix E for details).

Measurement tools were consistent with those used in Study 1, including perceived freshness (α = 0.84; AVE = 0.73; adapted from Gvili et al. [53]) and purchase intention

($\alpha = 0.88$; AVE = 0.65; adapted from Moon et al. [92]), with purchase intention measured before perceived freshness. To assess the validity of the experimental manipulations, we examined whether the live-streaming background and product processing level were perceived as intended.

7.2. Manipulation Test

Participants exposed to the origin-based background reported significantly greater recognition scores compared to those in the ordinary background condition ($M_{origin} = 5.45$, SD = 1.15; $M_{ordinary} = 2.29$, SD = 1.29; $|t| = 19.37$, $p < 0.001$). Also, participants in the highly processed condition perceived a significantly greater level of processing compared to those in the minimally processed group ($M_{highly} = 4.07$, SD = 1.30; $M_{minimally} = 2.93$, SD = 1.42; $|t| = 6.28$, $p < 0.001$).

7.3. Hypothesis Testing

A 2 × 2 factorial ANOVA was conducted, with gender and age included as covariates. Results indicated that live-streaming background significantly influenced purchase intention ($F(1, 185) = 53.79$, $p < 0.001$), whereas product processing level had no statistically significant impact ($F(1, 185) = 2.09$, $p > 0.05$). However, the interaction between the two variables was significant ($F(1, 185) = 33.17$, $p < 0.001$). To unpack this interaction, a simple effect analysis was performed (see Figure 2). The origin-based background significantly enhanced purchase intention for minimally processed products compared to the ordinary background ($M_{origin} = 5.21$, SD = 0.11; $M_{ordinary} = 4.29$, SD = 0.10; $F(1, 221) = 114.96$, $p < 0.001$). However, this difference was not statistically significant in the highly processed condition ($M_{origin} = 5.41$, SD = 0.11; $M_{ordinary} = 5.85$, SD = 0.10; $F(1, 221) = 1.83$, $p > 0.05$), providing further support for H1.

A separate ANOVA was conducted using perceived freshness as the dependent variable. Results indicated that live-streaming background significantly influenced perceived freshness ($F(1, 185) = 25.02$, $p < 0.001$), whereas product processing level had no statistically significant impact ($F(1, 185) = 1.14$, $p > 0.05$). However, the interaction between the two variables was significant ($F(1, 185) = 18.91$, $p < 0.001$). Subsequent simple slope analysis of the simple effects is illustrated in Figure 3. Results revealed that origin-based live-streaming background had a stronger influence on perceived freshness for minimally processed agricultural goods ($M_{origin} = 6.25$, SD = 0.11; $M_{ordinary} = 5.04$, SD = 0.11; $F(1, 221) = 58.95$, $p < 0.001$), with no significant difference for highly processed agricultural goods ($M_{origin} = 5.68$, SD = 0.11; $M_{ordinary} = 5.65$, SD = 0.11; $F(1, 221) = 0.05$, $p > 0.05$).

The analysis revealed that the indirect effect via perceived freshness was statistically significant for minimally processed goods (Effect = 0.66, CI = [0.42, 0.92]), but not for highly processed agricultural goods (Effect = 0.02, CI= [−0.10, 0.15]), supporting H2 again.

7.4. Discussion

By controlling for consistency in product appearance, Study 3 removed the possible confound caused by visual disparities, thereby reinforcing both the interaction between live-streaming background and product processing level and the mediating influence of perceived freshness. These findings enhance the robustness of the research conclusions.

8. Study 4: The Moderating Role of Rural Sentiment

To further elucidate the mechanisms underlying consumers' differentiated responses to live-streaming backgrounds, Study 4 introduces the construct of rural sentiment as a key moderating variable.

