BLOCKCHAIN=BETTER FOOD?

The Adoption of Blockchain Technology in the Food Supply Chain

Fei Hao[a*], Yueming Guo[a], Chen Zhang[a,b], Kaye Chon[a]

a. School of Hotel and Tourism Management, The Hong Kong Polytechnic University, Hong Kong, China.
b. Department of Computing, The Hong Kong Polytechnic University, Hong Kong, China.

* Corresponding author

Fei Hao is the corresponding author and she can be reached by Tel: +852-3400 2291 and Email: ffaye.hao@polyu.edu.hk

Emails: ffaye.hao@polyu.edu.hk (F Hao), yueming.guo@polyu.edu.hk (YM Guo), jason-c.zhang@polyu.edu.hk (C Zhang), kaye.chon@polyu.edu.hk (K Chon)

Fei Hao, Ph.D., is Assistant Professor in the School of Hotel and Tourism Management, The Hong Kong Polytechnic University, Hong Kong, China. https//orcid.org/0000-0002-2295-7255
Yueming Guo is Research Assistant in the School of Hotel and Tourism Management, The Hong Kong Polytechnic University, Hong Kong, China. https//orcid.org/0000-0003-2862-4870
Chen Zhang, Ph.D., is joint Assistant Professor in Department of Computing and School of Hotel and Tourism Management, The Hong Kong Polytechnic University, Hong Kong, China. https://orcid.org/0000-0002-3306-9317
Kaye Chon, Ph..D., is Dean and Chair Professor, Walter & Wendy Kwok Family Foundation Professor in International Hospitality Management in the School of Hotel and Tourism Management, The Hong Kong Polytechnic University, Hong Kong, China. https//orcid.org/0000-0001-7981-4741

Acknowledgments: The work described in this paper was fully supported by a grant from (1) a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (Project No. 25504823; PolyU/RGC Project No: P0047204; Project Name: Co-creating value with virtual humans: The effects of non-verbal communication during face-to-face service encounters); (2) a grant from the Innovation and Technology Commission of the Hong Kong Special Administrative Region, China (Project No. ITS/028/22FP; PolyU/RGC Project No: P0043294; Project Name: An Interaction Framework of Hospitality Virtual Human Persona and Brand Personality Consistency); (3) a grant from the Project P0045695, 'Multi-Modal Multi-Label Tourism Statistics Inferring from Publicly Available Geo-Social Footprint Data,' by PolyU (UGC); (4) Walter & Wendy Kwok Family Foundation Professorship in International Hospitality Management.

There is no conflict of interest to declare.

BLOCKCHAIN=BETTER FOOD? The Adoption of Blockchain Technology in Food Supply Chain

Abstract

Purpose - This study investigates the integration of blockchain technology into the food supply chain within the restaurant industry. It focuses on how blockchain can be applied to enhance transparency and trust in tracking food sources, ultimately impacting customer satisfaction.

Design/methodology/approach - A service design workshop (study 1) and three between-subjects experiments (study 2-4) were conducted.

Findings - Results indicate that blockchain adoption significantly improves traceability and trust in the food supply chain. This improvement in turn enhances customer satisfaction through perceived improvements in food safety, quality, and naturalness. The study also notes that the effects of blockchain technology vary depending on the type of restaurant (casual or fine dining) and its location (tourist destinations or residential areas).

Practical implications - The findings offer practical insights for restaurant owners, technology developers, and policymakers. Emphasizing the benefits of blockchain adoption, the study guides decision-making regarding technology investments for enhancing customer service and satisfaction in the hospitality sector.

Originality/value - This research contributes novel insights to the field of technology innovation in the hospitality industry. It extends the understanding of signaling theory by exploring how blockchain technology can serve as a tool for signal transmission in restaurant food supply chains.

Keywords: Blockchain, traceability, trust, food safety, food quality, food naturalness

1. Introduction

Food safety, quality, and naturalness are paramount in the food and beverage (F&B) industry, resonating with consumers worldwide. In the present landscape, consumers are increasingly seeking more information about the food products they purchase, such as the ingredients, the origin, the processing methods, the nutritional value, and the environmental and social impact (Konuk, 2019; Tandon et al., 2020). For example, more than one-third of U.S. adults actively avoid food products due to concerns regarding food safety (International Food Information Council, 2020). Moreover, there has been a notable increase in the demand for plant-based meat substitutes and organic food in the United States and the United Kingdom, respectively, indicating a rising preference for perceived healthier and more natural food alternatives (Good Food Institute, 2023; Bio Eco Actual, 2023). This societal shift towards making informed and conscious food choices underscores the evolving consumer attitudes towards food, recognizing it as an indispensable factor in maintaining a healthy lifestyle. However, the lack of transparency and control over information within the food supply chain can engender trust issues among consumers, thereby emphasizing the pressing need for innovative solutions (Duan et al., 2020).

Blockchain technology may offer a technological solution to the growing concern of food safety, quality, and naturalness in the F&B industry. The technology was first introduced in 2008 with the creation of Bitcoin, but it has since expanded to various industries beyond its initial use case in cryptocurrency (Duan et al., 2020). Blockchain can be defined as a decentralized, immutable ledger that facilitates secure, transparent, and trustworthy transactions without intermediaries (Queiroz et al., 2019). Blockchain's decentralized and distributed nature creates a transparent, permanent record of transactions that is secure and resistant to tampering (Kamilaris et al., 2019). Its immutability ensures data accuracy and consistency, and smart contracts automate processes, improving efficiency and reducing costs (Creydt & Fischer, 2019), and thus can be adopted to enhance food supply chain management.

Notably, blockchain can be used to track various types of information in the food supply chain, including the origin and quality of ingredients, production and processing details, distribution and transportation records, and sales and transaction data (Duan et al., 2020; Rana et al., 2021). Blockchain records every transaction in the supply chain, providing a secure and verifiable record of the origin, quality, and safety of ingredients used in food products (Kamilaris et al., 2019). Blockchain enables businesses to trace the entire journey of their ingredients, from farm to table, and verify their authenticity and quality, thus preventing food fraud and increasing trust between consumers and businesses. In addition, smart contracts in blockchain can automate compliance with food safety regulations and standards, reducing the risk of human error and increasing supply chain efficiency (Queiroz et al., 2019). Despite the growing literature discussing the theoretical benefits of using blockchain in the F&B industry, no empirical study has yet explored this phenomenon.

Therefore, this study aims to investigate the potential of blockchain in the food supply chain in restaurants, and its influence on customers' perceptions of food safety, quality, and naturalness. Specifically, this research paper attempts to explore (1) the impact of blockchain on traceability and trust; (2) the influence of traceability and trust on customers' perceived food safety, quality, and naturalness; (3) how food safety, quality, and naturalness contribute to customer satisfaction; as well as the moderating effects of restaurants' (4) type (casual dining vs. fine dining) and location (residential area vs. tourist destination) on influences of blockchain adoption on traceability and trust. This research paper contributes to the existing literature on technological innovation in hospitality and extends the signaling theory. This research provides valuable insights to restaurant owners, technology companies, and policymakers on the benefits of adopting blockchain to enhance customer satisfaction and make informed decisions to invest in new technologies for customer service in the F&B industry.

2. Literature review

2.1 Signaling theory, menu design, and blockchain technology

Signaling theory is a prominent framework used in social and behavioral sciences to explain how individuals use signals to influence others' perceptions (Connelly et al., 2011). Initially developed in economics to address information asymmetry in markets, signaling theory has found applications in various fields, including marketing, organizational behavior, and psychology (Karasek III & Bryant, 2012). It has been particularly useful in understanding consumer behavior by examining how signals shape consumers' perceptions of product quality and brand image (Peso et al., 2015). In the realm of service providers, signals are employed to convey reliability, competence, and trustworthiness to customers (Yasar et al., 2020).

Menus are essential in the F&B industry for conveying information to customers (Ip & Chark, 2023). They provide a comprehensive list of available food and beverage items, including names, brief descriptions, and prices. The design of a menu is crucial as it aims to attract customers and assist in making informed choices (Davis et al., 2018). It should present important details such as item, price, ingredients, allergens, and nutritional information in an appealing and easily comprehensible manner, ensuring effective communication with customers (Lee & Kim, 2020).

The adoption of QR code menus in restaurant servicescapes has been accelerated by the COVID-19 pandemic (Gonzalez et al., 2022). QR (Quick Response) code technology is a cost-free and widely accessible information technology (Iskender et al., 2022a). Utilizing QR codes can help the industry implement and expand the use of this nearly cost-free technology, leading to reduced printing costs and promotion of sustainability practices (Iskender et al., 2022b). Evidently, displaying nutritional components on e-menus influences customers' decision-making (Yepes, 2015). Moreover, e-menus facilitate communication between restaurants and customers, offering interactive features such as viewing photos, videos, and recipes (Lee & Kim, 2020).

The emergence of new technologies, like blockchain, has provided signaling opportunities through QR code menus in the F&B industry. Blockchain, acting as a shared and secure ledger, records transactions, tracks assets, and enhances trust. This transparent and tamper-proof system significantly improves trust and traceability in the food supply chain (Queiroz et al., 2019). Treiblmaier and Garaus (2023) discovered that blockchain labels can strengthen consumers' perceptions of food quality, leading to increased purchase intentions. Additionally, Bumblauskas et al. (2020) emphasize blockchain's potential to enhance trust and traceability in the food supply chain, ensuring data integrity.

