

# Impact of Blockchain Label on Brand Trust in the Organic Food Industry: Revealing the Role of Consumer Health Consciousness and Benefits Disclosure

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## 블록체인 라벨이 유기농 식품산업에서 브랜드 신뢰에 미치는 영향: 소비자의 건강 의식과 편익 공개의 역할

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### Abstract

This study explores the impact of blockchain traceability label on brand trust in the organic food industry. We collected 479 valid online questionnaires through a paid survey platform and employed one-way ANOVA to analyze brand trust across different label types. Two-way ANOVA was conducted to assess the moderating effects of consumer health consciousness and benefits disclosure. Our findings verify that customers exposed to blockchain traceability label

demonstrate higher brand trust level compared with those encountering standard label or no label. Furthermore, consumers with high level of health consciousness consistently show a stronger preference for products featuring blockchain traceability label or standard traceability label. Moreover, altruistic disclosure in the presence of blockchain traceability label enhances brand trust to a greater extent, despite the minimal difference between egoistic and altruistic disclosure. These insights provide valuable implications for businesses aiming to enhance brand trust and consumer confidence in the organic food industry.

*Keywords:* Blockchain Traceability Label, Signal Theory, Health Consciousness, Disclosure Scenarios

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## I. Introduction

The surge in organic food consumption in China, fueled by an escalating awareness of healthy dietary choices, has intensified competition among various organic food brands. The statistical data indicates that the market size of China in 2022 was approximately 869.4 billion yuan, with a total production volume of about 26.741 million tons. From industry giants like Sanyuan, Yili, and Mengniu to niche players such as Green Home and Nature's Bounty, the market has become increasingly diverse. While this heightened demand holds promise for brand manufacturers, concerns linger about potential adverse effects on broader organic brands (Ellison et al., 2016). In navigating this complex landscape, a closer examination of consumer behavior and decision-making within the Chinese organic food market is essential.

Organic foods, often produced through regulated and certified processes, establish credibility among consumers (Kahl et al., 2012). However, the elongated stages of production, processing, and marketing introduce information asymmetry between buyers and sellers (Zhao et al., 2019), making it challenging for consumers to assess the quality of organic food accurately. In addressing this challenge, governments have implemented food traceability systems, reduced un-

certainty and attracting consumers, thereby boosting organic food sales (Lin et al., 2021).

The rapid evolution of blockchain technology has introduced a revolutionary tool for enhancing traceability and transparency in the food supply chain. Blockchain's immutable records trace every step from production to sale, ensuring unparalleled traceability and quality. This technology not only aligns with consumer demands for verifiable information but also holds the potential to significantly increase consumer trust in food products (Niknejad et al., 2021). Blockchain tracking is already being used in various industries. For instance, in the pharmaceutical industry, blockchain ensures the authenticity of drugs, tracing them from manufacturing to the end consumer, thus preventing counterfeit drugs (Zhang et al., 2018). The automotive industry uses blockchain for tracking the provenance of car parts, ensuring quality and authenticity (Gerger, 2021). In contrast, the organic food sector uses blockchain to enhance transparency in the production process, providing consumers with detailed information about farming practices, organic certification, and supply chain logistics (Lin et al., 2021). Signal theory, which has been extensively utilized in assessing brand attributes, assumes critical importance in contexts where consumers face uncertainties regarding brand quality, as outlined by Karanges et al (2018). Despite the considerable body of research, including studies by Akdeniz and Talay (2013), Singh and Sirdeshmukh (2000), and Treiblmaier and Garaus (2023), that explores label as quality signal for products, there is a notable gap in empirical evidence concerning the effects of label, particularly those that leverage blockchain technology, on brand trust.

This study aims to bridge this research gap by focusing on consumer health consciousness (high concern, moderate concern and little or no concern) and blockchain benefits disclosure (self-disclosure, altruistic disclosure and no disclosure) as a crucial moderating variable. Unlike previous studies that technological application, this research will delve into the nuanced impact of consumer health consciousness and benefits disclosure on consumer perceptions of enhanced brand trust. To guide this exploration, the study poses the following research questions:

Q1: How does the use of blockchain traceable label contribute to greater consumer stronger brand trust in comparison to alternative label?

Q2: What role does consumer health consciousness (high concern, moderate concern and little or no concern) and benefits disclosure (altruistic benefits disclosure, egoistic benefits disclosure, or non-disclosure) play in consumers' perceptions of enhanced brand trust facilitated by blockchain traceable label?