8.1. Method

This study adopted a 2 (Live-streaming Background: origin-based vs. ordinary) × 2 (Product Processing Level: minimally processed vs. highly processed) × 2 (Rural Sentiment: low vs. high) between-group design. A sample of 294 qualified respondents was obtained through Credamo (https://aspredicted.org/g76j-5k8j.pdf; accessed on 20 February 2025). Among the participants, 105 were males, and their average age was 31.77 years (SD = 17.82). Participants were drawn from 28 provinces. The top three origins were Jiangsu (9.18%), Guangdong (8.50%), and Sichuan (8.16%). A statistical power analysis was conducted using G*Power 3.1 [87], based on an F-test for fixed and interaction effects in ANOVA. With an alpha level of 0.01 and a medium effect size estimate (f = 0.25), the achieved sample of 294 participants resulted in a power level of 0.95, sufficient for detecting the predicted effects. Milk and yogurt were utilized as stimuli, under the fictional brand name "MUBAO". The processing level was manipulated by emphasizing differences in the proportion of raw milk in the ingredients list (see Appendix F for details).

To further explore consumers' emotional tendencies, this study introduced the variable of rural sentiment. Rural sentiment was measured using four items (i.e., "I think it is important and worthwhile to help farmers earn a good life."; AVE = 0.69; α = 0.90; adapted from Han et al. [18]). Other variable measurements were consistent with Study 1 (perceived freshness, AVE = 0.71, α = 0.80; purchase intention, AVE = 0.6, α = 0.86). Participants received a small monetary incentive as compensation upon completion.

8.2. Manipulation Test

Participants in the origin-based background condition scored significantly higher on the background manipulation check than those in the ordinary background condition (M_{origin} = 5.11, SD = 1.49; $M_{ordinary}$ = 3.56, SD = 1.83; $|t|$ = 7.93, $p < 0.001$). Participants accurately distinguished highly and minimally processed agricultural products (M_{highly} = 3.77, SD = 1.31; $M_{minimally}$ = 2.95, SD = 1.00; $|t|$ = 6.01, $p < 0.001$).

8.3. Hypothesis Testing

A 2 × 2 factorial ANOVA was conducted. Results indicated that live-streaming background significantly influenced purchase intention (F(1, 252) = 37.25, $p < 0.001$), whereas product processing level had no statistically significant impact (F(1, 252) = 0.06, $p > 0.05$). However, the interaction between the two variables was significant (F(1, 252) = 21.46, $p < 0.001$). Simple effect analysis (Figure 2) showed origin-based living-streaming background had a stronger influence on purchase intention for minimally processed agricultural products (M_{origin} = 5.69, SD = 0.11; $M_{ordinary}$ = 4.61, SD = 0.10; F(1, 290) = 53.54, $p < 0.001$), with no significant difference for highly processed agricultural products (M_{origin} = 5.12, SD = 0.10; $M_{ordinary}$ = 5.04, SD = 0.10; F(1, 290) = 0.33, $p = 0.56 > 0.05$). Thus, H1 was supported again.

A separate ANOVA was conducted using perceived freshness as the dependent variable. Results showed significant effects of both live-streaming background (F(1, 252) = 27.32, $p < 0.001$) and product processing level (F(1, 252) = 4.08, $p < 0.05$), as well as a significant interaction (F(1, 252) = 6.44, $p < 0.05$). Subsequent analysis of the simple effects is illustrated in Figure 3. Simple slope analysis results revealed origin-based living-streaming background had a stronger influence on perceived freshness for minimally processed agricultural products (M_{origin} = 6.24, SD = 0.12; $M_{ordinary}$ = 5.42, SD = 0.12; F(1, 290) = 25.52, $p < 0.001$). The analysis revealed that the indirect effect via perceived freshness was statistically significant for minimally processed goods (Effect = 0.27, CI = [0.15, 0.41]). Thus, H2 was supported again.

To explore whether rural sentiment moderates the interactive effects of live-stream background and product processing level, we performed a moderated moderation analysis using PROCESS (Model 3) in SPSS. Gender and age were treated as control variables. A bootstrap analysis, with purchase intention as the dependent variable also revealed a significant interaction among live-streaming background, product type, and rural sentiment (beta = −0.31, bootstrap SE = 0.15, 95%CI = [−0.59, −0.02]).