2.2 Traceability

Traceability involves tracking a product or service's history, location, or usage through documented records (Bumblauskas et al., 2020). It allows for monitoring the safety, quality, and naturalness of food products throughout the supply chain (Duan et al., 2020). Blockchain records each transaction and movement in a chain of blocks, creating an unalterable and interconnected record (Queiroz et al., 2019). This transparent and tamper-proof information can be accessed and verified by all participants, providing a clear record of the product's journey (Duan et al., 2020). When integrated with technologies like the Internet of Things (IoT) and information and communication technology, additional details such as origin, production methods, quality, and distribution can be recorded and shared (Zhao et al., 2019). Therefore, the following hypothesis is proposed:

H1. The adoption of blockchain significantly increases perceived traceability.

2.3 Customer trust

Trust is the customer's confidence in a company's ability to meet their needs and deliver satisfactory outcomes (Morgan & Hunt, 1994). In the F&B industry, trust ensures customers feel confident about the products and services they consume (Erkmen & Hancer, 2019).

Blockchain has the potential to enhance trust by providing a transparent and tamper-proof record of transactions and movements in the food supply chain (Westerlund et al., 2021). Santos et al. (2019) developed a blockchain system that ensures ingredient authenticity, signaling to customers the use of genuine and high-quality ingredients. Guo et al. (2021) proposed a blockchain-based food traceability system that contributes to trust enhancement. Therefore, the following hypothesis is proposed:

H2. The adoption of blockchain significantly increases trust.

2.4 Food safety

Food safety refers to the measures and practices in place to prevent, reduce, and eliminate the risks of foodborne illnesses, diseases, and injuries caused by the consumption of contaminated or unsafe food (Knight et al., 2007). Food safety ensures the food products produced and served to consumers are safe to consume and meet regulatory requirements (Bai et al., 2019). Based on the signaling theory, suppliers that prioritize high traceability can improve food safety by providing more comprehensive information about the origin and handling of food products, signaling a business's commitment to transparency and accountability in the supply chain (Tessitore et al., 2022; Dinde & Shirgave, 2023). In a similar vein, food safety information and trust have positive relationships, thereby increasing purchase intention for restaurant customers (Shafieizadeh et al., 2023). Therefore, the following hypotheses are proposed:

H3. (a) Traceability and (b) trust significantly increase perceived food safety.

2.5 Food quality

Food quality encompasses the characteristics of a food product that influence its desirability and acceptability to consumers, including taste, texture, aroma, appearance, and nutritional value (Ha & Jang, 2010). Meeting or exceeding consumer expectations for quality drives customer satisfaction in the F&B industry (Konuk, 2019). Traceability and trust, according to signaling theory, play a role in shaping perceived food quality. Zhao et al. (2020) emphasized the importance of traceability in assessing food quality, using individual animal identification technologies to ensure meat product quality. Trust is also crucial in guaranteeing food quality. Liu et al. (2019) discovered that consumers are willing to pay for traceable food, but their trust in regulations affects their evaluation of food quality. Thus, establishing a reliable food system incorporating traceability is essential for effective food management in the F&B industry. Such a system signals to customers the restaurant's commitment to using high-quality ingredients. Therefore, the following hypotheses are proposed:

H4. (a) Traceability and (b) trust significantly increase perceived food quality.

2.6 Food naturalness

Food naturalness refers to the minimal processing and absence of artificial ingredients or additives in a food product (Siipi, 2013). With increased consumer health consciousness and environmental concerns in food production, the importance of food naturalness has grown (Huang et al., 2022). Natural foods are perceived as healthier and more environmentally sustainable, driving the demand for such products (Tandon et al., 2020). Signaling theory suggests that traceability and trust play crucial roles in shaping customers' perception of food naturalness (Lin et al., 2021; Lazaroiu et al., 2019). Traceability serves as a strategy to signal naturalness, employing molecular techniques to authenticate and detect adulteration in agri-food, enabling producers and retailers to promote their products based on traceability and naturalness (Fanelli et al., 2021). A blockchain-based tracking system, as found by Jannat et al. (2021), ensures food naturalness by assessing quality, source, and authenticity of food products. Additionally, Anastasiadis et al. (2021) discovered that trust values significantly influence consumer acceptance of a food traceability system. Therefore, the following hypotheses are proposed:

H5. (a) Traceability and (b) trust significantly increase perceived food naturalness.

2.7 Customer satisfaction

Customer satisfaction refers to the level of contentment or fulfillment a customer experiences with a product or service (Zhong & Moon, 2020). In the F&B industry, customer satisfaction is crucial for customer loyalty, repeat business, and positive word-of-mouth (Konuk, 2019). Factors such as food safety, quality, and naturalness shape customer satisfaction with restaurants. Implementing food safety measures helps retain customers and ensure loyalty (Dsouza & Sharma, 2020). Negative online reviews related to foodborne illness are linked to decreased customer satisfaction (Hodges et al., 2022). Perceived food quality affects customer satisfaction in various types of restaurants (Konuk, 2019; Zhong & Moon, 2020). The naturalness of food also plays a significant role in customer satisfaction, as a high perception of nutritional value enhances the perceived naturalness and the intention to purchase healthy foods (Huang et al., 2022). Therefore, the following hypotheses are proposed:

H6. Perceived food (a) safety, (b) quality, and (c) naturalness significantly increase customer satisfaction.

3. Study 1

Study 1 utilized a service design workshop to investigate customer perceptions of blockchain and its impact on their dining experience in different scenarios. Service design workshops are effective tools for studying blockchain adoption in the F&B industry. They foster creativity and collaboration, incorporate participant experiences and values, and use multiple methods for data collection. These features provide comprehensive insights into participant attitudes

and perceptions towards blockchain adoption, making workshops valuable and user-oriented research tools (Font et al., 2021).

3.1 Development of scenarios

The research team employed a multi-scenario approach to investigate customer perceptions of blockchain adoption in the F&B industry. This approach analyzes different potential outcomes and interpretations of data, enhancing the reliability, validity, and generalizability of findings (Rafiei & Ricardez-Sandoval, 2020). The selection of egg dishes, salads, coffee drinks, seafood cuisine, and wine as scenarios was based on various factors. Rising concerns about food contamination and foodborne illnesses led to the focus on salads with high-risk produce and seafood cuisine (Hodges, 2022). Food quality concerns prompted the inclusion of egg dishes, which serve as indicators of freshness, hygiene, and authenticity (Liu et al., 2019). Coffee drinks and wine were chosen to represent consumer priorities for health benefits and environmental impact, as they vary in naturalness (Ferreira et al., 2021; Basalekou et al., 2020).

By presenting a food poster of selected products and corresponding information flow chart (See Figures 1 &2), the participants were able to gain a comprehensive understanding of how blockchain can be applied to track the supply chain of ingredients and its potential benefits in the F&B industry. The use of different scenarios also allowed for a diverse range of perspectives and experiences to be considered, aiding in the development of a more comprehensive understanding of customer perceptions towards blockchain adoption.

