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Consumer attitudes towards blockchain food traceability technology in Sweden

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Abstract: The research utilizes a Discrete Choice Experiment to assess consumer preferences and determine blockchain-based food traceability's relative importance and utility in the food purchasing process. The study specifically tests five selected attributes of olive oil, including price, organic label, olive oil type, country of origin, and blockchain traceability. Additionally, a survey is conducted to evaluate Swedish consumers' knowledge levels concerning blockchain technology and its application in the food system to improve transparency. The study also explores consumer evaluations of safety and sustainability information and their willingness to pay price premiums for food products verified for safety and environmental claims. The findings indicate that while Swedish consumers possess moderate knowledge of blockchain technology, their understanding of its specific application in food traceability is limited. Nevertheless, consumers highly value access to accurate information about the safety and sustainability of their food purchases. A considerable portion of respondents express a willingness to pay a premium for products verified for safety, authenticity, and sustainability. The choice experiment results reveal that blockchain-based food traceability ranks lower in relative importance than the price and organic label but higher than olive oil type and country of origin. The findings of this study contribute to bridging the existing gap in the understanding of blockchain-based food traceability technology among Swedish consumers.

Keywords: food transparency, food fraud, discrete choice experiment, sustainable development, willingness to pay

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Summary: Food traceability is a critical aspect of ensuring transparency and pre-venting food fraud in our food systems. With the emergence of block-chain technology, there is a promising opportunity to revolutionize how we track and record data in a decentralized and tamper-free manner, ultimately enhancing food traceability. However, the implementation of this technology comes with its challenges and requires the support of consumers. This study aims to investigate the attitudes of Swedish consumers towards blockchain-based food traceability technology, bridging the gap in our understanding of this topic. To assess consumer preferences, a Discrete Choice Experiment, a research method that present respondents a set of choices to understand their preferences in the given context, was conducted. The choice experiment focused on five key aspects of olive oil: price, organic label, olive oil type, country of origin, and blockchain traceability. Additionally, a survey was conducted to gauge the knowledge levels of Swedish consumers regarding blockchain technology and its application in the food system to improve transparency. The study also explores consumer evaluations of safety and sustain-ability information, as well as their willingness to pay a premium for food products verified for safety and environmental claims. The findings of the study reveal that while Swedish consumers have a moderate understanding of blockchain technology, their knowledge specific to its application in food traceability is limited. However, it is evident that consumers highly value access to accurate information about the safety and sustainability of their food purchases. The choice experiment results indicate that blockchain-based food traceability ranks lower in relative importance compared to price and organic labeling, but higher than olive oil type and country of origin.

Keywords: food transparency, food fraud, discrete choice experiment, sustainable development, willingness to pay

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Abbreviations

BCT- Blockchain Technology

RUT- Random Utility Theory

DCE- Discrete Choice Experiment

WTP- Willingness to Pay

1. Introduction

In recent years, food traceability has emerged as one of the most important consumer concerns when choosing food products (Liu et al. 2019b; Garaus & Treiblmaier 2021). Consumers are willing to pay a premium for certified food products that are safe and sustainable and from a reliable supply chain (Cao et al. 2020; Rogerson & Parry 2020; Tiscini et al. 2020). Compared with the traditional third-party certification system, the emergence of blockchain technology (BCT) has provided a novel way of recording data in a decentralized manner, which can enhance the traceability, transparency, and efficiency of the agri-food industry, thereby increasing the trust between buyers and sellers (Tripoli & Schmidhuber 2018; Balzarova 2020). Other benefits of implementing BCT in food traceability includes reducing product recall costs, overheads and intermediary costs for retailers (Galvez et al. 2018).

1.1. Problem Statement

While some studies have been conducted in Sweden on adopting blockchain technology in the food system, they have mainly focused on organizational and management perspectives, there remains a gap in understanding consumers' attitudes and behavior towards this technology. For instance, through structured interviews, Linden and Persson (2021) identified the main factors affecting blockchain adoption among agri-food managers, highlighting that increased trustworthiness is the main driver for blockchain adoption, while complicated product characteristics and suppliers' lack of readiness are reasons for rejecting blockchain adoption. Additionally, a survey conducted by Elliot et al. (2021) revealed that Swedish CEOs of export-oriented companies, including agri-food companies show great receptiveness of blockchain and hold strong belief that BCT has the potential of reshaping the industries.

Implementing blockchain technology in food system can be costly and may affect consumers' willingness to pay (Galvez et al. 2018). Therefore, it is essential to understand consumers' perceptions of blockchain technology and their willingness to support blockchain-based traceability since consumers' support is crucial for technology advancement and industrial adoption. However, there is a notable research gap in understanding the attitudes and behaviors of Swedish consumers towards blockchain-based traceability, which is crucial for the technology adoption. Consequently, investigating consumers' attitudes towards blockchain-based traceability technology in Sweden is necessary to develop a comprehensive understanding of consumers' attitudes towards the technology and its acceptance.

1.2. Aim and Research Questions

The project aims to investigate Swedish consumers' knowledge and attitudes regarding blockchain-based food traceability technology. Furthermore, it seeks to identify the key factors that influence their willingness to invest in and support novel advancements in food traceability technology. The research seeks to answer the following key research questions:

1. What is the perception of Swedish consumers regarding the value of safety, authenticity, and environmental impact information in food products? Are they willing to pay a premium to obtain verified information in these aspects?
2. To what extent are Swedish consumers aware of blockchain technology and its application in food traceability?
3. How do Swedish consumers perceive and embrace blockchain-based food traceability technology compared to other third-party certified mechanisms like organic labelling? What is the level of importance assigned to blockchain-based food traceability in the decision-making process of Swedish consumers?

1.3. Research Outline

The structure of the study is as follows. Chapter 2 introduces the concept of food traceability and blockchain technology, followed by a literature review that provides an overview of recent research on the use of blockchain technology for traceability in food supply chains. Additionally, the role of traceability in influencing consumer behavior and their willingness to pay is explored in this chapter.

Chapter 3 presents the theoretical framework employed in this study. This includes the Fishbein Model, which focuses on the relationship between attitudes and behavior. The Random Utility Theory (RUT) is also discussed, as it examines the decision-making process of consumers. Furthermore, the chapter introduces the Discrete Choice Experiment (DCE), which is a tool for assessing the utility of specific product attributes.

Moving on to Chapter 4, we delve into the design of the survey and the DCE conducted as part of the research. In this chapter, we outline the specific details of the survey and DCE experiment, including the selection of olive oil as the test product. Olive oil was chosen due to the growing demand for high-quality olive oil products in EU countries and its historical traceability challenges. Additionally, the chapter provides the data collection process and highlights the ethical considerations that were taken into account during the study.

Chapter 5 focuses on the presentation and analysis of the survey results. The chapter is divided into six main topics, starting with exploring the demographic characteristics of the survey and DCE respondents. We then evaluated Swedish consumer attitudes towards food safety and sustainability information and their willingness to pay a price premium for the information. Additionally, the chapter examines Swedish consumers' knowledge regarding blockchain technology and its potential application for enhancing food traceability. Results from chi-squared tests and ANOVA tests are presented. Lastly, the DCE result is calculated, which offers insights into consumer preferences and decision-making processes when presented with different product attributes and choices.

Finally, in Chapter 6, the data presented in the results are interpreted, providing a comprehensive analysis and discussion of the findings.

1.4. Scope and Delimitations

The delimitations of this study have various dimensions: empirical, methodological, and theoretical. Firstly, the study concentrates on investigating the perceptions and attitudes of Swedish consumers towards blockchain-based food traceability technology, the scope of the study is Swedish consumers residing in Sweden. Therefore, it is essential to acknowledge that the findings may have limited generalizability beyond the Swedish population.

Regarding the empirical scope, the study considers demographic factors such as age, gender, education level, employment status, and income as influencers of consumer perceptions. However, it is important to note that other potential factors influencing consumer attitudes, such as whether having kids or not, may not be extensively explored.

Furthermore, the research design employs a discrete choice experiment as the chosen method. This approach focuses on specific attributes related to the study topic, such as price, organic labeling, blockchain-based traceability technology, country of origin, and olive oil type. Notably, factors like brand and package design are excluded from the research design to enhance the focus of the study and to avoid complexity for respondents.

Lastly, the choice of olive oil as the test product allows for an in-depth examination of consumer attitudes and behaviors related to traceability issues specifically within this food product category. However, it is acknowledged that the perspectives and preferences of consumers across all food product types may only be partially represented.

2. Background

Advanced technologies such as blockchain have emerged as a promising solution to enhance transparency and trust in food supply chains. This chapter delves deeper into food traceability and explores what blockchain is, and how it can be applied in food systems to address the existing challenges. We also examine why food traceability matters for sustainability and discuss the limitations of traditional food traceability methods. Additionally, this chapter presents the latest research on the use of blockchain for traceability in food supply chains, as well as the role of traceability in consumers' behaviour and willingness to pay.

2.1. Food Traceability and its Significance to Sustainability

Food systems are crucial in sustaining lives on Earth as they encompass food security, nutrition, human health, ecosystems, climate change, and social justice; thus, they are curial to sustainable development (Caron *et al.* 2018). Food systems also have negative impacts the environment, including biodiversity loss, water extraction, greenhouse gas emissions, deforestation, and pollution (Garnett 2013). The global food supply chain is responsible for a third of the total greenhouse gas emissions, contributing to global warming and climate change (Crippa *et al.* 2021). In addition, food production, especially the farming stage, also causes massive acidification and eutrophication, which can harm biodiversity and ecosystems (Poore & Nemecek 2018).

The food system is complicated, and the complexity arises from the multiple elements and processes involved in food production, processing, distribution, consumption, and disposal (Pereira *et al.* 2020). These interconnected activities make it challenging to ensure transparency, accountability, and sustainability throughout the entire food supply chain (ibid.).

Food traceability plays a crucial role in addressing these challenges and improving the sustainability of the food supply chain. As Zhou *et al.* (2022) noted, traceability practices can help standardize farming operations, improve management methods, minimize the use of pesticides, and encourage actions that help preserve the natural environment. To fully appreciate the importance of food traceability, it is essential to understand what “traceability” means and how does it work in food systems. Traceability means the ability to track the history, distribution, location, and application of products, parts, materials, or services (Olsen & Borit 2013; ISO 2017). In the agri-food sector, it specifically refers to the ability to track how food is produced, processed, and transported (Badia-Melis *et al.* 2015). Food traceability is essential for achieving various goals related to food safety and security; for instance, food traceability is significant in detecting and addressing food security risks and establishing a transparent chain of custody, which makes it effective and accurate in identifying the causes of food safety issues and targeting food recalls, thus can protect consumers (Storøy *et al.* 2013).

Besides addressing the environmental impacts of food production and protecting consumers in terms of food safety, food traceability is also an essential aspect of ensuring sustainability claims of food products are accountable (Garcia-Torres *et al.* 2019). Through improving traceability, greater visibility of labor conditions and environmental consequences associated with agri-food manufacturing can be achieved (UNDP 2021). In the context of sustainability, the adoption of food traceability technology plays a vital role in the food chain, offering food companies in the upstream sector an opportunity to achieve a high level of sustainable competitive advantage and improve their reputation (Brofman Epelbaum & Garcia Martinez 2014; Ingrassia *et al.* 2017). Food traceability is also a crucial factor for consumers at the downstream end of the food chain, as it enables them to make informed food choices that promote global sustainable food consumption (Walaszczyk *et al.* 2022).

Moreover, consumers today are increasingly concerned about the social, health, and environmental consequences of their food choices (Liu *et al.* 2019). With the information provided by the traceability system, consumers can choose products that are aligned with their values, such as ethically sourced and sustainably produced; in turn, the conscious choices consumers make can translate into an incentive for food companies to adopt more sustainable and ethical practices (Aung & Chang 2014).

2.2. Traditional Food Traceability Method and Challenges

Hatanaka and Busch (2008) discussed how the agri-food system is regulated and changing due to neoliberal trade policies and the opening of international trade. This shift has led to private organizations, such as third-party certification bodies, taking over responsibility for ensuring food safety and quality standards compliance. In addition to government regulations, third-party organizations certify adherence to specific food production or management standards, such as organic and halal standards (UNDP 2021). As a result, state regulation is becoming more indirect, leading retailers and NGOs to take more active roles in developing food safety and quality standards. Retailers are developing their own private standards to compete on quality, differentiate themselves from competitors, and manage risks. Third-party certification has become an increasingly important way to regulate food and agriculture globally (Hatanaka & Busch 2008).