For further interpretation, participants were classified into high and low rural sentiment groups based on ±1 standard deviation from the mean (M = 5.40, SD = 1.41). Simple effects were assessed accordingly (see Figure 4). In the case of highly processed agricultural goods, no meaningful differences in purchase intention were observed between the origin-based and ordinary background conditions, regardless of whether rural sentiment was high ($F(1, 286) = 0.245$, $p > 0.05$) or low ($F(1, 286) = 0.021$, $p > 0.05$). In contrast, for minimally processed goods, participants with stronger rural sentiment responded more favorably to origin-based backgrounds than to ordinary ones ($M_{origin} = 5.87$, SD = 0.11; $M_{ordinary} = 4.48$, SD = 0.12; $F(1, 286) = 69.35$, $p < 0.001$). Among those with lower rural sentiment, the background type had no significant influence on purchase intention ($M_{origin} = 4.98$, SD = 0.22; $M_{ordinary} = 4.89$, SD = 0.18; $F(1, 286) = 0.10$, $p > 0.05$). These results support both H3a and H3b.

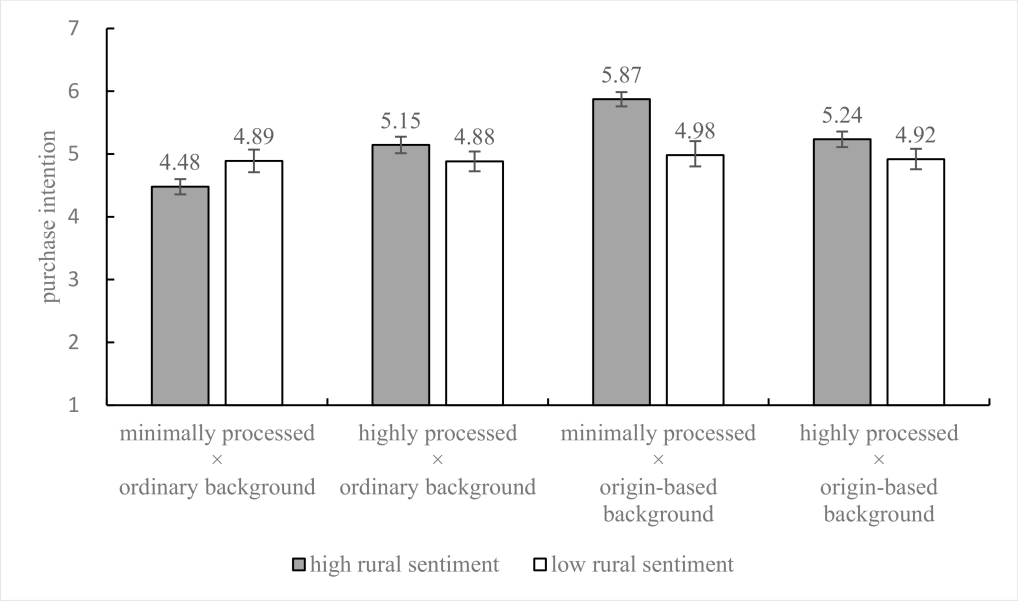


Figure 4. The moderating effect of rural sentiment.

8.4. Discussion

Study 4 highlights how rural sentiment serves as a key moderator in shaping the impact of live-streaming backgrounds on consumer responses. In particular, it strengthens the beneficial influence of origin-based scenes on the willingness to purchase minimally processed agricultural goods. These insights extend our comprehension of emotional drivers in the agricultural live-streaming context and provide actionable implications for targeted marketing practices.

9. General Discussion

This research systematically examined how live-streaming background and product processing level jointly shape consumers' purchase intention for agricultural products, with perceived freshness as a key mediating mechanism and rural sentiment as a moderator. Across four experiments using diverse product types (e.g., seafood, fruit, meat,

dairy), we consistently found that origin-based backgrounds enhance purchase intentions primarily for minimally processed products, and this effect is largely driven by elevated perceptions of freshness. Moreover, rural sentiment was shown to moderate these effects, highlighting the importance of consumers' emotional alignment with rural imagery in live stream environments.