Figure 1. Two Examples of Food poster

Source: Authors own creation

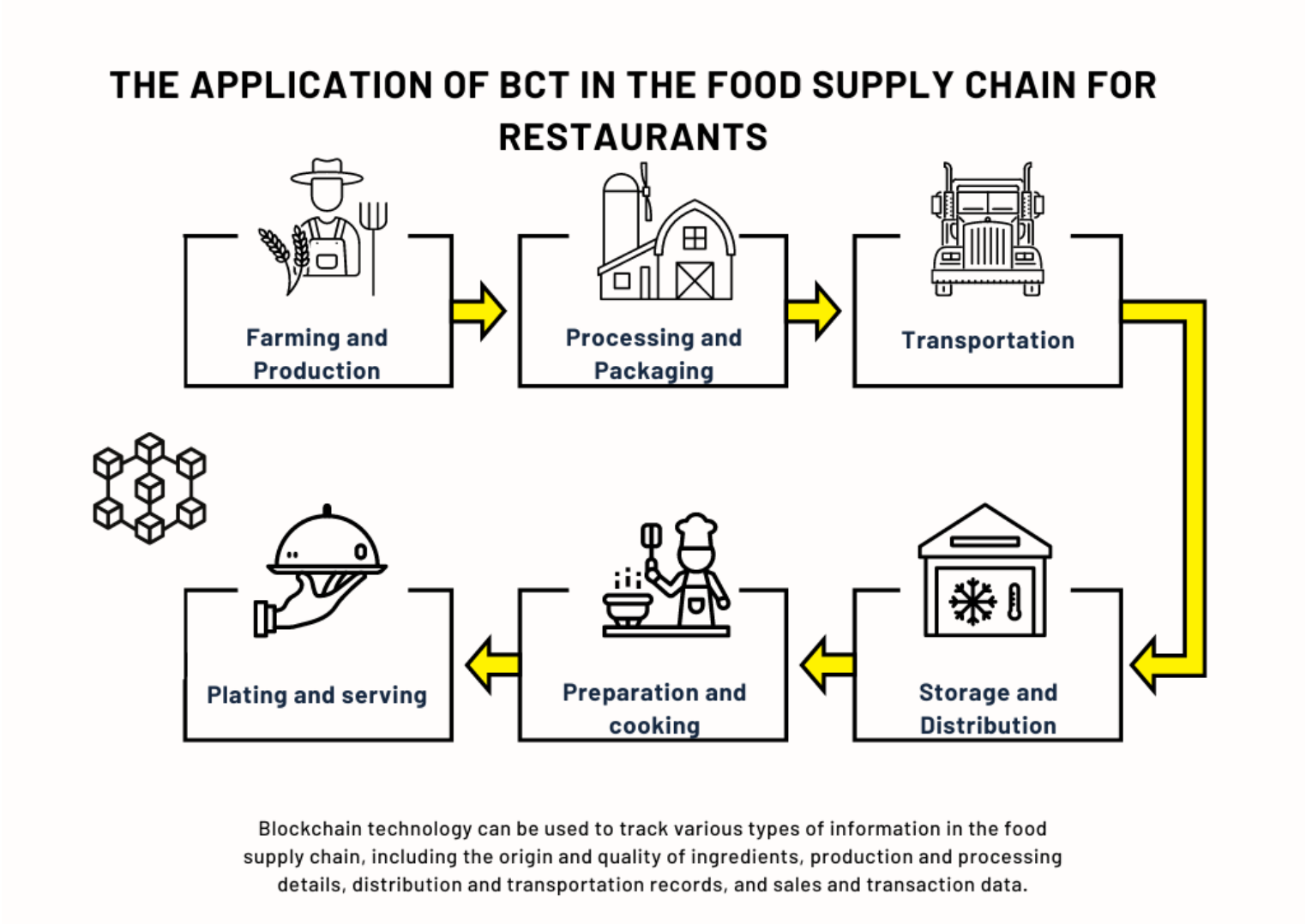

Figure 2. Information flow chart

Source: Authors own creation

3.2 Participants and procedure

The research team recruited ten participants and four facilitators from Texas, U.S. Facilitators were responsible for maintaining a positive atmosphere, managing time, minimizing interruptions, and providing participants with rules, regulations, and materials. Eligible participants had to be at least 21 years old with a minimum of three years of work experience in the technology or service sector. The participants included restaurant owners, technology experts, coffee shop managers, banquet servers, and recent customers. To ensure preparedness and understanding, participants received specific materials one week prior to the workshop, including information on USDA supply chain methods, an overview of the F&B industry, and an introduction to blockchain. These materials allowed participants to familiarize themselves with the content beforehand (shown in Online Appendix, created by authors). Individual online interviews were conducted with participants two days before the workshop to confirm their completion of the readings and readiness for engaging in meaningful discussions.

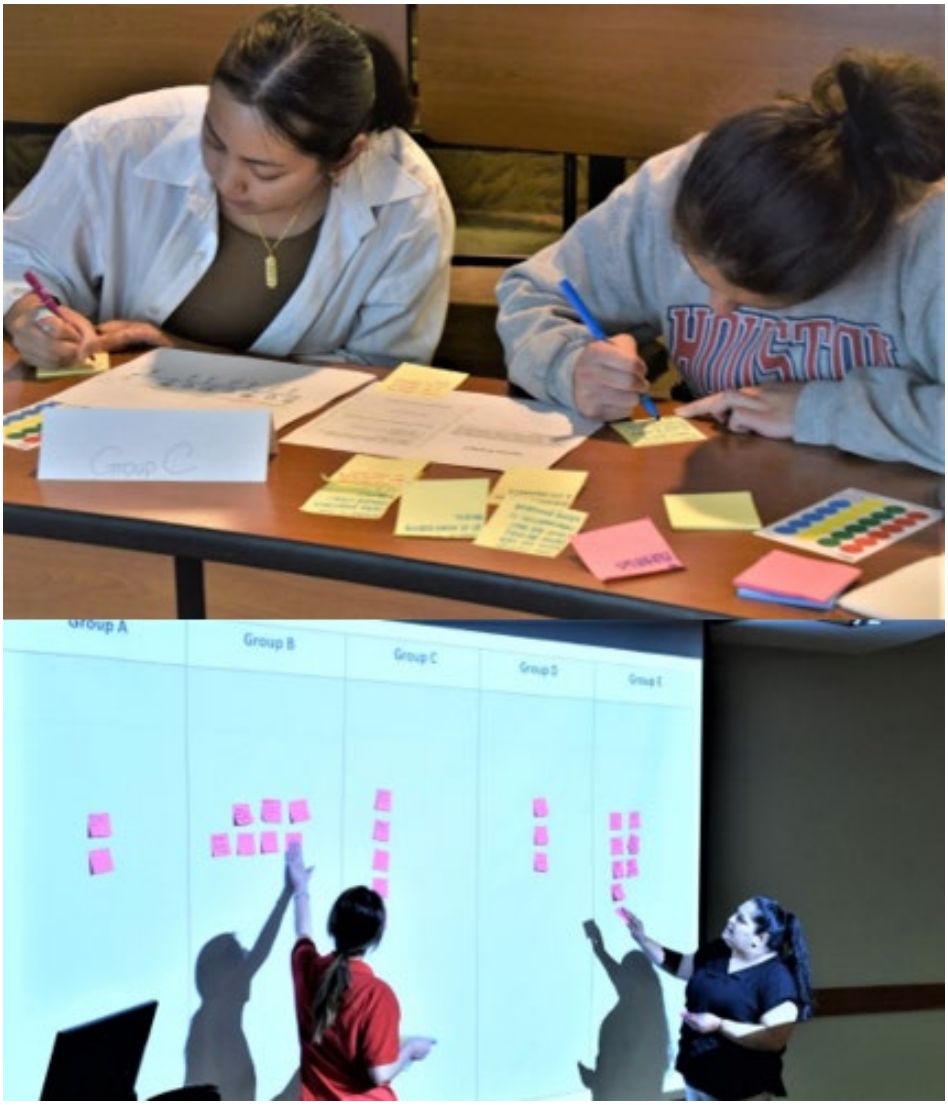

Figure 3. Service design workshop

Source: Photos taken by authors with consent

During the workshop, participants were asked to imagine themselves dining at a restaurant that adopted blockchain and answer a series of questions related to their thoughts on the food, their preference for using blockchain to track food ingredients, the information they would like to receive through blockchain, the benefits or disadvantages of using blockchain, and how blockchain would impact their business or dining experience. They were presented with various scenarios that included a food poster for a specific food product and a detailed information flow chart of blockchain to track the supply chain of ingredients. Sticky notes and pens were provided to help with the study completion, which lasted for five hours in a multimedia room. All data and photographs were collected and archived for further analysis (See Figure 3).

3.3 Results and discussion

During the service design workshop, participants across all five scenarios unanimously expressed their preference for utilizing blockchain to track ingredient supply chains (summarized in Supplementary Materials, Section 1). They consistently emphasized the traceability and trustworthiness of blockchain as the primary reasons for its adoption. The participants placed significant importance on food safety in their dining experiences and believed that implementing blockchain could effectively address these concerns. By enabling robust supply chain tracking, blockchain enhances traceability, thereby reducing the risk of foodborne illnesses and enhancing perceived food safety. Moreover, participants identified blockchain adoption as a means to improve the overall perceived food quality within the F&B industry. They emphasized the importance of factors such as freshness, consistency, and access to nutritional information, all of which blockchain can help ensure. Additionally, participants believed that blockchain adoption could contribute to the perceived naturalness of food products by providing information on origin, harvest date, and preservatives, empowering consumers to make more informed decisions.

Furthermore, participants emphasize that blockchain performance may vary depending on restaurant types and locations. The type of restaurant is a critical factor affecting the performance of the blockchain. The relationship between blockchain adoption, traceability, and trust may be stronger in casual dining restaurants than fine dining establishments due to their larger customer base and higher volume of food production (Iskender et al., 2022a; Choi et al., 2022). Additionally, casual dining restaurants may prioritize traceability, and blockchain can help demonstrate their commitment to traceability and build trust with customers. In contrast, fine dining restaurants may not require blockchain adoption since customers may already trust them due to their luxurious experiences and perceived higher standards of safety and quality. These findings are consistent with the findings of Cha and Borchgrevink (2019), who found a stronger correlation between perceived food safety and customer satisfaction in casual dining establishments compared to fine dining establishments. Therefore, the following hypotheses are proposed:

> *H7*. Restaurant types moderate the path between the adoption of the blockchain and (a) traceability and (b) trust. Compare to fine dining, in casual dining type the impact of blockchain adoption on traceability and trust will be strengthened.

The impact of blockchain adoption on traceability and trust may vary depending on the restaurant's location, with a stronger impact in tourist destinations compared to residential areas. Firstly, tourists may have greater safety concerns when traveling to unfamiliar places, making blockchain adoption crucial for ensuring food safety and quality. Secondly, businesses in tourist destinations have less time to establish trust with customers, making blockchain adoption a way to signal a commitment to food safety and quality in short time. Thirdly, blockchain can help restaurants verify the origin of ingredients, increasing customer trust, which is particularly important given tourists' interest in trying local cuisine. These findings align with Yasami et al.'s (2020) study, which found that tourists preferred restaurants providing clear information about food safety to avoid foodborne illnesses. Kala (2020) also found that food quality was a critical factor in determining tourists' overall satisfaction with their travel experience. Therefore, the following hypotheses are proposed (See Figure 4):

H8. Restaurant locations moderate the path between the adoption of the blockchain and (a) traceability and (b) trust. Compare to the residential area, in the tourist destination the impact of blockchain adoption on traceability and trust will be strengthened.

4. Study 2

Study 2 examines H1-H6 to investigate the influence of blockchain in the F&B industry from the customers' perspective. The blockchain adoption is expected to significantly increase traceability (H1) and trust (H2). Traceability and trust are then predicted to have a positive relationship with perceived food safety (H3a, b), quality (H4a, b), and naturalness (H5a, b) separately. Furthermore, the perceived food safety (H6a), quality (H6b), and naturalness (H6c) are predicted to increase customer satisfaction respectively.

4.1 Participants and procedure

The study employed a single-factor between-subjects design, which was prepared and distributed on Qualtrics, in two different settings, comparing the adoption of blockchain (yes vs. no). A total of 228 U.S. adult consumers (84.6% between the ages of 21-40, and 48.2% female) were recruited from Amazon MTurk's consumer panel. Each qualified participant was paid $3 U.S. dollars for successfully completing all survey questions. Participants were provided with a brief overview of the study and asked for their consent. Once they agreed, they were asked to answer a set of screening questions to ensure they meet the recruiting criteria: they were at least 21 years old, had dined out within the past three months, and did not work in the hospitality industry.