UNDP (2021) has identified that third-party certifications have limitations that may hinder their potential to improve traceability. For instance, more than 400 certification systems in the EU make it difficult for consumers to differentiate and assess the credibility of each certification, leading to decision paralysis. Additionally, companies may use unverified certifications to promote an environmentally friendly image, casting doubt on the legitimacy of certifications. The enforcement of certifications relies on audit processes that need to be improved to enhance traceability. While third-party certifications offer promises, they must address these limitations to improve traceability. Lastly, third-party certification can be expensive and thus can be exclusive to small business owners.

In today's global food supply chain, traditional food traceability methods play a dominant role in ensuring the safety and quality of our food. However, according to ZEBRA (2020), consumers have less trust in food safety guarantees from companies than industry decision-makers do; while 69% of decision-makers believe the industry can handle traceability and transparency, only 35% of consumers agree.

Traditional food traceability system, such as recording the product journey throughout the supply chain on paper-based documentation is not sufficient in meeting consumers' needs and building trust; the limitations include the lack of transparency in the system, errors in the recorded data, difficulties in tracing the product's journey, and the risk of losing or damaging the documents (Aung & Chang 2014). For instance, traditional food traceability methods, such as paper-based documents, can easily be misplaced or damaged, and it needs help to ensure the data is accurate (ibid.). As record keeping is the fundamental aspect of food traceability (Olsen & Borit 2013), and as data is the core of this process, it is essential to examine the challenges faced by traditional food traceability from data-related perspectives. The challenges include the scope of the data being collected, the authenticity of the data, its security, and its management.

One of the main challenges traditional food traceability systems faces is their limited data scope. These systems may only capture information about the immediate suppliers and customers in the food supply chain, making it difficult to trace products further upstream or downstream. Information asymmetry can occur when consumers and producers do not have equal access to information about the food, such as its origin and processing methods; in this case, when the scope of data is limited, consumers can have uncertainty and a lack of trust in the food's quality (Verbeke 2005).

Verdouw *et al.* (2013) identified high traceability demand as a critical challenge in agri-food supply chains. They noted that existing traceability services in the food system are not able to provide a complete view of the entire supply chain since companies rely on internal traceability or external tracking services facilitated by third-party service providers, meaning it would be hard for companies to track their products as they move through the entire supply chain. This lack of comprehensive traceability can be detrimental to the safety and quality of food products.

Another challenge faced by traditional food traceability technology is the authenticity of data. While record keeping is an essential aspect of food traceability, it does not guarantee the authenticity of the records. Intentional errors like fraud and unintentional errors in recording can lead to false claims about food products, undermining the trust of consumers and other stakeholders (Olsen & Borit 2013).

The security of data in traditional food traceability technologies is also a concern. For example, RFID technology, which is commonly used in food traceability technology, is vulnerable to attacks and data tampering as anyone can easily read RFID tags and even access the memory without authorization, which can compromise the integrity of data (Kelepouris *et al.* 2007).

Finally, traditional traceability methods rely heavily on a central party to manage information transfer, which can lead to errors and inauthentic claims about food products during the data acquisition phase (Xu *et al.* 2020). Although Verdouw *et al.*(2013) argue that all the data related to production, processing, and transportation needs to be provided to a central entity to gather the information, many actors in the food chain are reluctant to share their data with a centralized entity.

One potential solution to address the challenges of traditional traceability is the emergence and development of blockchain technology (Kamath 2018; Casino *et al.* 2021; Garaus & Treiblmaier 2021). Unlike the data structure of traditional food traceability technology, blockchain provides a decentralized system that can gather information from all food chain actors without a central party (Xu *et al.* 2020). By using a distributed ledger system, blockchain can help ensure the authenticity and security of data, while also providing comprehensive traceability across the entire food supply chain (Wang *et al.* 2020). More information will be provided in the following sections.

2.3. Blockchain Technology

Blockchain is a digital ledger that keeps the records of transactions on a decentralized network (Bodkhe *et al.* 2020). Blockchain consists of a chain of blocks that stores information that can be verified with a digital signature (ibid.). Each block in the chain contains a timestamp, transaction details, and a unique encrypted code, known as a hash, an encrypted version of the string that cannot be reversed into the original string, ensuring data integrity (Di Pierro 2017). The structure of a blockchain can be broken down into three main parts:

- Block: A block is a collection of transaction data verified, linked to the previous block, and added to the distributed ledger through a complex process called mining (Abeyratne & Monfared 2016).

- Nodes: A node is a participant that validates and relays transactions and can also maintain a copy of the distributed ledger (Rauchs *et al.* 2018).

- Consensus protocol: Consensus protocol is a set of rules and procedures used in a blockchain network to ensure that all nodes agree on the current state of the distributed ledger, which enables secure and transparent transactions without the need for a central authority (Sultan *et al.* 2018).

When implementing a blockchain, one of the crucial decisions that must be made is whether it will be permissioned or permissionless (McBee & Wilcox 2020). A permissionless blockchain, for example, Bitcoin, is public, which means that anyone can join the network, participate in the validation process, and access the blockchain's data (Liu *et al.* 2019). On the other hand, a permissioned blockchain is private, which means that access to the network is restricted to pre-approved users or entities. Permissioned blockchains are often used in enterprise settings, where companies want to keep their data private and limit the network's access to trusted partners (ibid.). Another consideration when implanting blockchain is whether it will be public or private (Yang *et al.* 2020). Based on the division of permissioned/permissionless and public/private, Tan *et al.* (2022) classified four types, see table 1.

Table 1. *Blockchain types and explanations*

Blockchain Type	**Explanation**
Public Permissionless Blockchain	A blockchain network with an open access policy where there are no limitations on participants to read, write and validate data. Bitcoin and Ethereum are examples of such permissionless networks.
Public Permissioned Blockchain	A blockchain network where there is an open policy to read and write data, but the consensus process has limitations on participation.
Private Permissionless Blockchain	A blockchain network where there are limitations on who can read and write data, but no restrictions on participation in the consensus process.
Private Permissioned Blockchain	A blockchain network where access to reading, writing, and validating data is restricted. When multiple organizations are involved in such networks, they are referred to as blockchain consortia.

While the most known application of blockchain is Bitcoin, its potential reaches far beyond cryptocurrency and finance (Foroglou & Tsilidou 2015), regardless of the initial purpose and design, blockchain has become a gamer changer in shifting the paradigm from relying on humans to machines with a decentralized control system (Aste *et al.* 2017). Unlike traditional systems, blockchain operates without intermediaries, and every participant in the network has equal access to the information, which helps to build trust in the system since, in such a distributed system, no individual or organization can alter the data without being noticed (Di Pierro 2017). As a result, blockchain technology has the potential to revolutionize various industries, including the argi-food system, by providing secure, transparent, and tamper-proof records.

2.4. Blockchain-based Food Traceability

In the agri-food sector, blockchain can be used to create a transparent and reliable food traceability system that tracks the journey of food products from farm to table (Chun-Ting *et al.* 2020), ensuring that every production and supply chain stage is recorded and validated, reducing the risk of fraud, errors, and contamination (Antonucci *et al.* 2019). As a result, blockchain technology can improve transparency and traceability, increase food security, and restore consumer confidence in food safety and quality (Zhao *et al.* 2019). As concerns over food safety and supply chain transparency continue to mount, implementing blockchain technology has emerged as a promising solution for achieving seamless food traceability (Kamath 2018).

In this section, we explore blockchain-based food traceability technology further and answer the question 'what is the role of blockchain technology in food traceability'. A literature review (Table 2) examines the current research on implementing blockchain technology in the food industry to achieve food traceability and enhance food safety and supply chain transparency. Blockchain type stated, food type researched, research design, aim, and main conclusion(s) or advantage(s) of blockchain for food traceability are included in the literature review.

Table 2. *Example of recent blockchain-based food traceability*

Author	Journal	Blockchain Type	Food Type	Research Design	Aim	Main Conclusion
(Cao *et al.* 2020)	Agricultural & Applied Economics Association	Unstated	Meat	Choice Experiment	Evaluate Chinese demand for U.S. beef and blockchain-based traceability	• Blockchain-based traceability meets Chinese import traceability requirements. • Blockchain-based traceability can address Chinese consumers' food safety concerns.
(Wünsche & Fernqvist 2022)	Sustainability	Unstated	Unsta ted	Interview	Identify the potential of blockchain technology in agri-food systems.	• Blockchain can restore consumer trust and increase trust within the food supply chain. • Blockchain can deliver transparency to the current food chain.
(Varavallo *et al.* 2022)	Sustainability	Unstated	Chees e	Case Study	Design and evaluate a blockchain for cheese production.	• Blockchain allows all the operator to record real-time information in all stages of food supply chain. • Blockchain can lead to the increased information exchange and data transparency between consortium operators.
(Tan *et al.* 2022b)	International Journal of Logistics	Private permissionless Blockchain	Halal food	Case Study	Test the feasibility of blockchain technology in tracing halal food throughout the food supply chain.	• Blockchain can bring real-time and accurate information. • It is possible to increase traceability of halal food through food supply chain with blockchain technology.
(Garaus & Treiblmaier 2021)	Food Control	Unstated	Food	Case Study	Investigate the role of traceability in consumers' preferences.	• Traceability can affect consumers' preferences on retailers. • Consumers have higher trust in retailers when blockchain-based traceability system is provided.
(Casino *et al.* 2021)	International Journal of Production Research	Local private Blockchain	Diary	Case Study	Access the benefits and challenges of food traceability facilitated by blockchain.	• Blockchain-based traceability system enables improved trust, efficiency, quality and resilience. • It also minimizes the overall handling cost and operating cost of traceability process.
(Behnke & Janssen 2020)	International Journal of Information Management	public permissioned Blockchain	Diary	Case study and template analysis of interviews	Define boundary conditions for BCT.	• Blockchain can be used in supply chains for traceability of goods. • Blockchain can create transparency in the goods supply.
(Iftekhar & Cui 2021)	Foods	Unstated	Food	System design	Propose a solution for tracking frozen meat packages.	• Traditional centralized tracking system is vulnerable to data tampering. • The tamper-proof audit trail of blockchain-based traceability systems can provide reliable traceability.

Recent studies (Table 2) highlight the potential benefits of blockchain-based traceability systems. It can be concluded that blockchain-based traceability has the potential to increase transparency and trust within the food supply chain, restore consumer trust, and deliver real-time and accurate information (Iftekhar & Cui 2021; Tan *et al.* 2022; Varavallo *et al.* 2022). Additionally, it can also lead to increased information exchange and data transparency between consortium operators (Varavallo *et al.* 2022), potentially increasing the traceability of different food systems (Behnke & Janssen 2020; Cao *et al.* 2020; Tan *et al.* 2022) , affecting consumer preferences for retailers (Garaus & Treiblmaier 2021), and reducing the overall handling cost and operating cost of the traceability process (Varavallo *et al.* 2022). Lastly, blockchain-based traceability systems are less vulnerable to data tampering than traditional centralized tracking systems (Iftekhar & Cui 2021).

2.5. The Role of Food Traceability in Consumer Behavior

Food traceability plays a vital role in shaping consumer behavior as it provides critical information about the safety, quality, and origin of agri-food products (Yu et al. 2021). Consumers evaluate the quality of agri-food products based on intrinsic qualities, such as taste and appearance, and external factors, such as where the food originates and how it is processed and labelled (Sadilek 2019). However, globalization has made the food supply chain more complex, making it challenging to maintain safety and quality standards throughout the entire supply chain (Bhat & Jõudu 2019). Food traceability, which enables tracking the production, processing, and transportation of food products, has been identified as an effective tool to monitor the safety and quality of food products to meet industry standards (Badia-Melis et al. 2015). By providing essential information to consumers, food traceability can promote transparency and accountability in the food system, allowing consumers to make informed decisions when making their food purchases (Yu et al. 2021) .

To further examine the role of food traceability in consumer behavior and decision-making, a comprehensive literature review (Table 3) that includes recent studies covering a variety of food types, such as fish, meat, fresh agricultural products, is presented, aiming to provide an overview of recent research on how traceability shapes consumers' behavior.