This research extends the domain of signal theory by examining how blockchain traceable label serve as quality signal that enhance brand trust. It addresses a critical gap identified in prior literature regarding the influence of technologically advanced labeling systems on consumer perceptions of brand credibility. Specifically, the study contrasts blockchain traceable label with alternative labeling mechanisms, providing empirical evidence on their relative efficacy in fostering trust among consumers. Additionally, by categorizing consumer health consciousness levels and types of benefit disclosures, this study offers a nuanced understanding of how different segments of consumers interpret and react to the blockchain traceable label, expanding the applicability of signal theory to more complex consumer decision-making scenarios. From a practical standpoint, this study provides actionable insights for marketers and brand managers in the organic food industry and potentially other sectors interested in leveraging blockchain technology for product labeling.

## II. Literature Review

### 2.1 Signal Quality in Marketing

Michael (1973) signal theory, serving as a fundamental framework for addressing information asymmetry within markets, plays a crucial role in deciphering consumer behavior. This theory, widely recognized in labor market research, elucidates how individuals strategically employ signals, such as educational credentials, to mitigate information asymmetries effectively. Kirmani and Rao (2000) illustrative example further dissects this signaling model, intricately distinguishing high-quality from low-quality firms. The emphasis lies on the perpetuating information asymmetry existing between firms and their external stakeholders.

In the domain of marketing, the fundamental elements of the marketing mix, including pricing descriptions, labels, and logos, serve as multifaceted signals that convey brand and firm quality, these components play a pivotal role in shaping consumer perceptions and behaviors, highlighting their significance in brand management and communication strategies (Boulding and Kirmani, 1993; Grunert, 2005). Credible sources, a cornerstone in consumer decision-making, play a vital role in augmenting trust, shaping attitudes, and fostering brand loyalty (Erdem and Swait, 2004; Singh and Banerjee, 2018). Recent research underscores the pivotal role of traceability label as potent signals denoting high product quality (Treiblmaier and Garaus, 2023). These labels, particularly significant in the organic food sector characterized by information asymmetry (Zhao et al., 2019), act as effective tools in mitigating perceived uncertainty for consumers (Pavlou et al., 2007). The advent of blockchain-enabled traceability systems further amplifies this influence, providing a transparent and verifiable information landscape that holds the potential to significantly shape brand trust and empower consumers in making well-informed choices.

## 2.2 Building Trust in Consumer Decision-Making

Trust, as a cornerstone in consumer and brand relationships, hinges on the belief in the honesty and reliability of the other party's behavior. Grounded in the notion of honesty, trust implies a commitment to promises without opportunistic intentions (Rubio et al., 2014). In consumption, trust reflects buyers' expectations about the transparency and integrity of information provided by sellers (Pavlou and Gefen, 2004). Brand credibility, as further elaborated by Erdem and Swait (2004), Hussain et al. (2020) and Jain et al. (2022), encompasses the collective influence of a company's past marketing efforts.

Brand trust is pivotal in consumer behavior, influencing perceptions, attitudes, and behaviors toward brands. It shapes brand loyalty, purchase intentions, and the willingness to engage with the brand (Chaudhuri and Holbrook, 2001). A key dimension of brand trust lies in the perceived believability of a brand's ability, dedication, and willingness to consistently fulfill promises (Bekk and Spörrle, 2010). When trust is established, consumers perceive the brand as reliable, fostering increased brand loyalty and positive word-of-mouth communication.

Beyond influencing consumer decisions, brand trust serves as a risk-reduction mechanism, making consumers feel less vulnerable in transactions (Kia, 2016).

In today's competitive marketplace, the establishment and sustenance of brand trust are pivotal for success. Assessing brand trustworthiness involves decoding various cues and signals (Hussain et al., 2020). Brand managers must prioritize strategies fortifying brand trust, given its direct impact on consumer choices and the cultivation of enduring brand relationships.

### 2.3 Consumer Health Consciousness

With a growing awareness of risk factors and the benefits of adopting healthier lifestyles, such as regular exercise and the consumption of fruits and vegetables, individuals are increasingly motivated to make choices that promote their well-being. This shift towards healthier living not only has the potential to mitigate the prevalence of diseases like cardiovascular ailments and cancer but also underscores a broader societal emphasis on wellness (Iversen and Kraft, 2006). A pivotal aspect of this health-conscious trend is the burgeoning interest in organic food consumption, driven by the belief that it contributes to improved health outcomes (Mollet and Rowland, 2002). The decision-making process regarding organic food purchases is often anchored in individuals' health consciousness, which encompasses a spectrum of attitudes towards disease prevention and health promotion (Newsom et al., 2005).