Qualified participants were given instructions and randomly assigned to one of the two experimental scenarios: 117 participants in the "yes" condition (9 were removed) and 111 participants in the "no" condition (12 were removed). The menus for two experimental scenarios are shown in Figure 5. Participants in the "yes" condition were required to scan the QR code and watch the video to understand how the blockchain tracks the salmon from the origin to the restaurant. Scenarios shown in Supplementary Materials, Section 3. We also set follow-up questions to filter out participants who did not pay attention to details in the video.

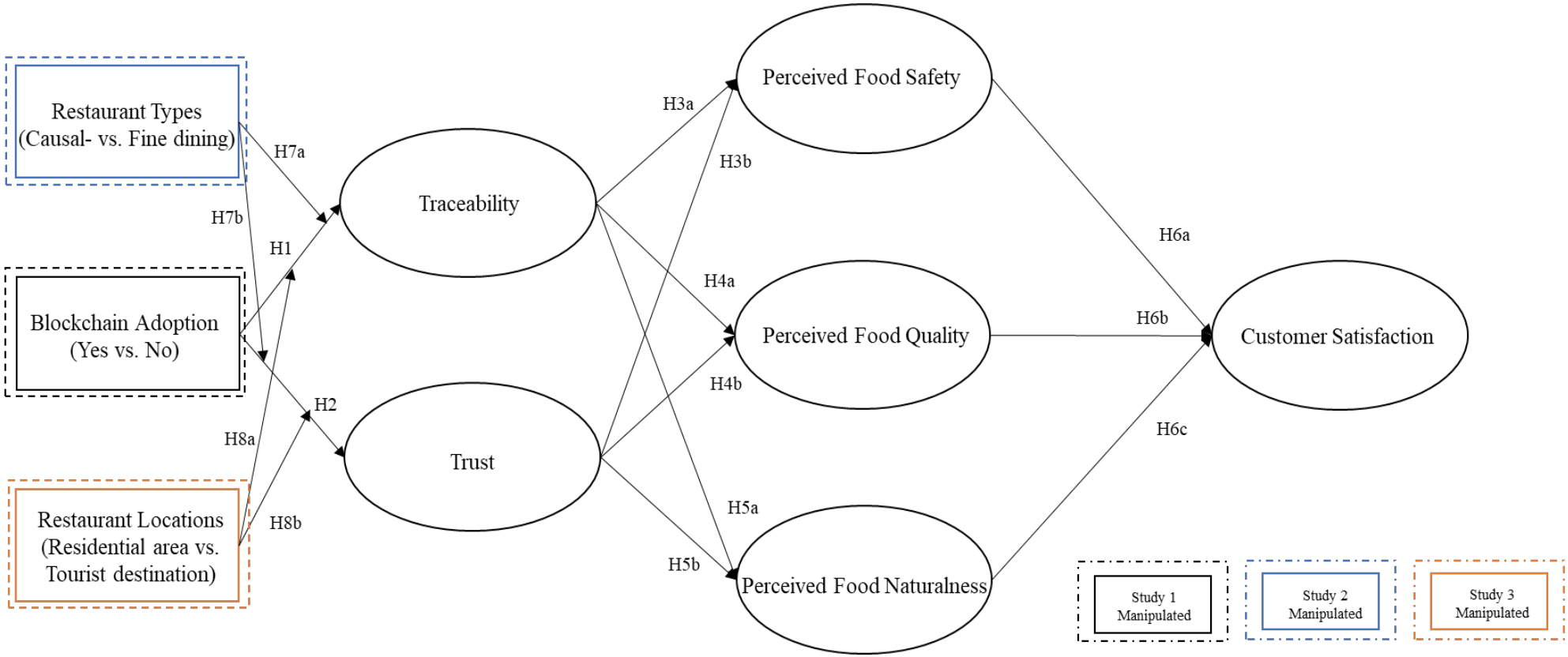

Figure 4. Conceptual model

Source: Authors own creation

Note(s): Study 2: BCT Adoption (Yes vs. No)
Study 3: BCT Adoption (Yes vs. No) × Restaurant Types (Causal dining vs. Fine dining)
Study 4: BCT Adoption (Yes vs. No) × Restaurant Locations (Residential area vs. Tourist destination)

Participants were then asked to evaluate traceability (α=0.874; Kamilaris et al., 2019; Yuan et al., 2020), trust (α=0.639; Yagoda & Gillan, 2012), perceived food safety (α=0.794; Van Rijswijk & Frewer, 2008), perceived food quality (α=0.759; Konuk, 2019), perceived food naturalness (α=0.788; Roman et al., 2017), and satisfaction (α=0.742; Ali & Omar, 2014). All items were measured using a seven-point Likert scale (1=strongly disagree, 7=strongly agree) and shown in Supplementary Materials, Section 2. Participants were also asked to respond to manipulation checks and attention checks. Food safety concerns, health consciousness, innovativeness, and purchase frequency of organic products were collected as control variables in subsequent analyses. Filling in the questionnaire required between 10 and 15 minutes.

4.2 Results and discussion

The experiment successfully manipulated blockchain adoption, evidenced by participants in the "yes" condition demonstrating significantly higher confidence in using blockchain for supply chain tracking than those in the "no" condition (M_yes = 5.76 vs. M_no = 5.29, $t(111) = -3.617$, $p < 0.005$). The study employed Partial Least Squares Structural Equation Modeling (PLS-SEM), a variance-based approach suitable for testing complex theoretical frameworks with multiple constructs, indicators, or model associations from a predictive standpoint, as outlined by Hair et al. (2019). This method aligns well with our study's objectives and framework complexity.

To evaluate the measurement model, we examined the indicator loadings, internal consistency reliability using Cronbach's alpha (α), Joreskog's rho (rho_A), composite reliability (CR), and convergent validity using average variance extract (AVE), and statistics for study 2,3, and 4 are shown in Supplementary Materials, Section 4 and section 5. After removing unqualified items, factor loadings were above the recommended value of 0.708, and all but one value of α, rho_A, and all values of CR were greater than 0.7 and less than 0.9, while the AVE for all constructs exceeded the recommended value of 0.5 (Hair et al., 2019). Discriminant validity was assessed using the HTMT ratio, a new and advanced criterion proposed by Henseler et al. (2015). All were below the recommended value of 0.9 (Hair et al., 2019). To evaluate the structural model, we used the coefficient of determination (R2) to measure the variance in the endogenous variable explained by the exogenous variables. R2 values are considered substantial, moderate, and weak at 0.75, 0.50, and 0.25, respectively. Our results indicate that the R2 of PFS (0.688), PFQ (0.723), and PFN (0.664) are moderate.

We evaluated the hypotheses in the structural model based on path coefficients, t-values, and p-values. The hypotheses were tested for main effects using the bootstrapping 5000 procedure in Smart PLS 4 (Nisar et al., 2021). As shown in Table 1, all hypotheses (H1-H6) were supported by the critical ratio evaluation ($t > 1.645$; $P < 0.05$). Our results show that the adoption of blockchain significantly increases traceability (H1, ß=0.536, t=4.756, p=0.000) and trust (H2, ß=0.602, t=5.773, p=0.000) compared to not adopting it. Both food traceability and trust have a significantly positive relationship with perceived food safety (H3a, ß=0.347, t=2.964, p=0.003; and H3b, ß=0.527, t=5.090, p=0.000), quality (H4a, ß=0.341, t=3.664, p=0.000; and H4b, ß=0.554, t=6.572, p=0.000), and naturalness (H5a, ß=0.496, t=5.819, p=0.000; and H5b, ß=0.363, t=4.054, p=0.000). Additionally, perceived food safety (H6a, ß=0.320, t=2.303, p=0.021), quality (H6b, ß=0.398, t=3.617, p=0.000), and naturalness (H6c, ß=0.215, t=2.336, p=0.020) have a significantly positive effect on customer satisfaction.

Table 1. Hypotheses tests

Hypotheses	β			SD			T			P			Results		
	S2	S3	S4	S2	S3	S4	S2	S3	S4	S2	S3	S4	S2	S3	S4
H1. BN-> TRA	0.536***	0.948***	0.363***	0.113	0.115	0.083	4.756	8.254	4.359	0.000	0.000	0.000	✓	✓	✓
H2. BN-> TRST	0.602***	0.888***	0.398***	0.104	0.117	0.082	5.773	7.594	4.834	0.000	0.000	0.000	✓	✓	✓
H3a. TRA-> PFS	0.347**	0.503***	0.444***	0.117	0.081	0.068	2.964	6.222	6.536	0.003	0.000	0.000	✓	✓	✓
H3b. TRST-> PFS	0.527***	0.340***	0.474***	0.104	0.090	0.070	5.090	3.768	6.796	0.000	0.000	0.000	✓	✓	✓
H4a. TRA-> PFQ	0.341***	0.500***	0.335***	0.093	0.083	0.083	3.664	6.007	4.030	0.000	0.000	0.000	✓	✓	✓
H4b. TRST-> PFQ	0.554***	0.315***	0.571***	0.084	0.089	0.076	6.572	3.524	7.518	0.000	0.000	0.000	✓	✓	✓
H5a. TRA-> PFN	0.496***	0.486***	0.477***	0.085	0.080	0.077	5.819	6.091	6.226	0.000	0.000	0.000	✓	✓	✓
H5b. TRST-> PFN	0.363***	0.345***	0.431***	0.090	0.081	0.075	4.054	4.267	5.781	0.000	0.000	0.000	✓	✓	✓
H6a. PFS-> SAT	0.320*	0.085	0.291***	0.139	0.089	0.076	2.303	0.964	3.839	0.021	0.335	0.000	✓	✘	✓
H6b. PFQ-> SAT	0.398***	0.445***	0.333***	0.110	0.077	0.067	3.617	5.807	4.958	0.000	0.000	0.000	✓	✓	✓
H6c. PFN-> SAT	0.215*	0.335***	0.329***	0.092	0.063	0.070	2.336	5.321	4.672	0.020	0.000	0.000	✓	✓	✓
H7a. CFBN-> TRA		-0.644***			0.168			3.842			0.000			✓	
H7b. CFBN-> TRST		-0.604***			0.160			3.779			0.000			✓	
H8a. RTBN-> TRA			0.387*			0.18			2.15			0.032			✓
H8b. RTBN-> TRST			0.397*			0.174			2.276			0.023			✓

Source: Authors own creation.