9.1. Theoretical Contributions

First, this paper provides initial evidence for the role of live-streaming backgrounds in agricultural marketing by shifting the focus from streamer-centric factors to the visual design of the live-streaming environment. Although prior research has examined background–product congruence in various forms, including scene–product matching [8], congruence between live-streaming elements and products [68], and product–background-color combinations [96], these studies have not considered how product characteristics moderate the effectiveness of background cues. Our work introduces product processing level as a potential boundary condition, offering preliminary evidence that origin-based backgrounds enhance purchase intention only for minimally processed products. This finding suggests that congruence may not be universally beneficial—its effectiveness may depend on the product's processing level. Thus, we incorporate product processing level into the analytical framework and emphasize the role of background–product congruence in shaping consumer decision-making, providing initial evidence for background effects in agricultural live stream marketing.

Second, this research introduces perceived freshness as a psychological mechanism in consumer decision-making within live-streaming e-commerce for agricultural products. Although freshness has been widely acknowledged as a fundamental indicator of food quality in conventional consumption settings [13,23], earlier studies have primarily concentrated on sensory cues such as color, saturation, gloss, and smell [50,51,97,98]. Additionally, non-sensory cues like shelf-life labeling and geographical distance from origin have also received attention [47,78]. With the emergence of live-streaming commerce, however, the way freshness is conveyed and interpreted has undergone meaningful transformation. Our findings suggest that live-streaming backgrounds can implicitly communicate freshness information and thereby influence consumer judgments. This work offers preliminary evidence that extends the scope of perceived freshness research beyond traditional offline or static digital settings to real-time digital environments.

Finally, our research offers a new emotional perspective for interpreting consumer behavior in livestream-based agricultural marketing. Prior studies have highlighted the role of rural emotion in shaping preferences for rural tourism [19], local food products [21], and agricultural heritage goods [20]. Building on these insights, this research found that rural sentiment, as a psychological state rooted in cultural memory and emotional identification, may moderate consumers' reactions to origin-based versus ordinary live-streaming backgrounds. Thus, this work suggests the importance of emotional alignment between consumers and marketing environments, identifying rural sentiment as a potentially important factor in livestream-based agricultural sales.

9.2. Practical Implications

This research offers valuable practical insights for optimizing live-streaming strategies in agricultural e-commerce. On one hand, live-streaming backgrounds should be tailored to the product's level of processing. While previous research has highlighted the benefits of showcasing production scenes (e.g., drawing visual attention) [99], our findings reveal that origin-based backgrounds only enhance consumer responses for minimally processed products. Specifically, such settings increase perceived freshness and boost

purchase intention. These results support existing literature on scene authenticity and immersive experiences, which suggests that realistic rural environments foster consumer trust [32]. Therefore, marketers promoting minimally processed goods should prioritize origin-location live streams and incorporate real-time visuals of harvesting, production, or farm scenery to evoke freshness. In contrast, for highly processed products, background effects are weaker. In these cases, marketers should emphasize other quality signals, such as organic certification, transparent processing methods, or expert endorsements.

On the other hand, our findings on rural sentiment provide guidance for audience segmentation in live-stream campaigns. For consumers with strong rural sentiment, origin-based backgrounds are especially effective in enhancing purchase intention for less processed goods. Marketers can tap into this emotional alignment by emphasizing regional branding (e.g., "local specialties" or "supporting local farmers"). Streamers might use local dialects, nostalgic storytelling, or folk references to strengthen emotional connection. For audiences with low rural sentiment, Study 4 shows that background cues are less impactful. Marketers targeting this segment should instead focus on rational appeals (e.g., price discounts, limited-time offers, health benefits, or cutting-edge food technologies) to increase engagement and conversion.