Comparative studies have shown that health-conscious consumers exhibit distinct purchasing behaviors compared to their counterparts who prioritize other factors over health concerns (Iversen and Kraft, 2006). Similarly, Buaprommee and Polyorat (2016) observed that health-conscious consumers place a premium on the quality attributes of meat products, viewing them as essential contributors to overall health. Consequently, these consumers may place greater reliance on quality assurance measures, such as traceability systems, to safeguard against potential health risks associated with inferior products. In this study, consumer health consciousness is framed as a multifaceted construct that molds individuals' perspectives on the traceability label of products.

### 2.4 Benefits Disclosure

Benefits disclosure, in the context of prior research, refers to the practice of providing individuals with clear and comprehensive information about the benefits they are entitled to receive (Cheng et al., 2021). The primary objective of benefits disclosure is to ensure that individuals have access to complete and transparent information about the advantages they can expect from a particular product, service, or employment package (Huaman-Ramirez et al., 2022; Wang et al., 2022). The concept of disclosure has received widespread attention, but most research on this topic has focused on consumers (Melumad and Meyer, 2020; Oghazi et al., 2020) and brand disclosure (Huaman-Ramirez et al., 2022). Little consideration has been given to third-party certifications, such as blockchain traceability systems, benefiting from disclosure.

Empirical evidence from blockchain-based food traceability systems suggests that they enhance seller trust (Garaus and Treiblmaier, 2021). However, consumers do not always comprehend this, and overall, consumer understanding of different attributes of blockchain remains limited. Therefore, the impact of third-party verification on consumer behavior depends not just on its mere existence but also on consumers' perception of its presence. Consequently, the influence of third-party verification on consumer trust depends on the communication process through which consumers gain insight into this institutional structure (Gorton et al., 2021). Recent research indicates that egoistic and altruistic values are significant factors influencing the willingness to purchase organic food (Yadav, 2016).

### III. Theoretical Model and Research Hypotheses

#### 3.1 Blockchain Traceability Label and Brand Trust

Drichoutis et al (2006) argue that nutritional label can be conceptualized as trust attributes, addressing consumers' information inefficiency and facilitating healthier food choices. Trust significantly influences consumer behavior, as distrust can lead to the discounting or disregard of label (Darnall and

Vázquez–Brust, 2018). Research by Fan et al (2022) and Garaus and Treiblmaier (2021) advocates for brand retailers to leverage blockchain advantages in marketing, emphasizing that credible sourcing can enhance consumer trust and influence choices. Blockchain label, compared to standard traceability label or no label, offer enhanced transparency and traceability, this level of transparency ensures that consumers can verify the authenticity and origins of the organic food they purchase, addressing concerns about food safety and fraud (Tian, 2016). Standard traceability label, while informative, do not offer the same level of security and trust due to potential vulnerabilities in traditional record–keeping and reporting system.

Therefore, blockchain label are more effective than standard traceability label or no label in enhancing brand trust. In the context of organic food, consumers rely on the credible signals conveyed by these labels to evaluate their trust in a brand, thereby reducing perceived risks. In summary, Hypothesis 1 is expressed as follows:

H1: Customers exposed to a blockchain–based traceability label will have stronger brand trust for the target product than those exposed to a standard traceability label or no label.

### 3.2 The Roles of Consumer Health Consciousness

Consumer health consciousness, defined as the extent to which individuals prioritize health–related factors in their decision–making processes, plays a significant role in shaping consumer perceptions and behaviors towards food products(Gould, 1988). Previous research has shown that individuals with higher levels of health consciousness tend to pay more attention to product attributes related to wellness and sustainability (Buhrau and Ozturk, 2018; Mai and Hoffmann, 2012; Uzdavinyte et al., 2019).

In the context of organic food, the presence of labeling, whether it's standard traceability label or blockchain traceability label, can influence consumer trust in brand. However, the unique attributes of blockchain technology, such as enhanced transparency and security, may contribute to higher levels of brand trust among consumers, especially those with heightened health consciousness. Research by

Mai and Hoffmann (2012) emphasizes the moderating role of consumer health consciousness in the relationship between labeling and brand trust. In the context of this study, the varying levels of consumer health consciousness influence the degree to which consumers perceive organic food-related traceability label as market signals. Therefore, hypothesis 2 can be formulated as follows:

H2: Higher health consciousness leads to greater brand trust in the presence of a blockchain traceability label compared to moderate or low health consciousness level. For standard traceability label and no label, the effect of health consciousness on brand trust is not significant.