Note(s): BN: blockchain or not; TRA: traceability; TRST: trust; PFS: perceived food safety; PFQ: perceived food quality; PFN: perceived food naturalness; SAT: satisfaction; CF: casual dining or fine dining; RT: residential area or tourist destination. * P ⩽ 0.05, ** P ⩽ 0.01, *** P ⩽ 0.001. ✓ for hypothesis supported, ✘ for hypothesis unsupported.

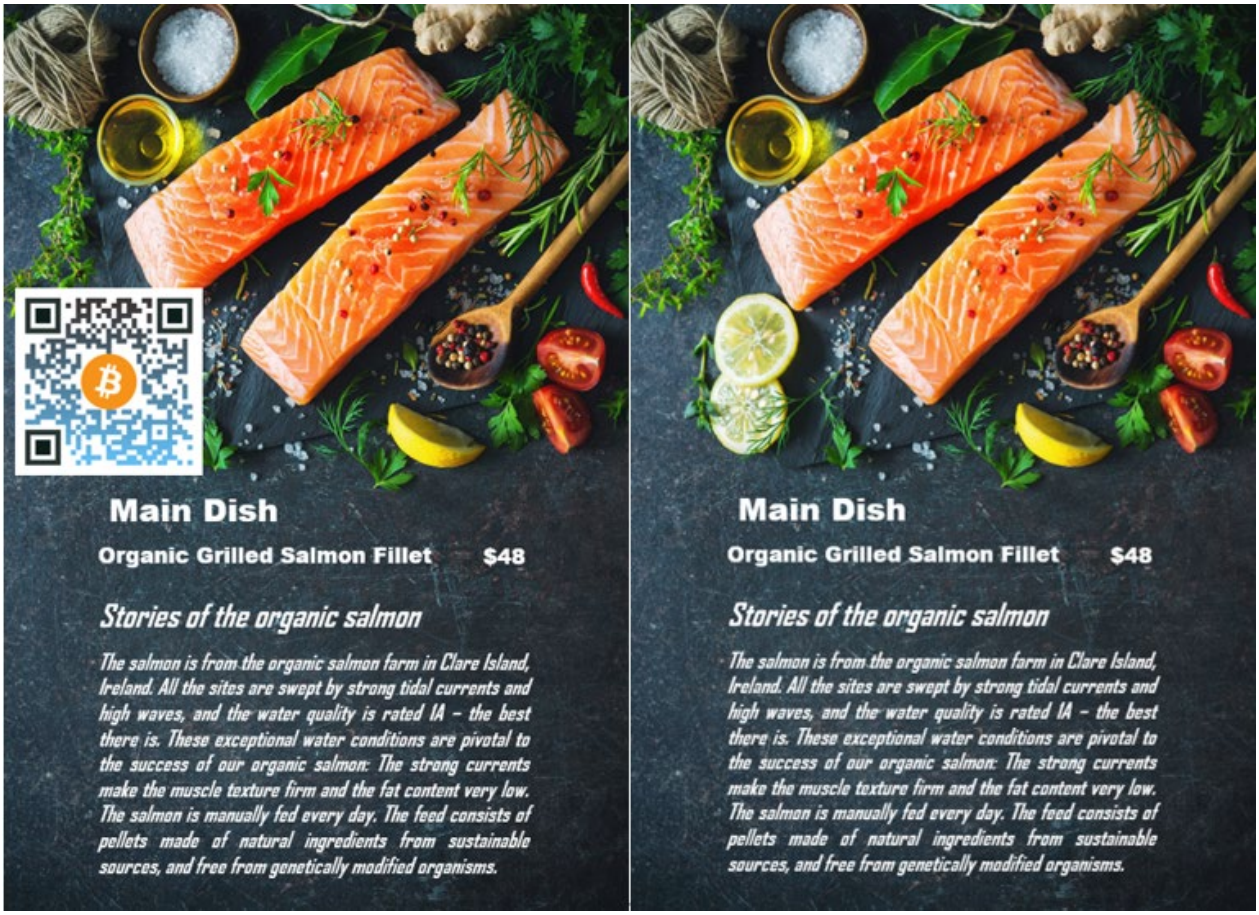

Figure 5. Menus for study 2&3 scenarios

Source: Authors own creation.
Note: left: “yes” condition; right: “no” condition

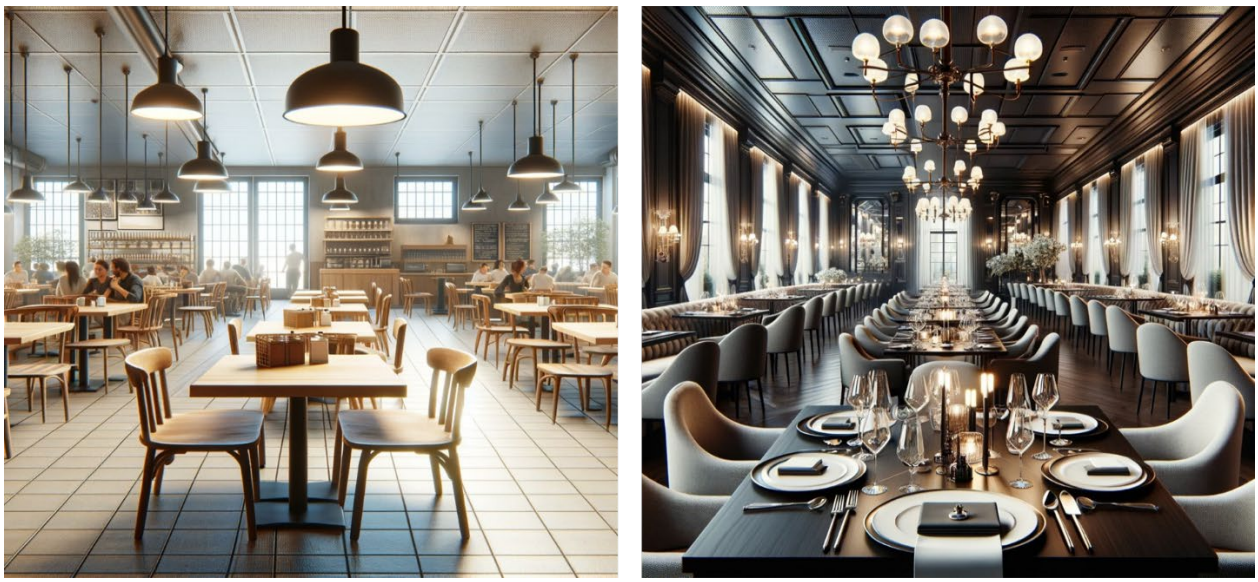

Figure 6. Restaurant scenarios for study 3

Source: Authors own creation.
Note: left: “casual-dining” condition; right: “fine-dining”

5. Study 3

Study 3 further examines the moderation effects of restaurant types (fine dining vs. casual dining) on the path between blockchain adoption and traceability (H7a) and the path between blockchain adoption and trust (H7b).

5.1 Participants and procedure

The study employed a 2 (blockchain adoption: yes vs. no) × 2 (restaurant types: casual dining vs. fine dining) between-subjects design. A total of 453 U.S. adult consumers (78.1% between the ages of 21-40, and 39.2% female), recruited from Amazon MTurk's consumer panel. Following the identical procedure of participants' screening and instructions as in Study 2, eligible participants were randomly assigned to one of four manipulated scenarios. Scenario 1 is a casual-dining restaurant with blockchain, with 93 participants (17 were removed). Scenario 2 is a fine-dining restaurant with blockchain, with 131 participants (6 were removed). Scenario 3 is a casual-dining restaurant without blockchain, with 120 participants (8 were removed). Scenario 4 is a fine-dining restaurant without blockchain, with 109 participants (11 were removed). Restaurant pictures were also provided to show the settings of casual and fine dining (See Figure 6). The experimental manipulations of both blockchain adoption ($M_{yes} = 5.64$ vs. $M_{no} = 5.24$, $t(224) = -3.879$, $p < 0.005$) and restaurant types ($M_{casual} = 5.32$ vs. $M_{fine} = 5.60$, $t(213) = -2.412$, $p < 0$) were successful. The rest of the experimental procedure, questionnaire design, general settings, and participants' payment were identical to Study 2.

5.2 Results and discussion

The indicator loadings, internal consistency reliability, convergent validity, and discriminant validity were examined, and the procedure and criteria were identical to study 2. The outcome indicates that the R2 of PFS is moderate (the value of 0.600 falls within the moderate range of 0.50–0.75). The R2 of PFQ is moderate as the value is 0.563 (0.563 falls within the 0.50-0.75 moderate range). The R2 of PFN is moderate as the value is 0.584 (0.584 falls within the 0.50-0.75 moderate range).