The literature review (Table 3) highlights the crucial role of food traceability in shaping consumers' behavior. Consumers expect to know where their food comes from and how it was handled at every supply chain step, and increasingly they are more interested in getting informative food traceability information to make sound purchasing decisions (Rodriguez-Salvador & Dopico 2020; Cavite *et al.* 2021). Food traceability is considered a crucial tool for reducing information asymmetry in the food industry, which can help consumers to make informed choices and avoid potential risks associated with food fraud. Therefore, traceability can also impact consumer perception of food quality and safety (Cavite *et al.* 2021; Yu *et al.* 2021; Hoque *et al.* 2022). When consumers are confident they can access accurate and reliable traceability information, they are more likely to trust the food industry and pay a premium for authentic food products (McCallum *et al.* 2022).

One of the most significant findings from the reviewed studies is that food traceability plays a pivotal role in rebuilding consumer trust in the food industry (Zhang *et al.* 2020; Hoque *et al.* 2022). Traceability can help verify the authenticity of food claims, such as organic or locally sourced, and assure consumers that their food is safe and of high quality (Nawi *et al.* 2018). The findings also suggest that consumers' knowledge of traceability, confidence, trust in the food system, and risk-taking tendencies can influence their preferences for traceability systems (Nawi *et al.* 2018; Yuan *et al.* 2020; McCallum *et al.* 2022). For example, consumers who are knowledgeable about food traceability tend to value traceability systems more highly and are willing to pay a higher price premium for traceable food products (Yuan *et al.* 2020), while more risk-taking consumers may not add high perceived value to traceability information when making purchasing decisions (McCallum *et al.* 2022).

Table 3. *Example of recent research on the role of food traceability in consumer behavior*

Author	Journal	Food Type	Research Design	Aim	Main Conclusion
(Rodriguez-Salvador Dopico 2020)	Food Control	Fish	Questionnaires	Provide consumers' perception and expectation of traceability in the fishery industry.	• Consumers believe traceability is a necessity for fishery products. • Consumers expect to know the origin of the fish and how it was processed through traceability.
(Zhang et al. 2020)	Journal of Consumer Protection and Food Safety	Food	Survey	Investigate consumers' perception and confidence in food traceability systems.	• Traceability is a vital tool to rebuild consumers' food trust. • Consumers have a strong inclination to know the food handling procedure. • It is more critical to trace imported food than locally produced food.
(Yuan et al. 2020)	Industrial Management & Data Systems	Food	Survey	Analyze the connections among the traceability system for food, the value perceived by consumers, and their intention to make a purchase.	• Food traceability is of great importance to food quality. • Consumers with traceability knowledge intend to add more perceived value to traceability systems.
(McCallum et al. 2022)	European Review of Agricultural Economics	Fish	Artefactual field experiment	Investigate consumers' perception on food fraud and attitudes toward food traceability.	• Consumers are willing to pay a price premium for authentic food products. • Consumers with traceability knowledge intend to add more perceived value to traceability systems.
(Nawi et al. 2018)	International Food Research Journal	Meat	Survey	Identify factors that impact consumers' preferences towards the traceability system of meat.	• Traceability systems can verify the authenticity of food claims. • Consumers have a positive attitude towards the traceability system on meat. • Factors such as knowledge of traceability, and confidence in food system, can influence consumers' preferences towards meat traceability systems.
(Hoque et al. 2022)	Foods	Seafood	Experimental survey	Explore the demand for traceability information in the seafood market.	• Consumers value traceability information like fish control. • Traceability program such as labelling plays a significant role in restoring consumers' trust in food quality and safety.
(Yu et al. 2021)	Open Journal of Business and Management	Fresh agricultural products	Survey	Inspect the impact of traceability information of fresh agricultural products on consumers' purchasing behavior.	• Traceability information influences consumers' behavior by changing their perceived value of the products. • Traceability can reduce information asymmetry and reduce food safety risks.
(Cavite et al. 2021)	British Food Journal	Rice	Face-to face survey	Analyze consumer tendencies toward buying organic rice using traceability information.	• Detailed information through traceability plays an essential role in consumers' intention to purchase organic rice. • Traceability can provide consumers with clear and comprehensive information about the product, which can help to change consumers' perceptions of the product.

Overall, the literature review demonstrates that food traceability is essential for addressing consumer concerns about food safety, quality, and authenticity. Traceability can help to rebuild consumer trust in the food industry and provide consumers with the information they need to make informed choices about their food purchases. It can change their perceived value of food and purchasing behavior. As a result, by fostering a traceability system in the agri-food sector, greater trust and confidence in the food system can be achieved, leading to positive outcomes for consumers and producers.

2.6. Consumers' Support of Blockchain-based Food Traceability

As a novel food traceability technology that has decentralized and tamper-resistant features, blockchain-based food traceability technology can achieve increased transparency and trust and improved food quality and safety (Behnke & Janssen 2020; Casino *et al.* 2021; Varavallo *et al.* 2022). However, its implementation comes with high cost, which could result in increased prices for consumers (Shew *et al.* 2022). Therefore, it is crucial to investigate consumers' attitudes towards blockchain-based food traceability to understand the feasibility and potential of this technology. This section aims to explore consumers' supports for blockchain-based food traceability technology. Willingness to pay (WTP) is the maximum amount a consumer is willing to pay for a particular product or service, reflecting the value they place on it, which can vary based on factors such as income, preferences, and availability of substitute products (Dwivedi *et al.* 2018). On the other hand, price premium refers to the extra amount a consumer is willing to pay for a product or service compared to similar offerings in the market, reflecting the extra value the consumer perceives in the product or service, and can be influenced by factors such as brand image, product quality, and uniqueness (Dwivedi *et al.* 2018). We use willingness to pay a price premium as a key indicator for assessing consumer's support.

A literature review (Table 4) is conducted to understand consumers' willingness to pay a price premium for blockchain-based traceability technology. Although there is limited academic research that specifically investigates this topic, we aim to provide a critical synthesis of the main findings and insights from previous research. It is important to note that as the number of papers focusing on blockchain-based technology is limited, we also incorporated relevant studies that explore other traceability technologies to ensure a comprehensive review of the literature on traceability methods.

The literature review (Table 4) indicates that consumers are willing to pay price premiums for food products that have blockchain-based traceability, organic certification labels, and origin labels (Nie et al. 2021; Dionysis et al. 2022; Duckworth et al. 2022; Liu et al. 2022; Shew et al. 2022). In our literature review, different studies have found varying results regarding how consumers value food labeling and blockchain-based traceability. For example, Shew et al.(Shew et al. 2022) found consumers in the USA are willing to pay more for USDA certification than blockchain traceability, while Lin et al. (2022) discovered that Chinese consumers trust blockchain-based traceability more than traditional traceability methods with a \$0.63 per pound more than traditional methods. Additionally, consumers' income level, having children in the family, knowledge, and trust in eco-labels significantly impact their willingness to pay (Czine et al. 2020; Liu et al. 2022; Tran et al. 2022). However, the influence of consumers' age, gender, and education level on willingness to pay is insignificant (ibid.). Finally, sustainably and locally sourced labels are essential to consumers, with locally sourced labels having the highest willingness to pay (Dionysis et al. 2022).

Overall, the literature review provides insights into consumer behavior and their willingness to pay for food products with blockchain-based traceability and various certification labels. The studies reviewed show that consumers are generally willing to pay price premiums for products that offer these attributes.

Table 4. *Recent research on consumers' support of blockchain-based and other traceability methods*

Author	**Journal**	**Country or region**	**Traceability technology**	**Food Type**	**Research Design**	**Main Conclusion**
(Shew et al. 2022)	Applied Economic Perspectives and Policy	USA	Blockchain	Meat	Discrete choice experiment	• Consumers have limited knowledge on blockchain technology and its potential in improving traceability. • Consumers valued USDA certification and BC certification labels at premiums, with USDA certification being valued at approximately $2.00 more than BC certification.
(Lin et al. 2022)	Applied Economic Perspectives and Policy	China	Blockchain	Meat	Discrete choice experiment	• Blockchain-based traceability is a significant driver of beef purchasing decisions, with consumers willing to pay an average premium of $0.63 per pound compared to regular digital traceability. • 31% of consumers in the sample consider blockchain-based traceability the most crucial factor when buying beef, and 37% of respondents would pay significant premiums for both U.S. beef and blockchain-traceable beef products.
(Tran et al. 2022)	Foods	Vietnam	Food labelling	Vegetable	Discrete choice experiment	• Trust is strongly associated with consumers' evaluation of food certification. • International organic certification is costly and thus is out of the reach of low-income consumers but is highly valued by high-income consumers.
(Dionysis et al. 2022)	British Food Journal	UK	Blockchain	Coffee	Questionnaire	• 75.6% of consumers indicated that they are willing to pay at least 5% more for blockchain traceable coffee than the base organic coffee price. • Consumers associate blockchain traceable coffee with the authenticity of known origin not improved health or taste.
(Liu et al. 2022)	British Food Journal	China	Food labelling	Egg	Discrete choice experiment	• Consumers' income level, having children in the family, knowledge and trust in eco-labels significantly impact their WTP. • The influence of consumers' age, gender, and education level on WTP is insignificant.
(Czine et al. 2020)	Nutrients	Hungary	Food labelling	Meat	Conjoint choice experiment	• The label of origin positively influences consumer preference and consumers are willing to pay a price premium. • Age, gender, and income have a significant impact on WTP.
(Nie et al. 2021)	British Food Journal	Taiwan	Third-party food labelling	Organic food	Discrete choice experiment	• Organic rice certification labels can effectively communicate the product's credence attributes and increase consumers' WTP. • Consumers prefer organic food with certification labels issued by foundations and universities over those issued by private businesses.
(Duckworth et al. 2022)	Journal of Cleaner Production	UK	Food labelling	Rice	Questionnaire	• Consumers are three times more likely to buy labelled food products. • "Sustainably sourced" and "locally sourced" are the most important labels; "locally sourced" label has the highest WTP.

3. Theoretical Framework

The significance of food traceability in restoring trust and confidence in the food system and promoting sustainability has been widely acknowledged. However, the traditional methods of tracing food products have faced challenges such as a lack of transparency, reliability, and efficiency. With the emergence of blockchain technology, there has been a growing interest in exploring its potential to revolutionize the food traceability system, while implementing blockchain-based traceability is costly and thus needs consumer support. In order to examine Swedish consumers' attitude towards blockchain-based food traceability and assess the importance of blockchain-based food traceability technology in decision-making process, we adopt Fishbein's multi-attribute model, Random Utility Theory (RUT), Discrete Choice Experiment (DCE) as theoretical frameworks for further research design development.

3.1. Fishbein Model

Fishbein Model, or the Theory of Reasoned Action, is theory that connects attitudes with behaviors. It is a psychology theory that aims to explain and predict individuals' behaviors based on their attitudes and subjective norms (Fishbein & Ajzen 1976). To visually represent the model, Figure 1 illustrates the key components and the relationships within the model. It demonstrates that an individual's behavioral intention is shaped by their attitudes towards the behavior and the subjective norms they perceive (ibid.).

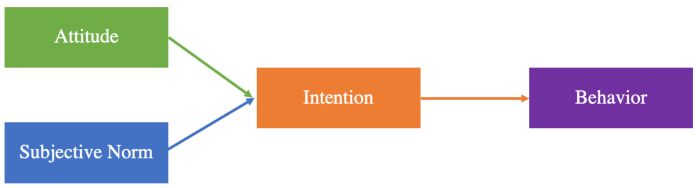


Figure 1. *Attitudes, subjective norms, and behavioral intentions in Fishbein Model (Fishbein & Ajzen 1976).*

A product can be seen as a collection of multiple attributes each with its own costs and benefits (Wilkie & Pessemier 1973). Consumers' attitude towards a product represents their evaluation of the entity in question, and we can predict consumers' behavior from their attitudes based on the concept of consistency; that is, consumers are likely to exhibit favorable behaviors if they hold favorable attitudes towards the product (Ajzen & Fishbein 1977). Therefore, by examining consumer behavior, we can determine their attitudes towards a product, as intention is a function of attitudes (Roberts *et al.* 2018).

The Fishbein Model has been widely used in research and practice to predict and explain a variety of behaviors, including health behaviors, consumer behaviors, and environmental behaviors (Mangham *et al.* 2009; Hendrarini *et al.* 2020; Su *et al.* 2022). In our study, Fishbein Model serves a theoretical framework for examining consumers' attitudes and behaviors towards blockchain-based food traceability.