9.3. Limitations and Further Research

Despite providing valuable insights into the interaction between live-streaming backgrounds and product characteristics, this research has several limitations. First, the lab-based nature of our experiments may limit external validity. We used static screenshots and short video clips with fictional brands, and no real money was involved. Factors such as price, brand, and social interactions were not controlled. Viewers might also respond differently to backgrounds over extended viewing periods; an origin-based background could become distracting after prolonged exposure. Future research could use field experiments on real platforms or analyze authorized transaction data to validate our findings. Second, this research did not examine other factors that may influence the observed effects. For example, streamer identity (e.g., "county mayor" vs. "influencer" streamers) could moderate consumer responses. Additionally, we did not collect detailed demographic information (e.g., education, income) beyond age, gender, and geographic location. Future studies could explore these factors and their interactions with background and product characteristics. Third, the generalizability of our findings may be limited by the specific product categories and sample characteristics. While we tested four product pairs spanning aquatic, fruit, meat, and dairy products, future research could extend to other agricultural categories. Our samples were recruited from Credamo, an online panel that skews toward younger, urban populations, which may not fully represent rural consumers. All data were collected from Chinese consumers; cross-cultural validation in other markets would also help establish broader applicability.

9.4. Conclusions

Across the four studies, the magnitude of the indirect effect of perceived freshness varied (Study 1: 0.67; Study 2: 0.18; Study 3: 0.66; Study 4: 0.27). This variation reflects deliberate methodological differences rather than theoretical inconsistency. Study 1 used static screenshots, which made the background highly salient, whereas Studies 2 and 4 used dynamic video clips (17–18 s), where richer sensory information naturally diluted the isolated effect of the background. Product perishability may also influence freshness salience. Importantly, despite variation in absolute magnitude, the direction and statistical significance of the mediation remained consistent across all studies—origin-based backgrounds enhanced purchase intention through perceived freshness for minimally processed

products, but not for highly processed ones. This pattern supports the robustness of our theoretical conclusions.

In summary, this research provides initial evidence that matching live-streaming backgrounds to product processing levels can enhance consumer purchase intentions, with perceived freshness as the key mechanism and rural sentiment as a boundary condition. These findings offer actionable insights for agricultural marketers seeking to optimize live-streaming strategies.

Author Contributions: Conceptualization, S.Y. and F.L.; methodology, F.L.; investigation, D.L. and L.S.; supervision, D.L. and L.S.; writing—original draft, S.Y. and F.L.; writing—review and editing, S.Y., F.L., D.L. and L.S.; data curation, D.L.; funding acquisition, S.Y. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the Key Project of National Social Science Foundation of China (grant no. 22AGL022), the National Natural Science Foundation of China (grant nos. 71772086, 72302119), the Outstanding Teaching Team of Jiangsu Colleges and Universities "Qing Lan Project", the Ministry of Education Humanities and Social Sciences Planning Project (grant no. 25YJA630069), and the Social Science Foundation of Jiangsu Province (grant nos. 24GLB007, 23GLC016).