All hypotheses (H1-H6) except one were supported (see Table 1) based on the critical ratio ($t > 1.645$; $P < 0.05$) using bootstrapping 5000. Our results show that the adoption of blockchain significantly increases traceability (H1, ß=0.948, t=8.254, p=0.000) and trust (H2, ß=0.888, t=7.594, p=0.000) compared to not adopting it. Both traceability and trust have a significantly positive relationship with perceived food safety (H3a, ß=0.503, t=6.222, p=0.000; and H3b, ß=0.340, t=3.768, p=0.000), quality (H4a, ß=0.500, t=6.007, p=0.000; and H4b, ß=0.315, t=3.524, p=0.000), and naturalness (H5a, ß=0.486, t=6.091, p=0.000; and H5b, ß=0.345, t=4.267, p=0.000). Additionally, perceived food quality (H6b, ß=0.445, t=5.807, p=0.000), naturalness (H6c, ß=0.335, t=5.321, p=0.000) but safety (H6a, ß=0.085, t=0.964, p=0.335), have a significantly positive effect on customer satisfaction.

Moreover, the results showed a significant interaction between blockchain adoption and restaurant types, indicating that restaurant type has a significant moderation effect on the path from blockchain adoption to traceability (ß=-0.644, t=3.842, p=0.000) and trust (ß=-0.604, t=3.779, p=0.000). Specifically, the impact of blockchain adoption on traceability and trust is strengthened in the casual dining scenario; whereas the impact of blockchain adoption on traceability and trust is relatively weaker in fine dining, supporting H7(a, b).

6. Study 4

Study 4 further examines the moderation effects of restaurant locations (tourist destination vs. residential area) on the path between blockchain adoption and traceability (H8a) and the path between blockchain adoption and trust (H8b).

6.1 Participants and procedure

The study employed a 2 (blockchain adoption: yes vs. no) × 2 (restaurant locations: residential area vs. tourist destination) between-subjects design. A total of 424 U.S. adult consumers (83% between the ages of 21-40, and 44.1% female) were recruited from Amazon MTurk's consumer panel and randomly assigned to one of the four experimental scenarios: Scenario 1 is a restaurant in a residential area with blockchain, with 104 participants (10 were removed). Scenario 2 is a restaurant in a tourist destination with blockchain, with 85 participants (18 were removed). Scenario 3 is a restaurant in a residential area without blockchain, with 111 participants (9 were removed). Scenario 4 is a restaurant in a tourist destination without blockchain, with 124 participants (7 were removed). To increase external validity, the organic salad menu was used for this study. Participants in scenarios 1 and 2 were required to scan the QR code and watch the video to fully understand how blockchain tracks the supply chain of salad ingredients. Participants in scenarios 3 and 4 were shown the identical menu without QR code. The menus for two experimental scenarios are shown in Figure 7. Location pictures were provided to illustrate the settings of residential area and tourist destination (See Figure 8). The rest of the questionnaire is identical to studies 2 and 3.

6.2 Results and discussion

The experimental manipulations of blockchain adoption ($M_{yes} = 5.52$ vs. $M_{no} = 5.28$, $t(189) = -2.183$, $p < 0.005$) and restaurant locations proved successful. Concerning restaurant locations, participants in the residential area scenario were more likely to feel more familiar with the area where the restaurant is located ($M_{residential} = 5.63$ vs. $M_{tourist} = 5.32$, $t(209) = 2.647$, $p < 0.005$) compared to their counterparts in the tourist destination scenario.

The indicator loadings, internal consistency reliability, convergent validity, and discriminant validity were examined, and the procedures and criteria were identical to studies 2 and 3. The outcome indicates that the R2 of PFS is substantial (with a value of 0.774, above 0.75). The R2 of PFQ is also substantial, with a value of 0.759 (above 0.75). The R2 of PFN is moderate, with a value of 0.758 (above 0.75).

Results showed support for all hypotheses (H1-H6) based on the critical ratio ($t > 1.645$; $P < 0.05$) with bootstrapping 5000 (see Table 1). Our results show that the adoption of blockchain significantly increases traceability (H1, ß=0.363, t=4.359, p=0.000) and trust (H2, ß=0.398, t=4.834, p=0.000) compared to not adopting it. Both traceability and trust have a significantly positive relationship with perceived food safety (H3a, ß=0.444, t=6.536, p=0.000; and H3b, ß=0.474, t=6.796, p=0.000), quality (H4a, ß=0.335, t=4.03, p=0.000; and H4b, ß=0.571, t=7.518, p=0.000), and naturalness (H5a, ß=0.477, t=6.226, p=0.000; and H5b, ß=0.431, t=5.781, p=0.000). Additionally, perceived food safety (H6a, ß=0.291, t=3.839, p=0.000), quality (H6b, ß=0.333, t=4.958, p=0.000), and naturalness (H6c, ß=0.329, t=4.672, p=0.000) have a significantly positive effect on customer satisfaction.

Figure 7. Menus for study 4 scenarios

Source: Authors own creation
Note: left: "yes" condition; right: "no" condition

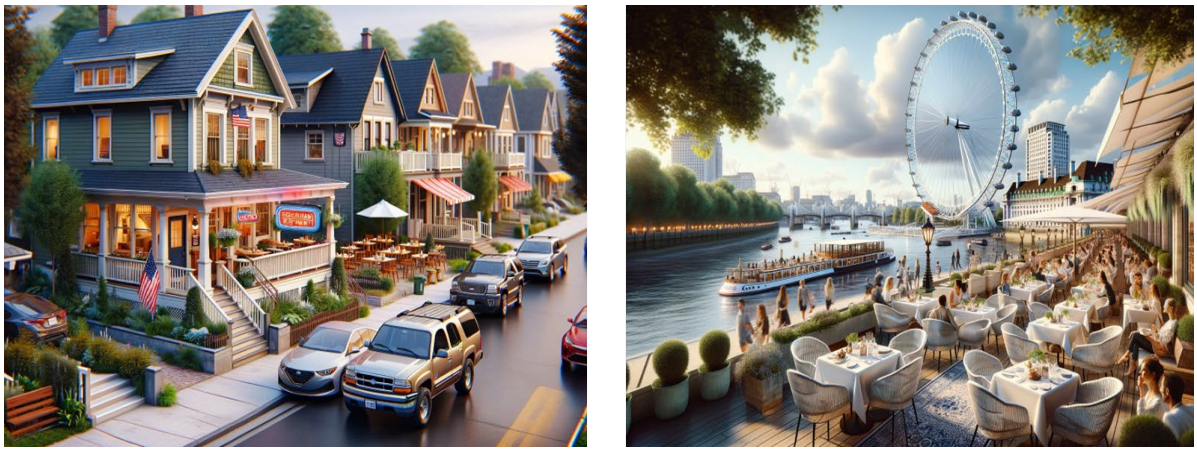

Figure 8. Location pictures for study 4 scenarios

Source: Authors own creation
Note: left: "residential area" condition; right: "tourist destination" condition

Moreover, the results showed a significant interaction between blockchain adoption and restaurant locations. The findings suggest restaurant location has a significant moderation effect on the path from blockchain adoption to traceability (ß=0.387, t=2.150, p=0.032) and trust (ß=0.397, t=2.276, p=0.023). Specifically, the impact of blockchain adoption on traceability and trust is strengthened in the tourist destination scenario, whereas the impact of blockchain adoption on traceability and trust is relatively weaker in residential areas, supporting H8(a, b). These findings align with the findings from study 1, which indicates that tourists preferred restaurants providing traceable and trustworthy information about food safety to avoid foodborne illnesses.

7. Discussion and conclusion

7.1 Conclusions

Four studies highlight the importance of blockchain adoption in the F&B industry to enhance traceability, trust, and ultimately improve customer satisfaction. Study 1 emphasizes the value of blockchain in traceability and trust, showing that adopting blockchain enhances food perceptions (safety, quality, and naturalness) and improves the customer dining experience, depending on the restaurant type and location. Studies 2, 3, and 4 confirm that blockchain adoption significantly increases traceability and trust, which in turn positively influence food safety, quality, naturalness, and customer satisfaction. Furthermore, studies 3 and 4 examine the moderation effects of restaurant types and locations, suggesting that the impact of blockchain adoption on traceability and trust varies, with more pronounced effects observed in casual dining and tourist destinations.

7.2 Theoretical implications

This study advances knowledge in the field of hospitality technology by examining the application of blockchain in the industry. While previous research has recognized benefits like cost reductions, efficiency improvements, and quality control (Treiblmaier & Garaus, 2023; Yong et al., 2020), limited research has focused on the customer perspective regarding blockchain traceability. The adoption of blockchain represents a significant technological advancement in the F&B industry, with the potential to revolutionize restaurant operations. By investigating stakeholder perceptions and attitudes towards this technology, the study sheds light on the potential benefits of blockchain adoption, such as enhanced traceability and trust. The findings offer insights for future research and development in the hospitality industry, contributing to its overall growth and sustainability.

Second, this study contributes to signaling theory by emphasizing the importance of blockchain adoption in signaling the commitment of restaurants to food safety, quality, and naturalness. Signaling theory suggests that companies use signals to convey their commitment to certain values and goals, and the adoption of blockchain can act as a signal of a restaurant's commitment to these values (Connelly et al., 2011). The findings of this study suggest that blockchain adoption can improve customer perceptions of food safety, quality, and naturalness, thereby increasing their satisfaction with the restaurant. Importantly, these findings identify blockchain-based traceability systems as signals of customer food perceptions, influencing their attitude and behavior, which aligns with previous studies (Treiblmaier & Garaus, 2023).