3.2. Random Utility Theory and Discrete Choice Experiment

To better explain consumers' behavior towards food traceability and blockchain technology, we can utilize the Random Utility Theory (RUT), an established economic model commonly used in consumer behavior research. RUT considers the complexity and variability of decision-making by assuming that individuals prefer different alternatives and ultimately choose the option that provides the highest overall satisfaction or utility (McFadden 1986). The utility function measures how much an individual values a specific alternative, and the preferred choice is the one that yields the highest level of utility (Croissant 2020).

In RUT, when making a choice, the decision maker considers the utility of each alternative and selects the one with the highest utility, and a Discrete Choice Experiment (DCE) can be used to separate different attributes of a product and calculate the importance of individual attributes (Joya *et al.* 2021).

DCE is widely used in market research to develop experiments allowing respondents to choose from distinct alternatives and examine how consumers make trade-offs between product attributes (Obadha *et al.* 2019). In a DCE, participants are presented with a series of hypothetical product profiles or service options that vary in their attributes, such as price, quality, and brand (Czine *et al.* 2020). Each product profile comprises a set of attribute levels, and participants are asked to choose their preferred option from a set of two or more alternatives (ibid.). The attributes and the combinations of attribute levels presented to participants are carefully designed to elicit information about the relative importance of each attribute and the trade-offs people are willing to make between different attributes (Mangham *et al.* 2009).

DCEs are based on RUT, which assumes that participants will choose the option with the highest utility in the choice experiment (Lancaster 1966). By analyzing the data from a DCE, researchers can quantify the utilities that product attributes bring to the whole utility of the product; in practice, it can also be used to calculate and estimate participants' willingness to pay for attributes (Felgner & Henschke 2023).

To have a better understanding of DCE, it is important to get familiar with some key terms:

- Attributes: Selected factors or features that are believed to impact decision-makers' preferences (Coast & Horrocks 2007).

- Levels: Attributes are comprised of various levels, each representing a different option for decision-makers. However, avoiding extreme and unrealistic levels is essential when assigning levels to attributes (ibid.).

- Profiles: A profile is a hypothetical product created by combing different levels of attributes (Dobra *et al.* 2021).

- Set: A set is the collection of concepts that are presented to decision-makers for making choices (ibid.) .

- Utilities: Utilities determine the value a respondent places on each attribute level. By analyzing the utilities for all respondents, the overall value of a product can be generated (Mangham *et al.* 2009).

A visual representation of the key terms associated with DCE is presented (Figure 2). However, it should be noted that utilities, which are the calculated results obtained after conducting the experiment and regression, are not included in the illustration as they cannot be visually represented.

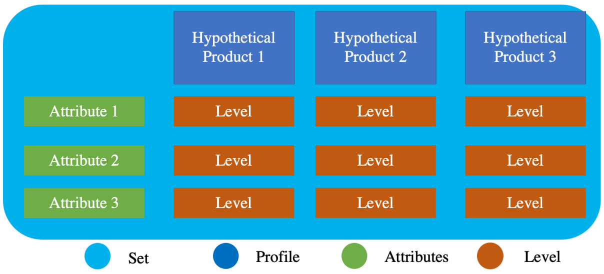


Figure 2. *Illustration of key terms including set, profile, attributes, and levels in Discrete Choice Experiment. Utility is not illustrated here.*

DCE has been widely used in agricultural marketing to examine food attributes, for example, place of origin, nutrition, and price (Czine *et al.* 2020). For example, Rotraris and Danielis (2011) adopted DCE to find out Italian consumers' willingness to pay for fair-trade coffee. Similarly, Shew *et al.* (2022) used DCE to analyze consumers' preferences for food labelling and blockchain-based food traceability technology and examined their willingness to pay for different traceability systems.

In conclusion, DCE is a helpful tool for investigating consumer preferences and understanding how they make trade-offs between different product attributes. By presenting consumers with a series of hypothetical product profiles that vary in attributes such as price, traceability technology, and place of origin, we can estimate the relative importance of each attribute and how Swedish consumers trade off one attribute against another. By conducting DCE, we can answer the research question regarding the relative importance of blockchain-based food traceability in the food purchase decision-making.

4. Method

In this chapter, we present the study's design, which includes selecting the test product, identifying relevant attributes, and determining attribute levels. Additionally, we have designed a survey to collect the respondents' demographic data, knowledge of blockchain-based food traceability technology, perception of the importance of safety and sustainability information of food products, and willingness to pay price premiums.

4.1. Design of the Study: Product, Attributes, and Levels

Our study seeks to examine Swedish consumers' attitudes towards blockchain-based food traceability technology. In order to conduct this study, olive oil has been selected as the product for our study, a vital food product for EU consumers because of the increasing demand for it (Marozzo *et al.* 2022). Additionally, olive oil is also identified by the EU Food Fraud Network as a susceptible product for food fraud, with typical food fraud practices like mislabeling virgin olive oil as extra virgin olive oil, as well as mixing olive oil with other vegetable oils and selling the mixture as pure olive oil (Casadei *et al.* 2021). Addressing these concerns is vital due to the growing market for olive oil and the heightened demand for high-quality products.

Sweden, one of the leading olive oil consumption EU countries that does not produce olive oil, has had an average annual increase in value and volume over the past five years (CBI, 2022). In Sweden, extra virgin olive oil is the most imported type, followed by virgin and non-virgin-olive oils. Italy, Spain, and Greece are the top three countries from which Sweden imports olive oil, in contrast, only 2% of the total imported volume are from non-EU countries, highlighting the dominance of EU suppliers in the Swedish market (ibid.)

According to Dekhili *et al.* (2011), consumers usually find it difficult to obtain intrinsic values, such as taste, quality, appearance of olive oil, when making purchasing decisions. As a result, they rely heavily on extrinsic cues or credence attributes, including factors such as place of origin, brand, labels, and price, to guide their decision-making process (Di Vita *et al.* 2021). In line with these studies, our study specifically focuses on examining the impact of credence attributes, including of blockchain-based traceability technology as one such attribute.

It is important to note that while brand is recognized as a significant credence attribute that can influence consumer behavior (ibid.). We have deliberately chosen not to include it in our study due to the complexities associated with the diverse range of brands in the Swedish market. By excluding brand as a variable, we aim to maintain better control over our analysis. The attributes selected for this study are price, blockchain-based traceability, organic label, country of origin, and extra virgin (Table 5).

Table 5. *An overview of attributes and levels for discrete choice experiment*

Attribute	Level
Price (SEK/L)	80
	135
	168
Blockchain-based traceability	Yes
	No
Organic label	Yes
	No
Country of origin	Italy
	Spain
	Greece
Extra-virgin	Yes
	No

Based on the information provided in Appendix A, we have established three price tiers for olive oil in the Swedish market. These tiers reflect different qualities and attributes associated with olive oil products. Our analysis's base price is 80 SEK/L, representing the cheapest available option. The second tier includes olive oils that are popular among consumers and encompass a mixture of extra-virgin and non-extra-virgin olive oils. It also includes products with and without organic labels. The average price for this tier is approximately 135 SEK/L. Lastly, we have the premium olive oil tier, representing the highest quality olive oils available in the market. Lastly, we have the premium olive oil tier, which represents the highest quality olive oils available in the market. To determine the price level for this tier, we referred to the research conducted by Di Vita *et al.* (2021) on olive oil prices. Based on their findings, we applied a coefficient of 1.25 to separate popular olive oils from the premium class. The price level for this tier is identified as 168 SEK/L.

Regarding the country of origin, we have chosen to focus on the top three olive oil-producing countries: Italy, Spain, and Greece. These countries account for the majority of imported olive oil in the Swedish market, while the share of olive oil from non-EU countries only comprises 2% of the market (CBI, 2022) . Therefore, for the purpose of our analysis, we have excluded the small market share of non-EU countries.

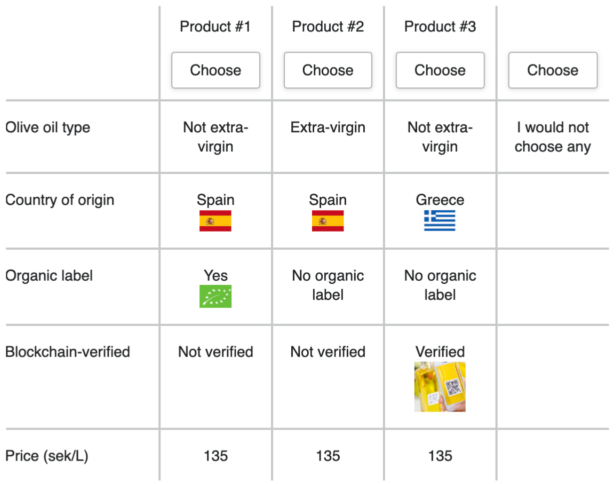
4.2. Survey Structure

The unit of analysis for this research is individual consumers residing in Sweden. The study's primary objective is to analyze consumers' preferences regarding blockchain-based food traceability technology in decision-making while purchasing hypothetical olive oil products.

To effectively capture consumer preferences, understand their trade-off reasoning, and provide a realistic choice context (Coast & Horrocks 2007), we have utilized DCE for our study. The survey consists of two parts.

The primary objective of the initial phase is to gather demographic data, assess the self-revealing level of knowledge among Swedish consumers regarding blockchain technology and its potential in food traceability, and investigate the consumers' concerns regarding food safety and sustainability and their willingness to pay for authentic and sustainable food. The demographic information collected encompasses details such as place of residence, age, gender, education level, employment status, and monthly income. To gauge respondents' perspectives on the significance of safety, authenticity, and sustainability information, as well as their willingness to pay a premium price for such features, we followed the 5-point rating scale *Haan et al.* (2018) used for a survey concerning sustainability attitudes, we used 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree. The survey questions of the first part of the survey can be seen in the Appendix B.

The subsequent part of the survey is a DCE that aims to ascertain the comparative significance of various external factors in influencing consumers' purchasing choices for hypothetical olive oil products. The credence attributes include price, blockchain-based traceability, organic label, country of origin, and whether the olive oil is extra virgin or not, on consumers' purchasing decisions for hypothetical olive oil products (Figure 3).



	Product #1	Product #2	Product #3	
	Choose	Choose	Choose	Choose
Olive oil type	Not extra-virgin	Extra-virgin	Not extra-virgin	I would not choose any
Country of origin	Spain	Spain	Greece	
Organic label	Yes	No organic label	No organic label	
Blockchain-verified	Not verified	Not verified	Verified	
Price (sek/L)	135	135	135	

Figure 3. *An example of the DCE. Three olive oil products exhibit a distinct combination of various attribute levels. Additionally, participants also have the option to select "I would not choose any" as a valid choice.*

Before conducting the DCE, participants are provided with information about blockchain technology and its potential benefits for enhancing food traceability. Additionally, an explanation of the meaning and significance of organic labels is given to ensure that participants clearly understand these terms.

4.3. Data Collection

A combination of methods is used to recruit respondents for this study. Firstly, an online survey is being distributed through targeted Facebook groups across Sweden, and Reddit r/Sweden to obtain a diverse sample of consumers. A message has been crafted to accompany the online survey, which describes the aim of the study, provides an estimated time required for completion, and explains the process of completing the choice experiment. Participants are instructed to follow the survey link provided to access the survey and proceed with the choice experiment.

A total of 86 qualified responses through this online survey were collected. In addition, we conducted on-site recruitment at two grocery stores: ICA Luthagen Livs and ICA Väst, on May 13th and May 14th, respectively. ICA Luthagen Livs is a regular store with above-average product prices, while ICA Väst is a budget store. During the on-site recruitment, we approached potential store participants, provided them with a brief explanation of the study's purpose, and offered guidance on completing the choice experiment. Participants were requested to complete the survey and choice experiment using our provided devices. We collected 26 responses from on-site recruitment.

4.4. Ethical Considerations

The study adheres the ethical guidelines outlined by Etikprovnings Myndigheten. All collected data is treated as confidential and solely used for research purposes.

Respondents are assured that the survey is anonymous, and their participation is voluntary. No deception or harm is involved in the study. The primary goal is to enhance comprehension regarding consumers' perception of blockchain-based food traceability technology and the relative importance of such serveries in their purchase decisions. The findings may have potential implications for product development and marketing strategies.

5. Result

This chapter encompasses key results of the study. Firstly, the demographic characteristics of the survey and DCE respondents are explored. Swedish consumer attitudes towards food safety and sustainability information, along with their willingness to pay a price premium for this information, are investigated. Additionally, the knowledge of Swedish consumers regarding blockchain technology and its potential application for enhancing food traceability is examined, offering insights into the level of awareness and acceptance of this technology. The results from chi-squared tests and ANOVA tests are presented to identify any significant differences or associations between variables in the study. Finally, the results of the DCE are calculated through ChoiceModelR, providing the relative importance of the selected attributes and the utilities of attribute levels in the experiment.