### 3.3 The Roles of Benefits Disclosure

In recent years, research has increasingly highlighted the pivotal role of values in shaping consumer behavior. For instance, in another study involving Australian wine consumers conducted by Remaud et al (2008), consumer preferences for organic attributes were compared to other environmental claims (e.g., carbon-neutral or environmentally responsible), price, and place of origin. The results indicated that while organic attributes received limited attention from typical Australian wine consumers, a minority highly valued environmentally friendly wines and were willing to pay a premium for them. Furthermore, Garaus and Treiblmaier's research in 2021 underscores the critical role of information diagnosticity in establishing trust with retailers. Their findings emphasize that regardless of whether egoistic or altruistic benefits are disclosed, the diagnosticity of information is pivotal in gaining consumer trust.

When blockchain traceability label is accompanied by information that emphasizes the ethical and societal advantages of transparent supply chain, consumers are more likely to perceive these brands as socially responsible and trustworthy. This is because altruistic disclosures highlight the broader impact on society and the environment, aligning with the values of socially conscious consumers who prioritize ethical consumption (Klein & Dawar, 2004). Conversely, egoistic benefits disclosure underscores the personal advantages consumers can derive from blockchain-based traceability, such as enhanced product quality and safety. While these personal benefits are important, they may not be as compel-

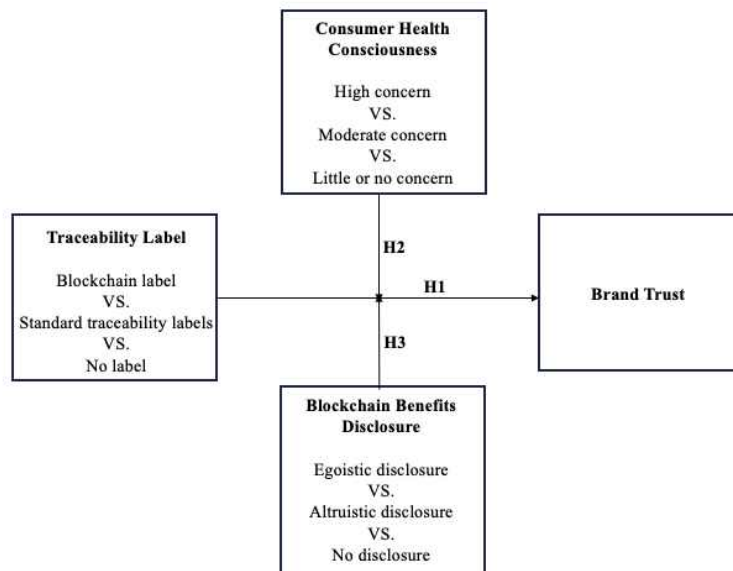
ling in fostering brand trust as altruistic benefits. This is because altruistic benefits resonate with consumers' desire to support socially responsible practices, which can enhance their overall perception of the brand's integrity and ethical standing (Ellen et al., 2006).

In the context of both blockchain and standard traceability label, altruistic disclosures are expected to foster higher brand trust compared to egoistic disclosures or no disclosures. However, the unique transparency and immutability features of blockchain technology may amplify the perceived credibility and trustworthiness of altruistic disclosures even further, making the impact more pronounced. In summary, Hypotheses 3 is expressed as follows:

H3: Altruistic disclosure lead to greater brand trust in the presence of a blockchain traceability label compared to egoistic or no disclosure. For standard traceability label and no label, the effect of the type of disclosure on brand trust is not significant.

The proposed model is illustrated in Figure 1.

<Figure 1> Research Model



## IV. Materials and Methods

In this research, we focused on participants who are consumers of organic food in China and carried out a national sampling survey using online questionnaires. To ensure the clarity and logical coherence of the questions, scholars knowledgeable about the topic and individuals unfamiliar with the research subject pre-tested all the questionnaires.

To validate the direct impact of traceability label on brand trust and investigate the influence of consumer health consciousness and benefits disclosure, this study focuses on the organic milk sector. Specifically, we chose a recently launched brand of organic milk to capture real-time consumer perceptions and behaviors in response to traceability label. We designated no label and standard traceability label as control groups, with blockchain-based traceability label as the experimental group (see Figure 2). In the no-label condition, the brand was presented without any manipulation or modification of its original appearance. In the standard traceability label and blockchain-based traceability label conditions, we created fictional labels (i.e., QR code and blockchain code).