Third, the study highlights the value of service design workshops as a methodology for understanding customer preferences and needs in the F&B industry. Service design workshops

were chosen due to their exploratory, user-oriented, creative, and collaborative nature (Font et al., 2021). By emphasizing experiences, needs, and values, and integrating multiple data collection methods, these workshops provide a comprehensive understanding of participants' attitudes and perceptions (Font et al., 2021). They serve as effective tools for designing and implementing new services or technologies in the F&B industry. The collaborative and creative nature of these workshops fosters the generation of innovative ideas, contributing to the industry's development.

Fourth, the study contributes to the understanding of the relationship between restaurant type and location and the adoption of blockchain. The findings suggest that casual dining restaurants and restaurants located in tourist destinations may be more likely to adopt blockchain and benefit from its impact on traceability and trust, while fine dining and restaurants located in residential areas may not experience as significant of an impact.

7.3 Managerial implications

This study has significant managerial implications that go beyond its theoretical contributions. First, it emphasizes the potential of tracking and verifying the safety, quality, and naturalness of food ingredients in the F&B industry to enhance traceability and build trust with customers. These efforts can foster improved business relationships and generate increased demand for products, as customers highly value transparency and reliability when making food choices.

Second, the study provides valuable insights for restaurant managers considering the blockchain implementation as a strategic tool to attract and retain customers. The security and immutability of blockchain enhance traceability and trustworthiness, enabling restaurants to offer transparent information about their food products (Queiroz et al., 2019; Duan et al., 2020). By providing this transparency, restaurants can elevate customers' perceptions of food products and strengthen their trust in the establishment.

Third, encouraging blockchain adoption in the F&B industry empowers government regulators to enhance food safety and quality standards, leading to improved public health outcomes and reduced economic costs related to foodborne illnesses. This involves establishing regulatory frameworks, promoting industry collaboration, and investing in necessary infrastructure. Actions include collaborating with experts and organizations to establish standardized practices and guidelines for blockchain implementation, addressing concerns regarding cost, scalability, and interoperability to facilitate adoption, and facilitating knowledge-sharing platforms and workshops to educate industry professionals about the benefits and practical applications of blockchain in the F&B industry. Engaging in public-private partnerships to invest in research and development is also crucial for streamlining blockchain implementation and addressing technological or operational challenges.

Fourth, the adoption of blockchain empowers customers by providing them with reliable and trustworthy information about the safety, quality, and naturalness of their food. This empowers them to make more informed decisions about their food choices, leading to improved health outcomes and increased confidence in the food they consume. Educating consumers through consumer education initiatives is crucial to ensure they understand the value of blockchain-enabled traceability.

Fifth, collaboration between destination management operators and local restaurants can result in the development of promotional programs focused on blockchain adoption. These

activities can highlight the importance of traceability in the food supply chain, differentiating the destination from competitors and attracting visitors who prioritize information transparency about food products.

7.4 Limitations and future research

This study has several limitations. Firstly, implementing a blockchain-based system requires a significant investment of time and finances. While a video demonstration was used to simulate the blockchain prototype, it may not provide a deep understanding of its technical aspects. Real-world usage could present challenges not evident in the demonstration, and the lack of hands-on experience with blockchain may limit the evaluation of practical considerations.

Secondly, the acceptance and adoption of QR code menus by consumers should be considered as a potential limitation. Although the study highlights the benefits of using QR codes, it does not specifically address customer attitudes and preferences towards this technology. Varying consumer perceptions of QR codes may impact the feasibility and success of blockchain implementation in restaurant menus.

Thirdly, this research primarily focuses on signaling theory to analyze how blockchain traceability influences customer food perceptions and the dining experience. However, it does not explicitly consider customer characteristics and their intention to use blockchain. Future research should incorporate established technology-based models to address this aspect.

Lastly, the research acknowledges the limitations of blockchain in handling offline processes within the food supply chain. While blockchain offers advantages in terms of traceability, challenges arise in implementing and synchronizing data for offline processes and interactions. Despite these limitations, this study provides valuable preliminary insights into the potential benefits of blockchain in the F&B industry. It lays the foundation for future comprehensive research involving diverse stakeholders, hands-on experiences with blockchain, and evaluations of the practical considerations for implementing this technology in the hospitality industry.

References

Ali, F., & Omar, R. (2014), "Determinants of customer experience and resulting satisfaction and revisit intentions: PLS-SEM approach towards Malaysian resort hotels", *Asia-Pacific Journal of Innovation in Hospitality and Tourism*, Vol. 3 No. 2, pp. 1–19.

Anastasiadis, F., Apostolidou, I., & Michailidis, A. (2021), "Food Traceability: A Consumer-Centric Supply Chain Approach on Sustainable Tomato", *Foods*, Vol.10 No.3, p. 3.

Bai, L., Wang, M., Yang, Y., & Gong, S. (2019), "Food safety in restaurants: The consumer perspective", *International Journal of Hospitality Management*, Vol. 77, pp. 139–146.

Bumblauskas, D., Mann, A., Dugan, B., & Rittmer, J. (2020), "A blockchain use case in food distribution: Do you know where your food has been?", *International Journal of Information Management*, Vol. 52, pp. 102008.

Basalekou, M., Pappas, C., Tarantilis, P. A., & Kallithraka, S. (2020), "Wine Authenticity and Traceability with the Use of FT-IR", *Beverages*, Vol. 6 No. 2, p. 30.

Bio Eco Actual. (2023). *UK's organic market delivers strong performance in exceptionally challenging year*. Bio Eco Actual. Available at: https://www.bioecoactual.com/en/2023/02/27/uk-organic-market-delivers-strong-performance-in-exceptionally-challenging-year/

Connelly, B. L., Certo, S. T., Ireland, R. D., & Reutzel, C. R. (2011), "Signaling theory: A review and assessment", *Journal of Management*, Vol. 37 No. 1, pp. 39–67.

Creydt, M., & Fischer, M. (2019), "Blockchain and more—Algorithm driven food traceability", *Food Control*, Vol. 105, pp. 45–51.

Cha, J., & Borchgrevink, C. P. (2019), "Customers' perceptions in value and food safety on customer satisfaction and loyalty in restaurant environments: moderating roles of gender and restaurant types", *Journal of Quality Assurance in Hospitality & Tourism*, Vol. 20 No. 2, pp. 143-161.

Choi, H., Joung, H. W., Choi, E. K., & Kim, H. S. (2022), "Understanding vegetarian customers: the effects of restaurant attributes on customer satisfaction and behavioral intentions", *Journal of Foodservice Business Research*, Vol. 25 No. 3, pp. 353-376.

Davis, B., Lockwood, A., Pantelidis, I. S., & Alcott, P. (2018). *Food and beverage management*. Routledge.

dos Santos, R. B., Torrisi, N. M., Yamada, E. R. K., & Pantoni, R. P. (2019), "IGR Token-Raw Material and Ingredient Certification of Recipe Based Foods Using Smart Contracts", *Informatics*, Vol. 6 No. 1, p. 1.

Dsouza, D., & Sharma, D. (2020), "Online food delivery portals during COVID-19 times: An analysis of changing consumer behavior and expectations", *International Journal of Innovation Science*, Vol. 13 No. 2, pp. 218–232.

Duan, J., Zhang, C., Gong, Y., Brown, S., & Li, Z. (2020), "A Content-Analysis Based Literature Review in Blockchain Adoption within Food Supply Chain", *International Journal of Environmental Research and Public Health*, Vol. 17 No. 5, p. 5.

Dinde, S., & Shirgave, S. (2023), "Improved Food Traceability for Restaurant customers using Blockchain Technology", in *2023 International Conference for Advancement in Technology (ICONAT)* pp. 1-7.

Erkmen, E., & Hancer, M. (2019), "Building brand relationship for restaurants: An examination of other customers, brand image, trust, and restaurant attributes", *International Journal of Contemporary Hospitality Management*, Vol. 31 No. 3, pp. 1469–1487.

Fanelli, V., Mascio, I., Miazzi, M. M., Savoia, M. A., De Giovanni, C., & Montemurro, C. (2021), "Molecular Approaches to Agri-Food Traceability and Authentication: An Updated Review", *Foods*, Vol. 10 No. 7, pp. 7.