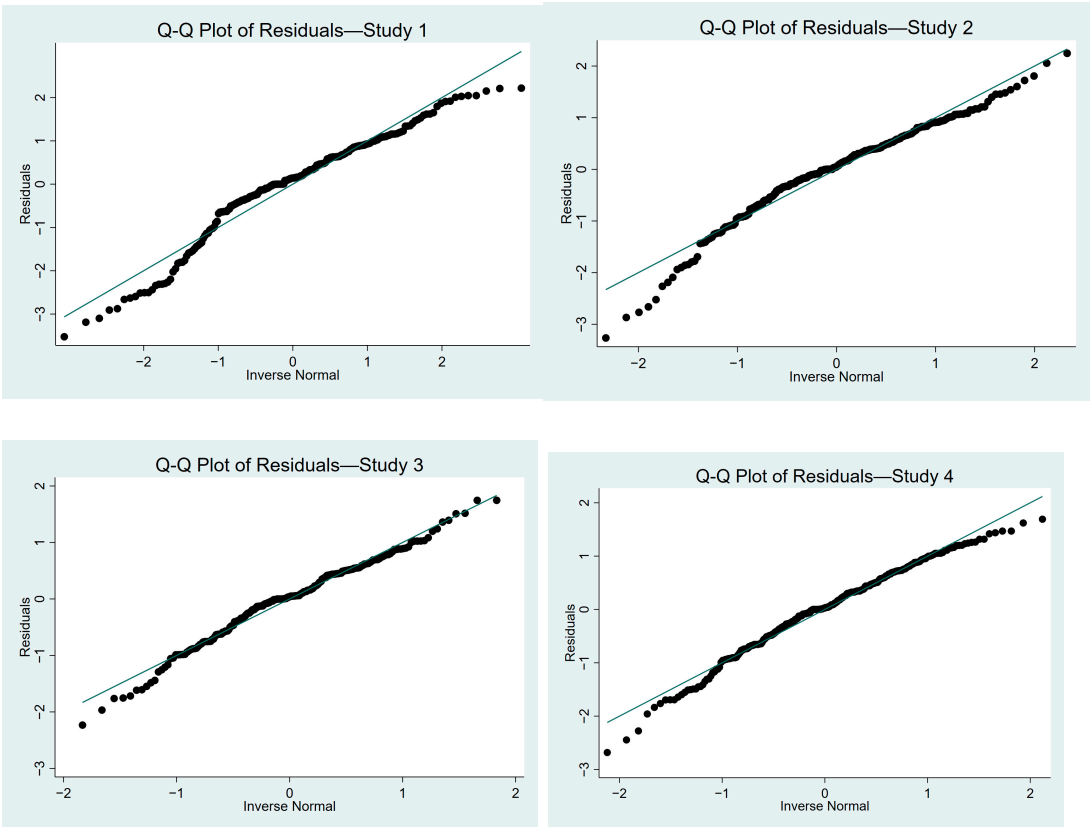
Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Nanjing Tech University Scientific Research Committee (protocol code 2025-01-0036 and date of approval 10 January 2025).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data that support the findings of this research are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A. Q-Q Plots of Residuals Across Four Studies



Appendix B. Variables Measured in the Experiments

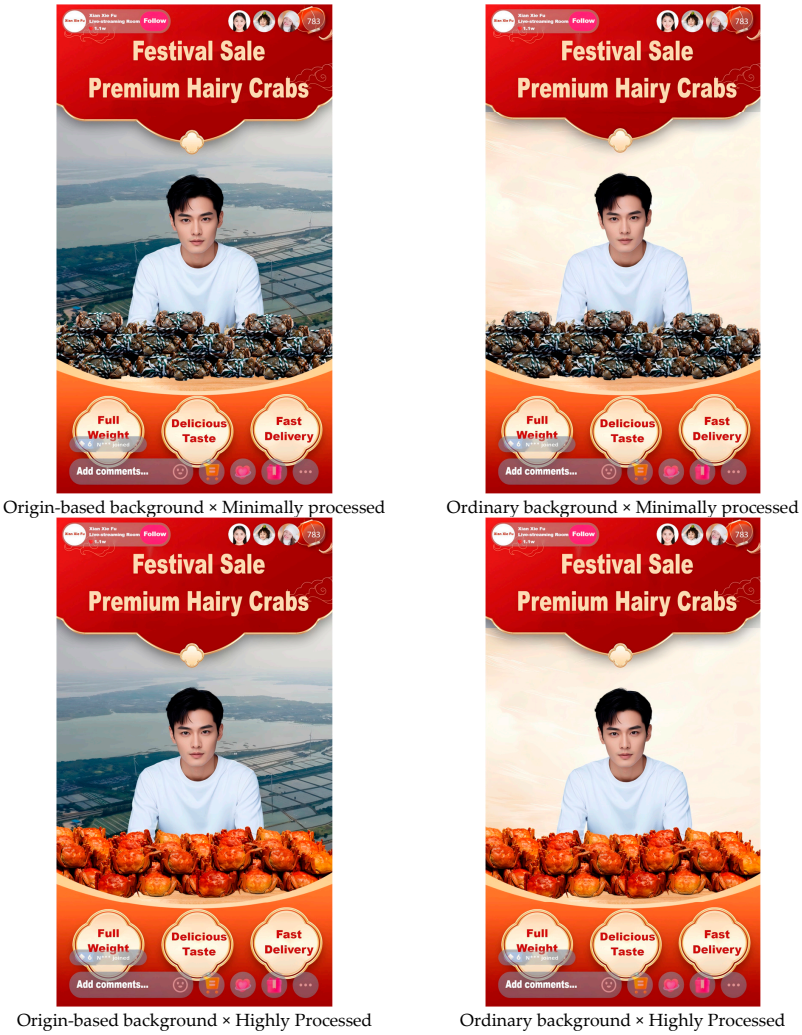
Table A1. Variables and measurement items.