Participants were informed that the standard traceability code provides only information related to the product's origin. This code offers details about where the product came from, but does not include information about the production process or other relevant details. On the other hand, the blockchain traceability code is designed to enable complete product tracing using blockchain technology. This code includes all relevant information such as the product's origin, production stages, transportation processes, storage conditions, and more. Since blockchain technology prevents data tampering and ensures the reliability of each stage, this code allows for trustworthy tracking of the entire product journey. At the beginning of the experiment, participants first reviewed detailed descriptions of the standard traceability label (QR code) and blockchain-based traceability label (blockchain code). Subsequently, participants were asked, "Can you clearly distinguish between standard traceability label and blockchain traceability label?" If they answered "yes", they were then randomly assigned to one of three experimental conditions and commenced evaluating products across all three experimental groups.

<Figure 2> Control Groups and Experimental Group



#### 4.1 Data Collection

The finalized surveys were collected online through the paid survey platform Sojump (<http://www.sojump.com>) in December 2023. After excluding incomplete responses, the ultimate dataset comprised a total of 479 valid questionnaires, with 235 respondents identifying as male (49.1%) and 244 as female (50.9%). In terms of age distribution, 123 participants were aged 29 or below (25.7%), 143 fell between 30 and 39 years old (29.9%), 116 were situated between 40 and 49 years old (24.2%), and 97 were 50 years old or above (20.3%). Regarding income, 119 individuals reported incomes of 5000 yuan or below (24.8%), 164 indicated incomes ranging from 5000 to 10000 yuan (34.2%), and 196 reported incomes of 10000 yuan or above (40.9%). In relation to educational background, 49 participants had completed high school or below (10.2%), 111 held college degrees (23.2%), 189 possessed undergraduate degrees (39.5%), and 130 had obtained master's degrees or above (27.1%). Geographically, 203 participants hailed from first-tier cities (42.4%), 170 from second-tier cities (35.5%), and 106 from third-tier cities (22.1%). Regarding their level of attention to personal health, 222 individuals expressed high concern (46.3%), 152 moderate concern (31.7%), and 105 little or no concern (21.9%).

## 4.2 Testing for Possible Biases in the Survey

The examination for non-response bias, a critical method in research (Armstrong and Overton, 1997), was conducted to ensure the integrity of our study. This test assesses whether the timing of survey responses influences survey outcomes. Participants were categorized based on their survey completion date: 362 respondents (75.57%) completed the survey in November 2023, while 117 respondents (24.43%) completed it in December 2023. Analysis via a t-test revealed no significant difference between early and late responders ( $p=0.186$ ), indicating the absence of non-response bias in our study. Furthermore, the reliability of study outcomes may be compromised by severe common method variance (Podsakoff and Organ, 1986). To address this concern, we employed the Harman single-factor test to evaluate variance homogeneity in our dataset. The unrotated first common factor accounted for 38.54% of the total load, falling below the 40% threshold. This suggests minimal common method bias, allowing us to proceed with confidence in our data analysis.

## 4.3 Measures

To examine the moderating influence of consumer health consciousness and benefits disclosure, we employed a 3 (label type: blockchain traceability label, standard traceability label, and no label) x 3 (consumer health consciousness: high concern, moderate concern and little or no concern) and a 3 (label type: blockchain traceability label, standard traceability label, and no label) x 3 (benefits disclosure: egoistic disclosure, altruistic disclosure, and no disclosure) full-factorial between-groups design (see table 1). We manipulated benefits disclosure in three ways: participants either did not receive a press release or read a press release describing either egoistic or altruistic disclosure of traceability. For egoistic disclosure, the press release highlighted benefits such as improved product quality and safety, while for altruistic disclosure, it emphasized societal benefits such as environmental sustainability and ethical sourcing practices. As a manipulation check for benefits disclosure conditions, participants were asked to indicate, under the benefits disclosure condition, which type of disclosure was described after reading the press release. To manipulate consumer

health consciousness, participants were asked about their levels of concern regarding health issues and instructed to select the corresponding category. We have categorized it into three groups: high concern, moderate concern, and little to no concern. This classification is derived from the diverse levels of attention consumers pay to health issues and their reactions to health-related information. The reliability of each item was evaluated through the intercorrelations of the items, resulting in a coefficient of 0.79.

For the assessment of brand trust, we utilized well-established and validated scales. Participants expressed their agreement or disagreement with each measurement item using a 5-point Likert-style scoring method, ranging from strongly disagree (1) to strongly agree (5). The international validation of these scales across diverse studies underscores the suitability and reliability of our chosen measurement instruments. Brand trust was assessed using four items adapted from Huaman-Ramirez et al (2022) and Hussain et al (2020), for example: "This brand's organic milk can ensure food safety." To assess the reliability of these items, Cronbach's alpha coefficient was calculated, resulting in 0.87.