5.1. Demographic Profile of Respondents

In this study, a total of 156 responses were collected. Out of these responses, 112 participants were qualified and met the criteria for inclusion in the category of consumers residing in Sweden, which formed the focus of the study.

Regarding age distribution (Table 6), the majority of participants fell within the 25-34 age range, accounting for 50.893% of the total. The next significant age group was 18-24, representing 12.5% of respondents, followed by 35-44 (12.5%), 55-64 (9.821%), 45-54 (8.036%), 65-74 (5.357%), and individuals aged 75 and older (0.893%).

In terms of gender (Table 6), the survey had a balanced representation, with 50% of respondents identifying as female and 49.1% identifying as male. A small proportion (0.9%) chose the "Other" category.

The participants in the study exhibited a range of high educational backgrounds, with a predominant proportion (36.6%) holding a master's degree. A significant percentage (34.8%) reported having a bachelor's degree, indicating a substantial level of education among the respondents. High school completion was reported by 16.1% of the participants, while 11.6% indicated possessing a doctorate. A small proportion (0.9%) chose the "Other" option to describe their educational attainment.

Table 6. *An overview of demographic profile of respondents*

Demographics	Response options	Count	% of Total
Age	25-34	57	50.9
	18-24	14	12.5
	35-44	14	12.5
	55-64	11	9.8
	45-54	9	8.0
	65-74	6	5.4
	75 and older	1	0.9
Gender	Female	56	50.0
	Male	55	49.1
	Other	1	0.9
Education Level	Master's degree	41	36.6
	Bachelor's degree	39	34.8
	High school	18	16.1
	Doctor's degree	13	11.6
	Other	1	0.9
Employment	Employed	56	50.0
	Unemployed	26	23.2
	Part-time	19	17.0
	Other	11	9.8
Income	Lower than 15,000 SEK	47	42.0
	Higher than 45,000 SEK	24	21.4
	35,000 SEK- 45,000SEK	18	16.1
	25,000 SEK - 35,000 SEK	13	11.6
	15,000 SEK - 25,000 SEK	10	8.9
Total		112	100.0

Regarding employment status, half of the respondents (50%) reported being employed. 23.2% were unemployed, while 17.0% worked part-time. The remaining 9.8% fell into the "Other" category, indicating a varied employment situation.

Income levels were diverse among the respondents. The largest group (42.0%) reported an income lower than 15,000 SEK, followed by 21.429% with an income higher than 45,000 SEK. Other income ranges included 35,000 SEK - 45,000 SEK (16.1%), 25,000 SEK - 35,000 SEK (11.6%), and 15,000 SEK - 25,000 SEK (8.9%).

5.2. Swedish Consumers' Attitudes on Food Safety, Authenticity, Sustainability Information, and Willingness to Pay a Price Premium

The survey includes four statements for respondents to indicate their agreement or disagreement (Table 7), capturing their attitudes on the importance of safety, authenticity, and sustainability information, as well as their willingness to pay a premium for these features. A grouped bar chart is provided to visually represent the distribution of responses (Figure 4).

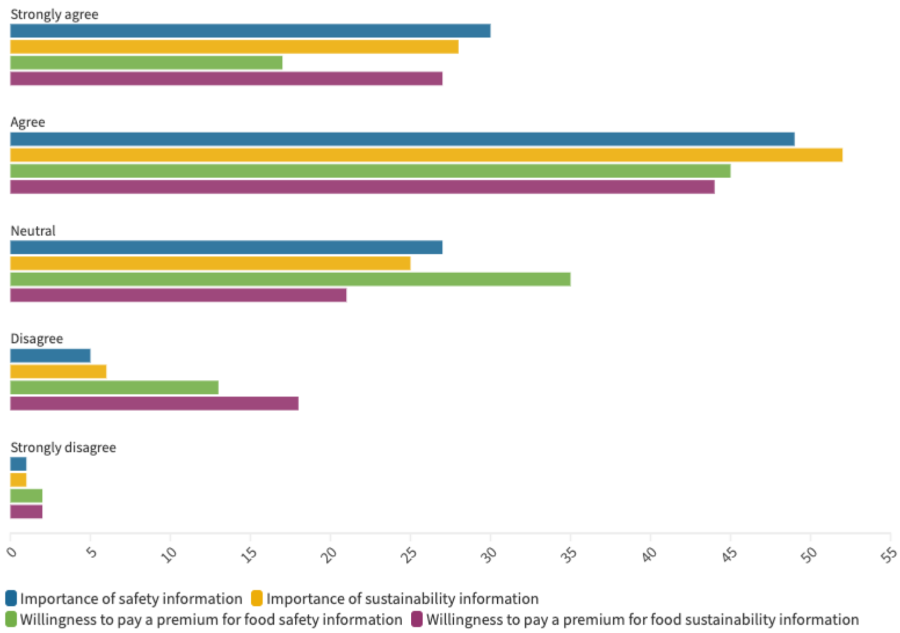


Figure 4. *Bar chart (grouped): evaluation of four statements. The statements are categorized into five levels ranging from "strongly disagree" to "strongly agree."*

For the statement "It is important for me to have access to accurate information about the safety and authenticity of the food products I purchase," 43.8% of respondents agreed and 26.8% respondents strongly agreed, indicating the significance they place on this information.

Similarly, when considering the importance of accurate information about the sustainability and environmental impact of food products, 46.4% of respondents agreed and 25.0% respondents strongly agreed, showing their awareness and concern for sustainability factors.

Table 7. *Swedish consumer attitudes and willingness to pay a price premium for safety and sustainability information of food products*

	Response	Count	% of
"It is important for me to have access to accurate information about the safety and authenticity of the food products I purchase."	Strongly disagree	1	0.9
	Disagree	5	4.5
	Neutral	27	24.1
	Agree	49	43.8
	Strongly agree	30	26.8
"It is important for me to have access to accurate information about the sustainability and environmental impact of the food products I purchase."	Strongly disagree	1	0.9
	Disagree	6	5.4
	Neutral	25	22.3
	Agree	52	46.4
	Strongly agree	28	25.0
"I am willing to pay a premium for food products that have been verified for their safety and authenticity."	Strongly disagree	2	1.8
	Disagree	13	11.6
	Neutral	35	31.3
	Agree	45	40.2
	Strongly agree	17	15.2
"I am willing to pay a premium for food products that have been verified to be sustainably produced and have minimal environmental impact."	Strongly disagree	2	1.8
	Disagree	18	16.1
	Neutral	21	18.8
	Agree	44	39.3
	Strongly agree	27	24.1
Total		112	100.0

Respondents had varied opinions when assessing the willingness to pay a premium for food products that are verified for their safety and authenticity. While a significant proportion expressed neutrality, 40.2% agreed, and 15.2% strongly agreed to pay a higher price for these attributes. Regarding sustainability, respondents displayed a similar distribution of opinions, with 39.3% agreeing and 24.1% strongly agreeing to pay a premium for getting verified information on food products that are sustainably produced and have a minimal environmental impact.

Moreover, by using the scale 1-5 to represent "strongly disagree" to "strongly agree", the quantification allows us to assign numerical values to the respondents' level of agreement or disagreement with each statement, facilitating the analysis of their preferences and attitudes (Table 8).

Table 8. *Swedish consumer attitudes and willingness to pay a price premium for safety and sustainability information of food products*

	Importance of	Importance of	Willingness to pay	Willingness to pay
Mean	3.91	3.89	3.55	3.68
Median	4.00	4.00	4.00	4.00
Standard	0.876	0.874	0.948	1.07
Variance	0.767	0.763	0.898	1.14

The analysis reveals those respondents highly valued food safety and authenticity information (mean = 3.91) and food sustainability information (mean = 3.89). There was a moderate willingness to pay for food safety and authenticity information (mean = 3.55) and food sustainability information (mean = 3.68). The data showed some variability with standard deviations of 0.876, 0.874, 0.948, and 1.07 for the respective measures, representing a moderate spread of responses on the importance of food safety information and sustainability information. However, the willingness to pay a price premium exhibits a broader response spread.

5.3. Swedish Consumers' Knowledge on Blockchain Technology

Overall Swedish consumers have a notable level of familiarity blockchain technology. Out of the total respondents, 70 respondents have knowledge about blockchain, while the remaining 42 respondents reported they had never heard about blockchain technology (Figure 5).

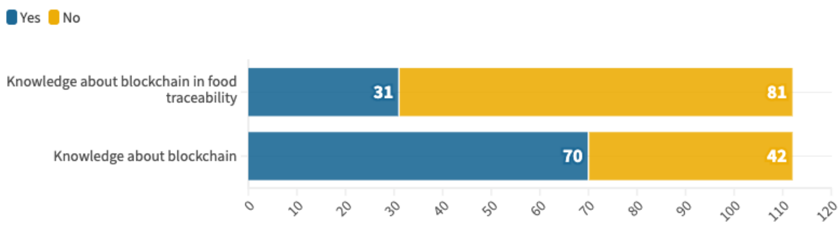


Figure 5. *Swedish consumer's self-revealing level of knowledge regarding blockchain and its application for food traceability.*

Upon specifically considering knowledge about blockchain in the context of food traceability, 31 of the respondents indicated knowing. At the same time, most 70 reported a lack of familiarity (Figure 5).

These results suggest that a significant portion of Swedish consumers are aware of blockchain technology. However, their knowledge about its application for food traceability is relatively limited.

5.4. Gender Differences in Blockchain Knowledge: A Chi-squared test Examination

Chi-squared tests were employed to investigate the potential impact of demographic data, including age, gender, education level, employment status, and income on respondents' knowledge of blockchain. Chi-squared tests can be used to examine the association or difference between two categorical groups (Franke et al. 2012) . All the collected demographic data are in the categorical forms, and self-revealing knowledge level regarding blockchain used Yes/No two categories, making it suitable for chi-squared test.

The results of the chi-squared tests indicated no significant differences in knowledge of blockchain among the categories based on age, education level, employment status, and income, see Appendix C. The chi-squared results (Table 9) revealed no statistically significant association or difference between gender and the knowledge of blockchain in enhancing food traceability. Conversely, the p-value of knowledge of blockchain has a statistically significant value of 0.002, indicating the association between gender and general familiarity with blockchain technology.

Table 9. *Chi-squared test on self-revealing knowledge level regarding blockchain*

Title	Class				Total	X^2	P
KnowBTC	Yes	26	43	1	70	12.542	**0.002*** **
	No	30	12	0	42		
Total		56	55	1	112		
KnowBTC_Food	Yes	13	18	0	31	1.641	0.440
	No	43	37	1	81		
Total		56	55	1	112		

5.5. The Impact of Income on Consumer Willingness to Pay Price Premium for Food Safety and Sustainability Information: Insights from One-Way ANOVA Test

Then the evaluation of four statements conserving the importance of food safety and authenticity information, sustainability information, and consumers' willingness to pay a price premium for that information were tested with the demographic attributes and knowledge of blockchain technology. Jones *et al.*(2019) used one-way ANOVA to test if there were significant differences in the level of agreement with sustainability statements across the demographic groups.

Upon analyzing the collected data using one-way ANOVA tests, the results revealed that among different age, gender, education, and employment groups, there is no significant difference. However, a notable finding emerged concerning the role of income (Table 10).