Variables and Items	Sources
Purchase intention	
1. I will purchase the product from this live-streaming room.	[92]
2. Given a choice, my friends will choose the product from this live-streaming room.	
3. There is a strong likelihood that I will buy the product from this live-streaming room.	
4. I would like to recommend the product from this live-streaming room to my friends.	
Perceived Freshness	
1. How fresh is the product sold in this live-streaming room?	[53]
2. The product sold in this live-streaming room was harvested or caught...	
Rural Sentiment	
1. I believe that the long-standing and splendid Chinese agricultural culture needs to be passed down.	[18]
2. I believe that developing agriculture is a strategic need to ensure the food security of the country.	
3. I think it is important and worthwhile to help farmers earn a good life.	
4. I have a dream of idyllic life in the countryside.	
Mental vividness	
1. My experience with the product in the live-streaming room is similar to that in the real world.	[93]
2. My experience with the product in the live-streaming room is that it feels like a "real product" rather than a "virtual product".	
3. When watching the live streaming, I feel like the product is presented in front of me physically.	
Positive emotions	
1. When watching the live streaming, I feel happy.	[94]
2. When watching the live streaming, I feel relaxed.	
3. When watching the live streaming, I feel cheerful.	
4. When watching the live streaming, I feel fun.	
5. When watching the live streaming, I feel a sense of closeness.	
Social presence	
1. There is a sense of human contact in the live streaming.	[42]
2. There is a sense of sociability in the live streaming.	
3. There is a sense of human warmth in the live streaming.	

Table A1. *Cont.*

Variables and Items	Sources
4. The live streaming makes it seem more like the others and I are in the same room.	
5. It seems more like the others and I are having a face-to-face conversation.	
Immersion	
1. When watching the live streaming, I am deeply engrossed.	
2. When watching the live streaming, I am absorbed.	[6]
3. When watching the live streaming, my attention is focused.	
Emotional attachment	
1. I would like to be friends with the live streamer.	
2. I would like to interact with the live streamer in the future.	[95]
3. I am interested in learning more about the live streamer.	

Appendix C. Experimental Materials Used in Study 1



Origin-based background × Minimally processed

Ordinary background × Minimally processed

Origin-based background × Highly Processed

Ordinary background × Highly Processed

Figure A1. Screenshots used in Study 1.

In the formal experiment, we set up the following scenario: "Suppose you are shopping online for live crabs (drunken crabs) and enter a live-streaming room while browsing a shopping app, where the streamer is introducing the product". Subsequently, we showed the participants a screenshot of the live-streaming room (as shown above) and the streamer's introduction to the product. The product introduction is as follows.

Introduction to live crabs: Welcome to the Xian Xie Fu live-streaming room, my dear friends! The link number 1 is for our premium live crabs. They are sourced from ecological waters and scientifically farmed. Each one has a thin shell, thick and juicy meat, and is full of roe and fat. They are incredibly delicious. A standardized cold chain logistics protocol is employed for the delivery of these products, ensuring compliance with quality and safety requirements during transportation. If you like it, don't hesitate and place your order quickly!

Introduction to drunken crabs: Welcome to the Xian Xie Fu live-streaming room, my dear friends! The link number 1 is for our premium drunken crabs. They are sourced from ecological waters and scientifically farmed. Each one has a thin shell, thick and juicy meat, and is full of roe and fat. They are incredibly delicious. A standardized cold chain logistics protocol is employed for the delivery of these products, ensuring compliance with quality and safety requirements during transportation. If you like it, don't hesitate and place your order quickly!