<Table 1> Experiment Design

Experimental groups	Label type	
Group 1	Blockchain traceability label	Egoistic disclosure
Group 2	Standard traceability label	
Group 3	No label	Altruistic disclosure
Group 4	Blockchain traceability label	
Group 5	Standard traceability label	
Group 6	No label	No disclosure
Group 7	Blockchain traceability label	
Group 8	Standard traceability label	
Group 9	No label	High concern
Group 10	Blockchain traceability label	
Group 11	Standard traceability label	
Group 12	No label	Moderate concern
Group 13	Blockchain traceability label	
Group 14	Standard traceability label	
Group 15	No label	Little or no concern
Group 16	Blockchain traceability label	
Group 17	Standard traceability label	
Group 18	No label	

## V. Research Results

### 5.1 Label Type Effect

Table 2's one-way analysis of variance (ANOVA) results confirm a significant difference in the impact on brand trust varies significantly among blockchain traceability label, standard traceability label, and product without label ( $F=118.096, p<0.01$ ). The brand trust associated with blockchain traceability label is significantly higher than that for standard traceability label ( $M_{\text{blockchain traceability label}}=4.064 > M_{\text{standard traceability label}}=3.195; t(476)=8.199, p<0.001$ ) and product without any label ( $M_{\text{blockchain traceability label}}=4.064 > M_{\text{no label}}=2.550; t(476)=15.354, p<0.001$ ). These findings underscore the significant advantages of blockchain traceability label, thereby supporting H1.

<Table 2> One-Way Analysis of Variance Results

	Sum of squares	df	MS	F	p
Brand trust	195.715	2	97.858	118.096	0.005**

\*  $p<0.05$  \*\*  $p<0.01$  \*\*\*  $p<0.001$

### 5.2 Label Type Effect with Consumer Health Consciousness

From Table 3, The interaction between label type and health consciousness is statistically significant ( $F=73.797, p<0.01$ ). Subsequent multiple comparisons indicate that in scenarios where the product displays a blockchain traceability label, consumers with high health concern exhibit higher level of brand trust compared to those with moderate health concern ( $M_{\text{high concern}}=4.266 > M_{\text{moderate concern}}=4.087; t(160)=2.731, p<0.001$ ) and those with little or no concern ( $M_{\text{high concern}}=4.266 > M_{\text{little or no concern}}=3.276; t(160)=5.055, p<0.001$ ). Similarly, in scenarios where the product displays a standard traceability label, consumers with high health concern exhibit higher level of brand trust compared to those with moderate health concern ( $M_{\text{high concern}}=3.542 > M_{\text{moderate concern}}=3.197; t(137)=1.703, p<0.001$ ) and those with little or no concern ( $M_{\text{high concern}}=3.542 > M_{\text{little or no concern}}=2.848; t(137)=4.349, p<0.001$ ). However, in scenarios where the product

has no label, consumers with high health concern do not exhibit higher level of brand trust compared to those with moderate health concern ( $M_{\text{high concern}}=2.492 < M_{\text{moderate concern}}=2.685$ ;  $t(182)=1.530$ ,  $p < 0.001$ ) and those with little or no concern ( $M_{\text{high concern}}=2.492 < M_{\text{little or no concern}}=2.528$ ;  $t(182)=2.644$ ,  $p < 0.001$ ).

The results indicate that higher levels of health consciousness not only lead to greater brand trust in product with blockchain traceability label but also in those with standard traceability label. These findings partially support H2. Figure 3 illustrates the interaction effect.

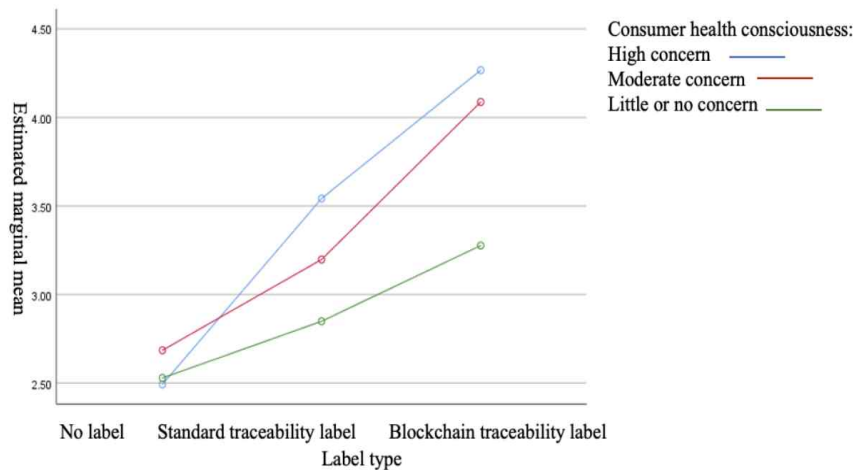
<Table 3> Two-Way Analysis of Variance Results