Table 10. *ANOVA result: level of agreement across income groups*

Safety_info	Lower than 15,000 SEK	47	3.894	0.84	0.297	0.879
	15,000 SEK - 25,000 SEK	10	3.9	0.876		
	35,000 SEK- 45,000SEK	18	3.889	0.9		
	25,000 SEK - 35,000 SEK	13	4.154	0.689		
	Higher than 45,000 SEK	24	3.833	1.049		
	Total	112	3.911	0.876		
Sustainability_info	Lower than 15,000 SEK	47	3.723	0.902	1.099	0.361
	15,000 SEK - 25,000 SEK	10	4.3	0.675		
	35,000 SEK- 45,000SEK	18	3.944	0.873		
	25,000 SEK - 35,000 SEK	13	3.923	0.862		
	Higher than 45,000 SEK	24	4	0.885		
	Total	112	3.893	0.874		
Pay_safetyinfo	Lower than 15,000 SEK	47	3.234	0.914	3.775	**0.007*** **
	15,000 SEK - 25,000 SEK	10	4.3	0.675		
	35,000 SEK- 45,000SEK	18	3.611	0.916		
	25,000 SEK - 35,000 SEK	13	3.923	0.76		
	Higher than 45,000 SEK	24	3.625	1.013		
	Total	112	3.554	0.948		
Pay_sustainabilityinfo	Lower than 15,000 SEK	47	3.34	1.048	2.928	**0.024** **
	15,000 SEK - 25,000 SEK	10	4.2	0.789		
	35,000 SEK- 45,000SEK	18	3.611	1.145		
	25,000 SEK - 35,000 SEK	13	4.154	0.801		
	Higher than 45,000 SEK	24	3.917	1.1		
	Total	112	3.679	1.067		

For the willingness to pay the price premium for safety information, the p-value of 0.007*** suggests a statistically significant difference in the level of agreement with safety information among different income groups. Similarly, regarding willingness to pay the price premium for sustainability information, the p-value of 0.024** suggests a statistically significant difference in the level of agreement with paying for sustainability information among different income groups.

However, the ANOVA test indicates no significant difference in the level of agreement with the importance of safety and sustainability information across income groups.

5.6. Discrete Choice Experiment Result

The data from the DCE was analyzed using the R package ChoiceModelR, which utilizes a Markov Chain Monte Carlo (MCMC) algorithm to estimate multinomial logit coefficients for each unit in the data (Sermas 2022). The results of the regression analysis provided insights into the relative importance of each attribute (Figure 6) and the utility of each attribute level (Figure 7). The regression result can be seen in Table 11. The complete regression calculation table can be found in Appendix C.

Table 11. *Result of Discrete Choice Experiment*

Attribute	Importance	Level	Utility
Blockchain-verified	16%	Not verified	-0,95
		Verified	0,95
Country of origin	9%	Spain	-0,5
		Greece	0,05
		Italy	0,55
Olive oil type	14%	Not extra-virgin	-0,85
		Extra-virgin	0,85
Organic label	27%	No organic label	-1,57
		Organic label	1,57
Price (SEK/L)	34%	168	-0,35
		135	0,9
		80	2,87

Figure 6 displays the relative importance of attributes in influencing respondents' purchasing decisions during the DCE.

Figure 6. *DCE result: relative importance of attributes. Price emerges as the attribute with the highest relative importance, followed by the organic label and blockchain verification. Olive oil type is deemed moderately important, while country of origin is identified as the least important attribute in the study.*

In Figure 7, the utilities of attribute levels are presented. The price level of "80 SEK/L" has the highest utility of 2.87, while "168 SEK/L" has a negative utility of -0.35. The attribute "Organic label" demonstrates the second-highest utility among all the tested levels, closely followed by the slightly lower utility of 0.95 for the "Blockchain verified" level. Regarding the attribute "Country of origin," "Extra virgin" shows a higher utility compared to "Italy," and "Greece" has a lower utility than both "Italy" and "Spain."

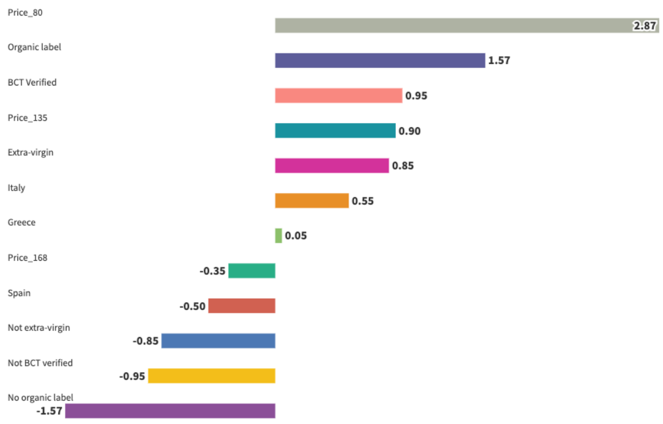


Figure 7. *DCE result: utilities of attribute levels. The cheapest price has the highest utility. Following closely, the organic label and blockchain verification options occupy the second and third positions in terms of utility. On the other hand, not having an organic label is associated with the highest negative utility.*

6. Discussion

This chapter examines Swedish consumers' perceptions and attitudes towards blockchain-based food traceability. Findings indicate that consumers prioritize access to verified food safety and sustainability information, aligning with previous research. Growing awareness of food traceability underscores its significance in purchasing decisions. Income level influences willingness to pay for verified information, while other demographic factors show limited impact. Consumers demonstrate knowledge of blockchain but limited understanding of its application in enhancing traceability. Price is the most important factor in decision-making, with a preference for affordable options. Organic labels receive higher acceptance and evaluation than blockchain-based technology. The relative importance of country of origin is low, suggesting trust in EU-made food products. Generalizing the findings should be done cautiously, as different food types and cultural factors can vary consumer preferences. Convenience sampling is a limitation, and future studies should employ random sampling for greater representativeness. Despite limitations, the study provides valuable insights into Swedish consumers' attitudes towards blockchain-based food traceability.

6.1. Swedish Consumer’s Perception of Food Safety and Authenticity Information

The findings presented in Figure 4 further support the significance of accurate information in the Swedish consumer market. The data demonstrates that Swedish consumers place significant importance on having access to verified food safety and sustainability information. This aligns with prior studies highlighting consumers' willingness to pay a price premium for such information (Cao *et al.* 2020; Rogerson & Parry 2020; Tiscini *et al.* 2020).

Moreover, the studies conducted by Liu *et al.* (2019b) and Garaus & Treiblmaier (2021) emphasize the growing awareness and concern among consumers regarding food traceability. These findings indicate that consumers now prioritize traceability as a key factor when making food purchasing decisions. By combining this knowledge with the willingness to pay a premium for certified food products (Cao *et al.* 2020; Rogerson & Parry 2020; Tiscini *et al.* 2020), it becomes evident that

Swedish consumers are not only seeking information on safety and sustainability but also actively supporting their preferences through purchasing decisions.

The analysis of the data revealed interesting patterns in the agreement levels among consumers regarding safety, sustainability, and willingness to pay for verified information. While there is a general consensus on the importance of these factors, the variance in agreement levels displays different patterns. The evaluation of safety and sustainability demonstrates a more concentrated distribution, indicating that consumers place consistent emphasis on these aspects. In contrast, the willingness to pay a price premium for verified information exhibits a broader spread, suggesting that consumer preferences vary in terms of their readiness to invest financially in obtaining verified information (Table 8).

To investigate the factors influencing consumers' willingness to pay, a one-way ANOVA test (Table 10) was conducted across different demographic groups. The results indicate that among all demographic groups, individuals with different income levels exhibit distinct preferences regarding their willingness to pay for verified safety and sustainability information. This finding suggests that income plays a significant role in shaping consumer behavior and decision-making processes. However, it is worth noting that irrespective of other demographic groups, all participants express a high level of evaluation regarding the importance of safety and environmental impact information. This underscores the overall significance consumers attribute to these factors when making food purchasing decisions.

While the findings from the literature review highlight the influence of age, gender, income, and knowledge about food traceability on consumers' willingness to pay (Czine et al. 2020; Liu et al. 2022; Tran et al. 2022). However, in the case of our sample, age, gender, and knowledge about food traceability do not show significant impact. These findings indicate that while income level plays a crucial role in consumers' willingness to pay for verified information, other demographic factors may not have a significant impact in the context of our study. However, it is important to acknowledge that these findings may be specific to our sample and may not be generalizable to all consumer populations. Further research is needed to explore the influence of demographic factors in different contexts and diverse consumer groups.

6.2. Swedish Consumer's Self-revealing Knowledge Level Regarding Blockchain Technology

Among the Swedish consumers surveyed, a majority demonstrated a solid understanding of blockchain technology. Out of the 112 respondents, 70 reported being aware of blockchain (Figure 5). However, their knowledge regarding how blockchain can enhance food traceability is limited, with only 31 respondents indicating familiarity with this aspect (ibid.).

The chi-squared test (Table 9) revealed that gender was the sole demographic factor correlated with knowledge of blockchain. However, no significant correlation was found between gender and knowledge of blockchain's application in enhancing food traceability. It is important to note that the correlation between gender and self-reported blockchain knowledge does not imply causation, and further research is required to explore the underlying mechanisms involved.

6.3. Swedish Consumer's Support of Blockchain-based Food Traceability

The findings from the discrete choice experiment (DCE) highlight the high relative importance of price in consumers' decision-making process (Figure 6). Specifically, our analysis reveals that an olive oil price of 80 SEK/L received the highest utility score of 2.87, indicating that respondents highly prioritize obtaining the cheapest olive oil (Figure 7). Higher prices were associated with lower and negative utilities, suggesting a strong preference for affordable options among the participants.

Regarding traceability methods, previous studies show consumers are willing to pay price premium for product with verified authenticity (McCallum *et al.* 2022). In our study, both organic label and blockchain verification received rather high utility, and the organic label received higher utility than blockchain verification (Figure 7), indicating a stronger acceptance and evaluation of organic labels over blockchain-based food traceability technology. Shew *et al*. (2022), in a similar DCE study, found that US consumers are willing to pay more for the USDA label than blockchain verification.

In contrast to the findings of Duckworth *et al.* (2022), who reported that place of origin label has the highest importance for purchasing rice in the UK, our study suggests a relatively low relative importance of country of origin. This suggests a generally high level of trust in EU-made food products among our participants, given that 98% of olive oil imported by Sweden originates from within the EU (CBI, 2022). However, it is important to note that if the studied product heavily relies on imports from outside the EU, the relative importance of country of origin could differ. Further studies are required to explore this aspect.

Although price emerges as the most important factor in this study, it is crucial to avoid generalizing these results to all food products. Different food types possess unique characteristics, and other considerations hold significant weight in the decision-making process. For example, ethical concerns such as fair trade label may be prominent in coffee purchases (Rotaris & Danielis 2011), while animal welfare could be a crucial factor in meat product choices (Nawi et al. 2018). Therefore, the relative importance of different factors may vary depending on the specific food product and consumer preferences.

Furthermore, it is important to acknowledge that the results of this study should not be generalized to other countries or regions. Cultural and social factors play a pivotal role in shaping individuals' attitudes and subjective norms, which in turn can greatly influence consumer behavior and preferences (Ajzen & Fishbein 1977; Fishbein 1979), making it necessary to conduct separate studies in different contexts to obtain comprehensive insights.

6.4. Limitations

While this study provides valuable insights into the perceptions and attitudes of Swedish consumers towards blockchain-based food traceability technology, it is important to acknowledge the limitations associated with the use of convenience sampling. Convenience sampling involves selecting participants based on their accessibility and willingness to participate, rather than through randomization (Emerson 2015). In this study, the on-site recruitment was conducted solely in Uppsala, a young student town, resulting in an overrepresentation of low-income and young students among the respondents. As a result, the sample may not fully represent the diverse and heterogeneous nature of Swedish consumers, and caution should be exercised when generalizing the findings to the broader population.

To mitigate the limitations of convenience sampling, techniques such as random sampling are encouraged to be employed in the future studies to obtain a more representative sample. Despite the limitations, the current study provides insights and understanding into the attitudes and perceptions of the specific sample of Swedish consumers included in the study. The findings contribute to the existing body of knowledge on consumer attitudes towards blockchain-based food traceability technology in the Swedish context.

7. Conclusions

7.1. Key Findings

The study provides insights into Swedish consumers' perception of food safety and authenticity information, their self-revealing knowledge level regarding blockchain technology, and their support for blockchain-based food traceability. Swedish consumers prioritize having access to accurate information about the safety, authenticity, and sustainability of food products. They are willing to pay a price premium for verified information in these areas. The evaluation of safety and sustainability importance shows a concentrated distribution, while the willingness to pay for verified information displays a broader spread.

The majority of Swedish consumers surveyed demonstrate a solid understanding of blockchain technology in general, although their knowledge of how blockchain can enhance food traceability is limited. Gender was found to be correlated with knowledge of blockchain, but no significant correlation was observed between gender and knowledge of blockchain's application in enhancing food traceability.

In the DCE that involves price, country of origin, olive oil type, organically labelled or not, blockchain verified or not, price was identified as the most important factor in consumers' decision-making process for purchasing olive oil. The organic label received higher utility than blockchain verification, indicating a stronger acceptance and evaluation of organic labels over blockchain-based traceability technology. The importance of whether the olive oil is extra-virgin was moderately low, while the country of origin had the least importance.