Font, X., English, R., Gkritzali, A., & Tian, W. (2021), "Value co-creation in sustainable tourism: A service-dominant logic approach", *Tourism Management*, Vol. 82, p. 104200.
Ferreira, T., Galluzzi, L., de Paulis, T., & Farah, A. (2021), "Three centuries on the science of coffee authenticity control", *Food Research International,* Vol. 149, p. 110690.
Guo, J., Cengiz, K., & Tomar, R. (2021), "An IOT and Blockchain Approach for Food Traceability System in Agriculture", *Scalable Computing: Practice and Experience*, Vol. 22 No. 2, pp. 127–137.
Gonzalez, R., Gasco, J., & Llopis, J. (2022), "Information and communication technologies in food services and restaurants: a systematic review", *International Journal of Contemporary Hospitality Management*, Vol. 34, No.4, pp. 1423-1447.
Ha, J., & Jang, S. (2010), "Effects of service quality and food quality: The moderating role of atmospherics in an ethnic restaurant segment." *International Journal of Hospitality Management*, Vol. 29 No. 3, pp. 520–529.
Henseler, J., Ringle, C. M., & Sarstedt, M. (2015), "A new criterion for assessing discriminant validity in variance-based structural equation modeling." *Journal of the Academy of Marketing Science*, Vol. 43, pp. 115-135.
Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019), "When to use and how to report the results of PLS-SEM', *European Business Review*, Vol. 31 No. 1, pp. 2–24.
Hodges, J. R., Lee, M., DeFranco, A., & Sirsat, S. A. (2022), "Exploring Foodborne Illness and Restaurant Cleanliness Reporting in Customer-Generated Online Reviews Using Business Analytics", *Journal of Environmental Health*, Vol. 85 No. 3.
Huang, Z., Zhu, Y.-D., Deng, J., & Wang, C.-L. (2022), "Marketing Healthy Diets: The Impact of Health Consciousness on Chinese Consumers' Food Choices", *Sustainability*, Vol. 14 No. 4, p. 4.
International Food Information Council. (2020), *2020 Food & Health Survey* (pp. 5–6), available at: foodinsight.org, (accessed April 22, 2023).
Iskender, A., Sirakaya-Turk, E., Cardenas, D., & Hikmet, N. (2022a), "Restaurant patrons' intentions toward QR code menus in the US during COVID-19: acceptance of technology adoption model (ATAM)", *Journal of Foodservice Business Research*, pp. 1-26.
Iskender, A., Sirakaya-Turk, E., Cardenas, D., & Harrill, R. (2022b), "COVID or VOID: A systematic literature review of technology adoption and acceptance in hospitality and tourism since the breakout of COVID-19", *Tourism and Hospitality Research*, Vol. 0 No. 0.
Ip, M. M. H., & Chark, R. (2023), "The effect of menu design on consumer behavior: A meta-analysis", *International Journal of Hospitality Management*, Vol. 108, p. 103353.
Jannat, M. U., Ahamed, R., Mamun, A., Ferdaus, J., Costa, R., & Biswas, M. (2021), "Organic food supply chain traceability using blockchain technology", in *2021 International Conference on Science & Contemporary Technologies (ICSCT),* pp. 1-6.
Kamilaris, A., Fonts, A., & Prenafeta-Boldú, F. X. (2019), "The rise of blockchain technology in agriculture and food supply chains", *Trends in Food Science & Technology*, Vol. 91, pp. 640–652.
Karasek III, R., & Bryant, P. (2012), "Signaling theory: Past, present, and future", *Academy of Strategic Management Journal*, Vol. 11 No. 1, p. 91.
Knight, A. J., Worosz, M. R., & Todd, E. C. D. (2007), "Serving food safety: Consumer perceptions of food safety at restaurants", *International Journal of Contemporary Hospitality Management*, Vol. 19 No. 6, pp. 476–484.

Konuk, F. A. (2019), "The influence of perceived food quality, price fairness, perceived value and satisfaction on customers' revisit and word-of-mouth intentions towards organic food restaurants", *Journal of Retailing and Consumer Services*, Vol. 50, pp. 103–110.
Kala, D. (2020), "Examining the impact of food attributes and restaurant services on tourist satisfaction: evidence from mountainous state of India", *Journal of Quality Assurance in Hospitality & Tourism,* Vol. 21 No. 4, pp. 430-453.
Liu, R., Pieniak, Z., & Verbeke, W. (2019), "Consumers' attitudes and behaviour towards safe food in China: A review", *Food Control*, Vol. 98, pp. 66-75.
Liu, R., Gao, Z., Nayga, R. M., Snell, H. A., & Ma, H. (2019), "Consumers' valuation for food traceability in China: Does trust matter?", *Food Policy*, Vol. 88, p. 101768.
Lazaroiu, G., Andronie, M., Uţă, C., & Hurloiu, I. (2019), "Trust management in organic agriculture: sustainable consumption behavior, environmentally conscious purchase intention, and healthy food choices", *Frontiers in Public Health*, Vol. 7, p. 340.
Lee, A., & Kim, M. G. (2020), "Effective electronic menu presentation: From the cognitive style and mental imagery perspectives", *International Journal of Hospitality Management*, Vol. 87, p. 102377.
Lin, X., Chang, S. C., Chou, T. H., Chen, S. C., & Ruangkanjanases, A. (2021), "Consumers' intention to adopt blockchain food traceability technology towards organic food products", *International Journal of Environmental Research and Public Health*, Vol. 18 No. 3, p. 912.
Morgan, R. M., & Hunt, S. D. (1994), "The commitment-trust theory of relationship marketing", *Journal of Marketing*, Vol. 58 No. 3, pp. 20–38.
Nisar, Q. A., Haider, S., Ali, F., Naz, S., & Ryu, K. (2021), "Depletion of psychological, financial, and social resources in the hospitality sector during the pandemic", *International Journal of Hospitality Management*, Vol. 93, p. 102794.
Peso, M., Elgar, M. A., & Barron, A. B. (2015), "Pheromonal control: Reconciling physiological mechanism with signalling theory", *Biological Reviews*, Vol. 90 No. 2, pp. 542–559.
Queiroz, M. M., Telles, R., & Bonilla, S. H. (2019), "Blockchain and supply chain management integration: A systematic review of the literature", *Supply Chain Management: An International Journal*, Vol. 25 No. 2, pp. 241–254.
Román, S., Sánchez-Siles, L. M., & Siegrist, M. (2017), "The importance of food naturalness for consumers: Results of a systematic review", *Trends in Food Science & Technology*, Vol. 67, pp. 44–57.
Rafiei, M., & Ricardez-Sandoval, L. A. (2020), "New frontiers, challenges, and opportunities in integration of design and control for enterprise-wide sustainability", *Computers & Chemical Engineering*, Vol. 132, p. 106610.
Rana, R. L., Tricase, C., & De Cesare, L. (2021), "Blockchain technology for a sustainable agri-food supply chain", *British Food Journal*, Vol. 123 No. 11, pp. 3471-3485.
The Good Food Institute. (2023), *Retail sales data: Plant-based meat, eggs, dairy: GFI*., available at https://gfi.org/marketresearch/
Siipi, H. (2013), "Is Natural Food Healthy?", *Journal of Agricultural and Environmental Ethics*, Vol. 26 No. 4, pp. 797–812.
Shafieizadeh, K., Alotaibi, S. and Tao, C. (2023), "Information processing of food safety messages: what really matters for restaurant customers?", *International Journal of Contemporary Hospitality Management*, Vol. 35 No.10, pp. 3638-3661.
Tandon, A., Dhir, A., Kaur, P., Kushwah, S., & Salo, J. (2020), "Why do people buy organic food? The moderating role of environmental concerns and trust", *Journal of Retailing and Consumer Services*, Vol. 57, p. 102247.

Tessitore, S., Iraldo, F., Apicella, A., & Tarabella, A. (2022), "Food traceability as driver for the competitiveness in Italian food service companies", *Journal of Foodservice Business Research*, Vol. 25 No. 1, pp. 57-84.

Treiblmaier, H., & Garaus, M. (2023), "Using blockchain to signal quality in the food supply chain: The impact on consumer purchase intentions and the moderating effect of brand familiarity", *International Journal of Information Management*, Vol. 68, p. 102514.

Van Rijswijk, W., & Frewer, L. J. (2008), "Consumer perceptions of food quality and safety and their relation to traceability", *British Food Journal*, Vol. 110 No. 10, pp. 1034-1046.

Westerlund, M., Nene, S., Leminen, S., & Rajahonka, M. (2021), "An Exploration of Blockchain-based Traceability in Food Supply Chains: On the Benefits of Distributed Digital Records from Farm to Fork", *Technology Innovation Management Review*, Vol. 11 No. 6, pp. 6–18.

Yagoda, R. E., & Gillan, D. J. (2012), "You want me to trust a ROBOT? The development of a human–robot interaction trust scale", *International Journal of Social Robotics*, Vol. 4 No. 3, pp. 235–248.

Yepes, M. F. (2015), "Mobile tablet menus: attractiveness and impact of nutrition labeling formats on millennials' food choices", *Cornell Hospitality Quarterly*, Vol. 56 No.1, pp. 58-67.

Yasami, M., Wongwattanakit, C., & Promphitak, K. T. (2020), "INTERNATIONAL TOURISTS'PROTECTION INTENTIONS TO USE FOOD HYGIENE CUES IN THE CHOICE OF DESTINATION LOCAL RESTAURANTS", *Geo Journal of Tourism and Geosites*, Vol. 29 No. 2, pp. 583–596.

Yasar, B., Martin, T., & Kiessling, T. (2020), "An empirical test of signalling theory", *Management Research Review*, Vol. 43 No. 11, pp. 1309–1335.

Yuan, C., Wang, S., & Yu, X. (2020), "The impact of food traceability system on consumer perceived value and purchase intention in China", *Industrial Management & Data Systems*, Vol. 120 No. 4, pp. 810-824.

Yong, B., Shen, J., Liu, X., Li, F., Chen, H., & Zhou, Q. (2020), "An intelligent blockchain-based system for safe vaccine supply and supervision", *International Journal of Information Management*, Vol. 52, p. 102024.

Zhao, G., Liu, S., Lopez, C., Lu, H., Elgueta, S., Chen, H., & Boshkoska, B. M. (2019), "Blockchain technology in agri-food value chain management: A synthesis of applications, challenges and future research directions", *Computers in Industry*, Vol. 109, pp. 83–99.

Zhao, Z., Chen, L., Liu, F., Zhou, F., Peng, J., & Sun, M. (2020), "Fast Classification of Geographical Origins of Honey Based on Laser-Induced Breakdown Spectroscopy and Multivariate Analysis", *Sensors*, Vol. 20 No. 7, p. 7.

Zhong, Y., & Moon, H. C. (2020), "What Drives Customer Satisfaction, Loyalty, and Happiness in Fast-Food Restaurants in China? Perceived Price, Service Quality, Food Quality, Physical Environment Quality, and the Moderating Role of Gender", *Foods*, Vol. 9 No. 4, p. 4.