Source of differences	Sum of squares	df	MS	F	p
Label type	116.813	2	58.407	73.797	0.000***
Consumers health consciousness	19.146	2	9.573	12.096	0.000***
Label type * Consumers health consciousness	13.689	4	3.422	4.324	0.002**
Error	371.98	470	0.791		

$R^2: 0.246$

\*  $p < 0.05$  \*\*  $p < 0.01$  \*\*\*  $p < 0.001$

<Figure 3> Interaction Effects Line Chart for Two Factors (Consumer Health Consciousness)



### 5.3 Label Type Effect with Benefits Disclosure

Through a two-way analysis of variance, exploring the intricate interaction between label types and benefits disclosure in brand trust, the results in Table 4 indicate that the interaction between label types and benefits disclosure is statistically significant ( $F=114.676$ ,  $p<0.05$ ). Subsequent multiple comparisons indicate that in scenarios where the product displays a blockchain traceability label, altruistic disclosure result in higher level of brand trust compared to egoistic disclosure ( $M_{\text{altruistic disclosure}}=4.184 > M_{\text{egoistic disclosure}}=4.141$ ;  $t(160)=4.965$ ,  $p<0.001$ ) and no disclosure ( $M_{\text{altruistic disclosure}}=4.184 > M_{\text{no disclosure}}=3.828$ ;  $t(160)=9.637$ ,  $p<0.001$ ). However, in scenarios where the product displays a standard traceability label, no disclosure demonstrates higher level of brand trust compared to altruistic disclosure ( $M_{\text{no disclosure}}=3.358 > M_{\text{altruistic disclosure}}=3.163$ ;  $t(137)=4.483$ ,  $p<0.001$ ) and egoistic disclosure ( $M_{\text{no disclosure}}=3.358 > M_{\text{egoistic disclosure}}=3.025$ ;  $t(137)=8.506$ ,  $p<0.001$ ). In scenarios where the product has no label, egoistic disclosure demonstrates higher level of brand trust compared to altruistic disclosure ( $M_{\text{egoistic disclosure}}=2.683 > M_{\text{altruistic disclosure}}=2.405$ ;  $t(182)=4.772$ ,  $p<0.001$ ) and no disclosure ( $M_{\text{egoistic disclosure}}=2.683 > M_{\text{no disclosure}}=2.583$ ;  $t(182)=8.640$ ,  $p<0.001$ ).

The results indicate that only in the presence of blockchain traceability label, altruistic disclosure leads to greater brand trust compared to egoistic or no disclosure. This supports hypothesis H3, although the difference between egoistic and altruistic disclosure is minimal. Figure 4 illustrates the interaction effect.

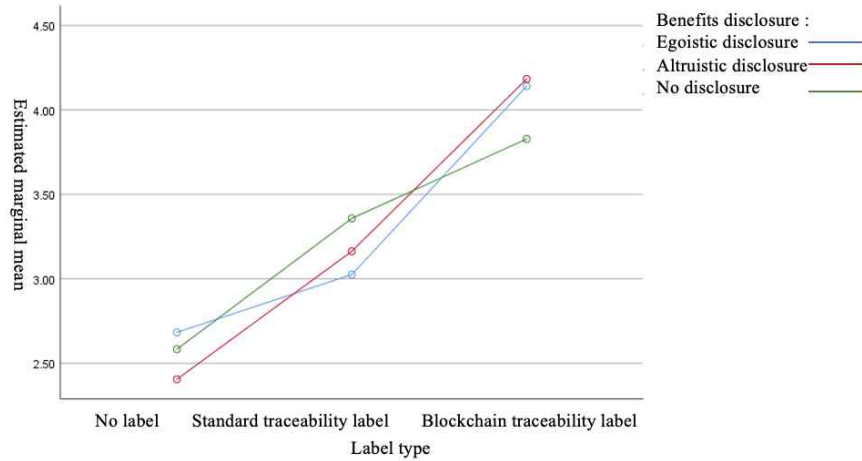
<Table 4> Two-Way Analysis of Variance Results