The study suggests a high level of trust in EU-made food products among Swedish consumers, given the low relative importance of country of origin. However, the relevance of country of origin may vary depending on the product and its reliance on imports from outside the EU. Further research is needed to explore this aspect.

While the findings highlight the importance of price and offer insights into consumer acceptance of blockchain-based food traceability, it is important to consider that different food types have unique characteristics, and other factors may play significant roles in consumer decision-making. This study should not be generalized to all food products or extended to other countries or regions.

The study acknowledges some limitations, including the skewed representation of young individuals with low income among the respondents. Future research should strive to include participants from more diverse backgrounds to obtain a more comprehensive understanding of consumer behavior in relation to food purchasing decisions.

7.2. Implications

The key findings of this study have important implications for food producers, retailers, and policymakers. The high evaluation of transparent and verified information by Swedish consumers highlights the importance of meeting their expectations in terms of food safety and authenticity. It is crucial for businesses to prioritize providing accurate and reliable information to build consumer trust and meet the growing demand for safety and sustainability. Incorporating food traceability methods, such as blockchain technology, can be a viable option for enhancing traceability and addressing consumer concerns. However, it is essential for businesses to carefully evaluate the cost and acceptance of implementing blockchain-based food traceability, taking into account the specific food type and the dynamics of the market. Policymakers can play a role in promoting transparency and encouraging the adoption of innovative traceability technologies through supportive regulations and incentives.

7.3. Suggestions for Future Research

To obtain a more representative sample, future studies should consider employing random sampling techniques. This will help ensure a more diverse and heterogeneous participant group, allowing for better generalizability of the findings.

Additionally, while this study focused some demographic factors, future research could consider incorporating other characteristics such as whether participants have children or not. These factors may influence consumer attitudes, perceptions, and purchasing decisions related to food safety and traceability.

Lastly, future studies can expand the scope of research to include food products that present traceability challenges intertwined with concerns such as animal welfare and fair trade. Investigating how these factors interact and influence consumer decision-making will provide a more comprehensive understanding of the complexities involved in consumer preferences and choices. Consumer attitudes are not solely driven by traceability; ethical concerns also play a significant role. Future studies can investigate how traceability initiatives interact with ethical considerations, such as environmental sustainability or labor practices. Understanding the interplay between traceability and ethical concerns will inform the development of comprehensive strategies that address multiple consumer priorities.

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Reference List

Abeyratne, S.A. & Monfared, R.P. (2016). Blockchain ready manufacturing supply chain using distributed ledger. *International journal of research in engineering and technology*, 5 (9), 1–10

Ajzen, I. & Fishbein, M. (1977). Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychological Bulletin*, 84, 888–918. https://doi.org/10.1037/0033-2909.84.5.888

Antonucci, F., Figorilli, S., Costa, C., Pallottino, F., Raso, L. & Menesatti, P. (2019). A review on blockchain applications in the agri-food sector. *Journal of the Science of Food and Agriculture*, 99 (14), 6129–6138. https://doi.org/10.1002/jsfa.9912

Aste, T., Tasca, P. & Di Matteo, T. (2017). Blockchain technologies: The foreseeable impact on society and industry.

Aung, M.M. & Chang, Y.S. (2014). Traceability in a food supply chain: Safety and quality perspectives. *Food Control*, 39, 172–184. https://doi.org/10.1016/j.foodcont.2013.11.007

Badia-Melis, R., Mishra, P. & Ruiz-García, L. (2015). Food traceability: New trends and recent advances. A review. *Food Control*, 57, 393–401. https://doi.org/10.1016/j.foodcont.2015.05.005

Balzarova, M.A. (2020). Blockchain technology – a new era of ecolabelling schemes? *Corporate Governance: The International Journal of Business in Society*, 21 (1), 159–174. https://doi.org/10.1108/CG-08-2020-0328

Behnke, K. & Janssen, M. (2020). Boundary conditions for traceability in food supply chains using blockchain technology. *International Journal of Information Management*, 52, 101969

Bhat, R. & Jõudu, I. (2019). Chapter 2 - Emerging issues and challenges in agri-food supply chain. In: Accorsi, R. & Manzini, R. (eds) *Sustainable Food Supply Chains*. Academic Press. 23–37. https://doi.org/10.1016/B978-0-12-813411-5.00002-8

Bodkhe, U., Tanwar, S., Parekh, K., Khanpara, P., Tyagi, S., Kumar, N. & Alazab, M. (2020). Blockchain for industry 4.0: A comprehensive review. *IEEE Access*, 8, 79764–79800

Brofman Epelbaum, F.M. & Garcia Martinez, M. (2014). The technological evolution of food traceability systems and their impact on firm sustainable performance: A RBV approach. *International Journal of Production Economics*, 150, 215–224. https://doi.org/10.1016/j.ijpe.2014.01.007

Cao, S., Dulleck, U., Uwe, Powell, Warwick, T.-M., Charles, Natanelov, V., & Foth (2020). *BeefLedger blockchain-credentialed beef exports to China: Early consumer insights*. https://doi.org/10.13140/RG.2.2.23195.28961

Caron, P., Ferrero y de Loma-Osorio, G., Nabarro, D., Hainzelin, E., Guillou, M., Andersen, I., Arnold, T., Astralaga, M., Beukeboom, M., Bickersteth, S., Bwalya, M., Caballero, P., Campbell, B.M., Divine, N., Fan, S., Frick, M., Friis, A., Gallagher, M., Halkin, J.-P., Hanson, C., Lasbennes, F., Ribera, T., Rockstrom, J., Schuepbach, M., Steer, A., Tutwiler, A. & Verburg, G. (2018). Food systems for sustainable development: proposals for a profound four-part transformation. *Agronomy for Sustainable Development*, 38 (4), 41. https://doi.org/10.1007/s13593-018-0519-1

Casadei, E., Valli, E., Panni, F., Donarski, J., Farrús Gubern, J., Lucci, P., Conte, L., Lacoste, F., Maquet, A., Brereton, P., Bendini, A. & Gallina Toschi, T. (2021). Emerging trends in olive oil fraud and possible countermeasures. *Food Control*, 124, 107902. https://doi.org/10.1016/j.foodcont.2021.107902

Casino, F., Kanakaris, V., Dasaklis, T.K., Moschuris, S., Stachtiaris, S., Pagoni, M. & Rachaniotis, N.P. (2021). Blockchain-based food supply chain traceability: a case study in the dairy sector. *International Journal of Production Research*, 59 (19), 5758–5770

Cavite, H.J., Mankeb, P. & Suwanmaneepong, S. (2021). Community enterprise consumers' intention to purchase organic rice in Thailand: the moderating role of product traceability knowledge. *British Food Journal*, 124 (4), 1124–1148. https://doi.org/10.1108/BFJ-02-2021-0148

CBI (2022). *The European market potential for olive oil*. https://www.cbi.eu/market-information/processed-fruit-vegetables-edible-nuts/olive-oil/market-potential [2023-05-08]

Chun-Ting, P., Meng-Ju, L., Nen-Fu, H., Jhong-Ting, L. & Jia-Jung, S. (2020). Agriculture blockchain service platform for farm-to-fork traceability with IoT sensors., 2020. 158–163. IEEE

Coast, J. & Horrocks, S. (2007). Developing Attributes and Levels for Discrete Choice Experiments Using Qualitative Methods. *Journal of health services research & policy*, 12, 25–30. https://doi.org/10.1258/135581907779497602

Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., Tubiello, F.N. & Leip, A. (2021). Food systems are responsible for a third of global anthropogenic GHG emissions. *Nature Food*, 2 (3), 198–209. https://doi.org/10.1038/s43016-021-00225-9

Croissant, Y. (2020). Estimation of random utility models in R: the mlogit package. *Journal of Statistical Software*, 95, 1–41

Czine, P., Török, Á., Pető, K., Horváth, P. & Balogh, P. (2020). The Impact of the Food Labeling and Other Factors on Consumer Preferences Using Discrete Choice Modeling—The Example of Traditional Pork Sausage. *Nutrients*, 12 (6), 1768. https://doi.org/10.3390/nu12061768

Dekhili, S., Sirieix, L. & Cohen, E. (2011). How consumers choose olive oil: The importance of origin cues. *Food quality and preference*, 22 (8), 757–762

Di Pierro, M. (2017). What Is the Blockchain? *Computing in Science & Engineering*, 19 (5), 92–95. https://doi.org/10.1109/MCSE.2017.3421554

Di Vita, G., Zanchini, R., Falcone, G., D'Amico, M., Brun, F. & Gulisano, G. (2021a). Local, organic or protected? Detecting the role of different quality signals among Italian olive oil consumers through a hierarchical cluster analysis. *Journal of Cleaner Production*, 290, 125795. https://doi.org/10.1016/j.jclepro.2021.125795

Di Vita, G., Zanchini, R., Gulisano, G., Mancuso, T., Chinnici, G. & D'Amico, M. (2021b). Premium, popular and basic olive oils: mapping product segmentation and consumer profiles for different classes of olive oil. *British Food Journal*, 123 (13), 178–198. https://doi.org/10.1108/BFJ-08-2020-0677

Dionysis, S., Chesney, T. & McAuley, D. (2022). Examining the influential factors of consumer purchase intentions for blockchain traceable coffee using the theory of planned behaviour. *British Food Journal*, 124 (12), 4304–4322. https://doi.org/10.1108/BFJ-05-2021-0541

Dobra, R.A., Boeri, M., Elborn, S., Kee, F., Madge, S. & Davies, J.C. (2021). Discrete choice experiment (DCE) to quantify the influence of trial features on the decision to participate in cystic fibrosis (CF) clinical trials. *BMJ Open*, 11 (3), e045803. https://doi.org/10.1136/bmjopen-2020-045803

Duckworth, J.J., Randle, M., McGale, L.S., Jones, A., Doherty, B., Halford, J.C.G. & Christiansen, P. (2022). Do front-of-pack 'green labels' increase sustainable food choice and willingness-to-pay in U.K. consumers? *Journal of Cleaner Production*, 371, 133466. https://doi.org/10.1016/j.jclepro.2022.133466

Dwivedi, A., Nayeem, T. & Murshed, F. (2018). Brand experience and consumers' willingness-to-pay (WTP) a price premium: Mediating role of brand credibility and perceived uniqueness. *Journal of Retailing and Consumer Services*, 44, 100–107. https://doi.org/10.1016/j.jretconser.2018.06.009

Elliot, V., Floden, J., Overland, C., Raza, Z., Staron, M., Woxenius, J., Basu, A., Rajput, T., Schneider, G. & Stefansson, G. (2021). CEOs' understanding of blockchain technology and its adoption in export-oriented companies in West Sweden: a survey. *Journal of Global Operations and Strategic Sourcing*,

Emerson, R.W. (2015). Convenience sampling, random sampling, and snowball sampling: How does sampling affect the validity of research? *Journal of Visual Impairment & Blindness*, 109 (2), 164–168

Felgner, S. & Henschke, C. (2023). Patients' preferences in dental care: A discrete-choice experiment and an analysis of willingness-to-pay. *PLOS ONE*, 18 (2), e0280441. https://doi.org/10.1371/journal.pone.0280441

Fishbein, M. (1979). A theory of reasoned action: Some applications and implications. *Nebraska Symposium on Motivation*, 27, 65–116

Fishbein, M. & Ajzen, I. (1976). Misconceptions about the Fishbein model: Reflections on a study by Songer-Nocks. *Journal of Experimental Social Psychology*, 12 (6), 579–584. https://doi.org/10.1016/0022-1031(76)90036-6

Foroglou, G. & Tsilidou, A. (2015). *Further applications of the blockchain*.