Appendix D. Experimental Materials Used in Study 2

Origin-based live-streaming background × Minimally processed
https://b23.tv/BV1SpcteREyf (accessed on 17 April 2026)
Ordinary live-streaming background × Minimally processed
https://b23.tv/BV1gpctedEjt (accessed on 17 April 2026)
Origin-based live-streaming background × Highly processed
https://b23.tv/BV1aEctetEaj (accessed on 17 April 2026)
Ordinary live-streaming background × Highly processed
https://b23.tv/BV1aEctetEyb (accessed on 17 April 2026)
Streamer's product introduction is as follows.

Introduction to oranges: Welcome to the Cheng Xiao Xian live-streaming room, my dear friends! The link number 1 is for our fresh oranges that we pick directly from our farm. They are rich in high levels of Vitamin C. If you place an order in the live room now, we will arrange for shipping within 24 h and deliver them through a cold chain logistics system. If you like it, don't hesitate to place your order quickly!

Introduction to orange juice: Welcome to the Cheng Xiao Xian live-streaming room, my dear friends! The link number 1 is for our freshly squeezed orange juice that we pick directly from our farm. They are rich in high levels of Vitamin C. If you place an order in the live room now, we will arrange for shipping within 24 h and deliver them through a cold chain logistics system. If you like it, don't hesitate to place your order quickly!

Appendix E. Experimental Materials Used in Study 3

Origin-based live-streaming background × Minimally processed
https://b23.tv/BV1pBcteyEt5 (accessed on 17 April 2026)
Ordinary live-streaming background × Minimally processed
https://b23.tv/BV1kBcteyEr5 (accessed on 17 April 2026)
Origin-based live-streaming background × Highly processed
https://b23.tv/BV18HctexER9 (accessed on 17 April 2026)
Ordinary live-streaming background × Highly processed
https://b23.tv/BV1pBcteyEFV (accessed on 17 April 2026)

Streamer's product introduction is as follows.

Introduction to raw beef: Welcome to the Niu Xiang Fu live-streaming room, my dear friends! We use authentic yellow cattle and only select fresh beef hind legs to restore the original flavor of beef. It is nutritious and healthy, and adults and children can eat it with confidence. The whole process is cold chain transportation and door-to-door delivery. If you like the product, don't hesitate to place an order!

Introduction to spiced beef: Welcome to the Niu Xiang Fu live-streaming room, my dear friends! We use authentic yellow cattle and only select fresh beef hind legs to restore the original flavor of beef. It is nutritious and healthy, and adults and children can eat it with confidence. The whole process is cold chain transportation and door-to-door delivery. If you like the product, don't hesitate to place an order!

Appendix F. Experimental Materials Used in Study 4

Origin-based live-streaming background × Minimally processed
https://b23.tv/BV18pcteREJV (accessed on 17 April 2026)
Ordinary live-streaming background × Minimally processed
https://b23.tv/BV18pcteREMn (accessed on 17 April 2026)
Origin-based live-streaming background × Highly processed
https://b23.tv/BV1DpcteRENW (accessed on 17 April 2026)
Ordinary live-streaming background × Highly processed
https://b23.tv/BV1hpcteREw2 (accessed on 17 April 2026)
Streamer's product introduction is as follows.

Introduction to milk: Welcome to the Mu Bao live-streaming room, my dear friends! The link number 1 is for our fresh milk. It contains 100% raw cow's milk. It is high in calcium and protein, and has high nutritional value. The production date is very recent. It is shipped from the official flagship store, delivered via SF Express cold chain. The earlier you place the order, the sooner it will be shipped. If you like it, don't hesitate and place your order quickly!

Introduction to yogurt: Welcome to the Mu Bao live-streaming room, my dear friends! The link number 1 is for our fresh milk. It contains over 95% raw cow's milk. It is high in calcium and protein, and has high nutritional value. The production date is very recent. It is shipped from the official flagship store, delivered via SF Express cold chain. The earlier you place the order, the sooner it will be shipped. If you like it, don't hesitate and place your order quickly!

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