Source of differences	Sum of squares	df	MS	F	p
Label type	188.147	2	94.074	114.676	0.000***
Benefits disclosure	0.089	2	0.044	0.054	0.947
Label type * Benefits disclosure	8.662	4	2.165	2.364	0.017*
Error	385.562	470	0.820		

$R^2: 0.347$

\*  $p<0.05$  \*\*  $p<0.01$  \*\*\*  $p<0.001$

<Figure 4> Interaction Effects Line Chart for Two Factors (Benefits Disclosure)



## 5.4 Further Analysis

We further examined the impact of other factors on brand trust. Conversely, the statistical findings concerning the interplay between demographic factors such as gender, age, educational background, income levels, and residential location groups with various label types did not yield significant results in impacting brand trust. This underscores the pivotal influence of health consciousness and benefits disclosure in shaping consumer perceptions of label types, particularly within the realm of brand trust.

## VI. Discussion and Conclusions

The continuous development of blockchain technology offers a promising solution through the implementation of a food traceability system, aimed at enhancing consumer trust. Building on this, our study, grounded in the early theoretical work of signal theory perspective, delves into the intricate relationships among

quality signals, traceability label, consumer health consciousness, disclosure of interests, and brand trust. This research contributes to the field of service management by demonstrating how innovative technologies like blockchain can enhance service delivery and customer trust, which are critical aspects of service quality.

The findings reveal that customers exposed to blockchain-based traceability label exhibit higher levels of brand trust compared to those exposed to standard traceability label or no label. This increased trust can be attributed to the perceived integrity and transparency associated with blockchain technology. These results contribute to signaling theory by examining how blockchain traceable label serve as quality signals that enhance brand trust. From a service management perspective, this highlights the importance of integrating cutting-edge technology to improve service transparency and customer perceptions of brand integrity.

Furthermore, the results indicate that higher level of health consciousness not only lead to greater brand trust in product with blockchain traceability label but also in those with standard traceability label. This finding does not support our initial research hypothesis that consumers with high health consciousness are more likely to prioritize products with blockchain label. Consumers perceive both blockchain and standard traceability label as indicators of transparency and reliability, aligning with their stringent standards for health and product integrity. This alignment suggests that health conscious consumers value detailed information about product attributes and production practices, regardless of whether it is provided through blockchain technology or standard methods of traceability. In the context of service management, this emphasizes the need for personalized service strategies that cater to the specific health consciousness level of different consumer segments.

Furthermore, Compared to egoistic or no disclosure, altruistic disclosure in the presence of blockchain traceability labels enhances brand trust to a greater extent, despite the minimal difference between egoistic and altruistic disclosures. However, it's noteworthy that altruistic disclosure still holds importance in specific contexts. Consumers may perceive brands that prioritize transparency and ethical values more positively, particularly when supported by blockchain technology. Brands emphasizing sustainability and ethical practices are more likely to resonate positively with consumers (De Pelsmacker et al., 2005).

Within the realm of service management, this illustrates how ethical practices and transparent communication can significantly enhance service credibility and customer loyalty, providing a strategic advantage in competitive markets.

Thus, while blockchain technology enhances brand trust across various sectors by providing transparency and authenticity, the specific mechanisms and consumer priorities it addresses differ significantly. In the pharmaceutical and automotive industries, the focus is on preventing counterfeits and ensuring product integrity (Gerger, 2021; Zhang et al., 2018), whereas in the organic food sector, the emphasis is on transparency and meeting diverse consumer demands.

## VII. Limitations and Future Research

While our study provides valuable insights into the relationship between label types, health consciousness, benefits disclosure, and brand trust, it is not without limitations. One limitation is the use of a survey-based methodology, which may be subject to limited generalizability. Future research could employ experimental designs or qualitative approaches to provide a deeper understanding of consumer perceptions and behaviors related to label types and brand trust.

Another limitation is the focus on a specific demographic or geographic region, which may limit the applicability of our findings to broader populations. Future studies could explore cross-cultural differences in consumer responses to label types and brand trust to provide a more comprehensive understanding of these phenomena.

Furthermore, while our study identified altruistic disclosure as a significant factor influencing brand trust, the underlying mechanisms driving this relationship remain unclear. Future research could explore the psychological processes underlying consumer responses to different types of disclosure to shed light on this issue.

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경북대학교에서 경제학사, 경영석사를 취득하였으며 현재 경북대학교 경영학부에서 박사과정에 재학 중이다. 주요 관심분야는 물류, 운영관리, 고객만족경영 등이다.

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