Franke, T.M., Ho, T. & Christie, C.A. (2012). The chi-square test: Often used and more often misinterpreted. *American journal of evaluation*, 33 (3), 448–458

Galvez, J.F., Mejuto, J.C. & Simal-Gandara, J. (2018). Future challenges on the use of blockchain for food traceability analysis. *TrAC Trends in Analytical Chemistry*, 107, 222–232. https://doi.org/10.1016/j.trac.2018.08.011

Garaus, M. & Treiblmaier, H. (2021). The influence of blockchain-based food traceability on retailer choice: The mediating role of trust. *Food Control*, 129, 108082. https://doi.org/10.1016/j.foodcont.2021.108082

Garcia-Torres, S., Albareda, L., Rey-Garcia, M. & Seuring, S. (2019). Traceability for sustainability – literature review and conceptual framework. *Supply Chain Management: An International Journal*, 24 (1), 85–106. https://doi.org/10.1108/SCM-04-2018-0152

Garnett, T. (2013). Food sustainability: problems, perspectives and solutions. *Proceedings of the Nutrition Society*, 72 (1), 29–39. https://doi.org/10.1017/S0029665112002947

Haan, M., Konijn, E.A., Burgers, C., Eden, A., Brugman, B.C. & Verheggen, P.P. (2018). Identifying Sustainable Population Segments Using a Multi-Domain Questionnaire: A Five Factor Sustainability Scale. *Social Marketing Quarterly*, 24 (4), 264–280. https://doi.org/10.1177/1524500418794019

Hatanaka, M. & Busch, L. (2008). Third-Party Certification in the Global Agrifood System: An Objective or Socially Mediated Governance Mechanism? *Sociologia Ruralis*, 48 (1), 73–91. https://doi.org/10.1111/j.1467-9523.2008.00453.x

Hendrarini, H., Sunarsono, R.J., Erviyanti, Y. & Soedarto, T. (2020). The identification of ready-to-eat banana's superior attributes through the fishbein multi-attribute approach. *Bulgarian Journal of Agricultural Science*, 26 (1), 34–42

Hoque, M.Z., Akhter, N. & Chowdhury, M.S.R. (2022). Consumers' preferences for the traceability information of seafood safety. *Foods*, 11 (12), 1675

Iftekhar, A. & Cui, X. (2021). Blockchain-Based Traceability System That Ensures Food Safety Measures to Protect Consumer Safety and COVID-19 Free Supply Chains. *Foods*, 10 (6), 1289. https://doi.org/10.3390/foods10061289

Ingrassia, M., Bacarella, S., Columba, P., Altamore, L. & Chironi, S. (2017). Traceability and Labelling of Food Products from the Consumer Perspective. *Chemical Engineering Transactions*, 58. https://doi.org/10.3303/CET1758145

ISO (2017). *ISO 28594:2017(en) Combined accept-zero sampling systems and process control procedures for product acceptance*. https://www.iso.org/obp/ui/#iso:std:iso:28594:ed-1:v1:en:term:3.1.30 [2023-03-22]

Jones, R., Wham, C. & Burlingame, B. (2019). New Zealand's Food System Is Unsustainable: A Survey of the Divergent Attitudes of Agriculture, Environment, and Health Sector

Professionals Towards Eating Guidelines. *Frontiers in Nutrition*, 6. https://www.frontiersin.org/articles/10.3389/fnut.2019.00099 [2023-05-22]

Joya, K., Ramli, N.N., Shamsudin, M.N. & Kamarulzaman, N.H. (2021). Consumers' willingness to pay for food safety attributes of tomato. *British Food Journal*, 124 (3), 701–717. https://doi.org/10.1108/BFJ-02-2021-0164

Kamath, R. (2018). Food traceability on blockchain: Walmart's pork and mango pilots with IBM. *The Journal of the British Blockchain Association*, 1 (1)

Kelepouris, T., Pramatari, K. & Doukidis, G. (2007). RFID-enabled traceability in the food supply chain. *Industrial Management & Data Systems*, 107 (2), 183–200. https://doi.org/10.1108/02635570710723804

Lancaster, K.J. (1966). A new approach to consumer theory. *Journal of political economy*, 74 (2), 132–157

Lin, W., Ortega, D.L., Ufer, D., Caputo, V. & Awokuse, T. (2022). Blockchain-based traceability and demand for US beef in China. *Applied Economic Perspectives and Policy*, 44 (1), 253–272

Lindén, T. & Persson, J. (2021). *Blockchain technology adoption in agri-food supply chains: why or why not? : Exploring Swedish organizations' reasoning and approach to adoption*. http://urn.kb.se/resolve?urn=urn:nbn:se:hj:diva-52730 [2023-01-03]

Liu, C., Liu, X., Yao, L. & Liu, J. (2022). Consumer preferences and willingness to pay for eco-labelled eggs: a discrete choice experiment from Chongqing in China. *British Food Journal*, 125 (5), 1683–1697. https://doi.org/10.1108/BFJ-12-2021-1305

Liu, M., Wu, K. & Xu, J.J. (2019a). How will blockchain technology impact auditing and accounting: Permissionless versus permissioned blockchain. *Current Issues in auditing*, 13 (2), A19–A29

Liu, R., Gao, Z., Nayga, R.M., Snell, H.A. & Ma, H. (2019b). Consumers' valuation for food traceability in China: Does trust matter? *Food Policy*, 88, 101768. https://doi.org/10.1016/j.foodpol.2019.101768

Mangham, L.J., Hanson, K. & McPake, B. (2009). How to do (or not to do) … Designing a discrete choice experiment for application in a low-income country. *Health Policy and Planning*, 24 (2), 151–158. https://doi.org/10.1093/heapol/czn047

Marozzo, V., Vargas-Sánchez, A., Abbate, T. & D'Amico, A. (2022). Investigating the importance of product traceability in the relationship between product authenticity and consumer willingness to pay. *Sinergie Italian Journal of Management*, 40 (2), 21–39. https://doi.org/10.7433/s118.2022.02

McBee, M.P. & Wilcox, C. (2020). Blockchain technology: principles and applications in medical imaging. *Journal of digital imaging*, 33, 726–734

McCallum, C.S., Cerroni, S., Derbyshire, D., Hutchinson, W.G. & Nayga Jr, R.M. (2022). Consumers' responses to food fraud risks: an economic experiment. *European Review of Agricultural Economics*, 49 (4), 942–969

McFadden, D. (1986). The choice theory approach to market research. *Marketing science*, 5 (4), 275–297

Nawi, N.M., Basri, H.N., Kamarulzaman, N.H. & Shamsudin, M.N. (2018). Factors influencing consumers' preferences towards meat and meat products with traceability systems in Malaysia. *International Food Research Journal*, 25

Nie, Y.Y., Liang, A.R.-D. & Wang, E.C. (2021). Third-party certification labels for organic food: consumers' purchase choice and willingness-to-pay. *British Food Journal*, 124 (11), 3993–4008. https://doi.org/10.1108/BFJ-07-2021-0777

Obadha, M., Barasa, E., Kazungu, J., Abiiro, G.A. & Chuma, J. (2019). Attribute development and level selection for a discrete choice experiment to elicit the preferences of health care providers for capitation payment mechanism in Kenya. *Health Economics Review*, 9 (1), 30. https://doi.org/10.1186/s13561-019-0247-5

Olsen, P. & Borit, M. (2013). How to define traceability. *Trends in Food Science & Technology*, 29 (2), 142–150. https://doi.org/10.1016/j.tifs.2012.10.003

Pereira, L.M., Drimie, S., Maciejewski, K., Tonissen, P.B. & Biggs, R. (Oonsie) (2020). Food System Transformation: Integrating a Political–Economy and Social–Ecological Approach to Regime Shifts. *International Journal of Environmental Research and Public Health*, 17 (4), 1313. https://doi.org/10.3390/ijerph17041313

Poore, J. & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science*, 360 (6392), 987–992

Rauchs, M., Glidden, A., Gordon, B., Pieters, G.C., Recanatini, M., Rostand, F., Vagneur, K. & Zhang, B.Z. (2018). Distributed ledger technology systems: A conceptual framework. *Available at SSRN 3230013*,

Roberts, J., Popli, G. & Harris, R.J. (2018). Do Environmental Concerns Affect Commuting Choices?: Hybrid Choice Modelling with Household Survey Data. *Journal of the Royal Statistical Society Series A: Statistics in Society*, 181 (1), 299–320. https://doi.org/10.1111/rssa.12274

Rodriguez-Salvador, B. & Dopico, D.C. (2020). Understanding the value of traceability of fishery products from a consumer perspective. *Food Control*, 112, 107142

Rogerson, M. & Parry, G.C. (2020). Blockchain: case studies in food supply chain visibility. *Supply Chain Management: An International Journal*, 25 (5), 601–614. https://doi.org/10.1108/SCM-08-2019-0300

Rotaris, L. & Danielis, R. (2011). Willingness to pay for fair trade coffee: A conjoint analysis experiment with Italian consumers. *Journal of Agricultural & Food Industrial Organization*, 9 (1)

Sadilek, T. (2019). Perception of food quality by consumers: literature review.

Sermas, R. (2022). ChoiceModelR: Choice Modeling in R. https://cran.r-project.org/web/packages/ChoiceModelR/ChoiceModelR.pdf

Shew, A.M., Snell, H.A., Nayga Jr, R.M. & Lacity, M.C. (2022). Consumer valuation of blockchain traceability for beef in the U nited S tates. *Applied Economic Perspectives and Policy*, 44 (1), 299–323

Storøy, J., Thakur, M. & Olsen, P. (2013). The TraceFood Framework–Principles and guidelines for implementing traceability in food value chains. *Journal of food engineering*, 115 (1), 41–48

Su, J., Lee, Y. & Byrd, K. (2022). U.S. Millennial Consumers and Their Purchase Intention of Sustainable Apparel: The Mediating Role of Consumer Concern. *International Textile and Apparel Association Annual Conference Proceedings*, 78 (1). https://doi.org/10.31274/itaa.13580

Sultan, K., Ruhi, U. & Lakhani, R. (2018). Conceptualizing blockchains: Characteristics & applications. *arXiv preprint arXiv:1806.03693*,

Tan, A., Gligor, D. & Ngah, A. (2022a). Applying blockchain for halal food traceability. *International Journal of Logistics Research and Applications*, 25 (6), 947–964

Tan, A., Gligor, D. & Ngah, A. (2022b). Applying blockchain for halal food traceability. *International Journal of Logistics Research and Applications*, 25 (6), 947–964

Tiscini, R., Testarmata, S., Ciaburri, M. & Ferrari, E. (2020). The blockchain as a sustainable business model innovation. *Management Decision*, 58 (8), 1621–1642. https://doi.org/10.1108/MD-09-2019-1281

Tran, D., Broeckhoven, I., Hung, Y., Diem My, N.H., De Steur, H. & Verbeke, W. (2022). Willingness to Pay for Food Labelling Schemes in Vietnam: A Choice Experiment on Water Spinach. *Foods*, 11 (5), 722. https://doi.org/10.3390/foods11050722

Tripoli, M. & Schmidhuber, J. (2018). Emerging Opportunities for the Application of Blockchain in the Agri-food Industry.

UNDP (2021). *Blockchain for Agri Food Traceability*

Varavallo, G., Caragnano, G., Bertone, F., Vernetti-Prot, L. & Terzo, O. (2022). Traceability Platform Based on Green Blockchain: An Application Case Study in Dairy Supply Chain. *Sustainability*, 14 (6), 3321. https://doi.org/10.3390/su14063321

Verbeke, W. (2005). Agriculture and the food industry in the information age. *European review of agricultural economics*, 32 (3), 347–368

Verdouw, C.N., Sundmaeker, H., Meyer, F., Wolfert, J. & Verhoosel, J. (2013). Smart agri-food logistics: requirements for the future internet., 2013. 247–257. Springer

Walaszczyk, A., Koszewska, M. & Staniec, I. (2022). Food Traceability as an Element of Sustainable Consumption—Pandemic-Driven Changes in Consumer Attitudes. *International Journal of Environmental Research and Public Health*, 19 (9), 5259. https://doi.org/10.3390/ijerph19095259

Wang, Y., Chen, K., Hao, M. & Yang, B. (2020). Food safety traceability method based on blockchain technology., 2020. 012025. IOP Publishing

Wilkie, W.L. & Pessemier, E.A. (1973). Issues in Marketing's Use of Multi-Attribute Attitude Models. *Journal of Marketing Research*, 10 (4), 428–441. https://doi.org/10.2307/3149391

Wünsche, J.F. & Fernqvist, F. (2022). The Potential of Blockchain Technology in the Transition towards Sustainable Food Systems. *Sustainability*, 14 (13), 7739. https://doi.org/10.3390/su14137739

Xu, J., Guo, S., Xie, D. & Yan, Y. (2020). Blockchain: A new safeguard for agri-foods. *Artificial Intelligence in Agriculture*, 4, 153–161. https://doi.org/10.1016/j.aiia.2020.08.002

Yang, R., Wakefield, R., Lyu, S., Jayasuriya, S., Han, F., Yi, X., Yang, X., Amarasinghe, G. & Chen, S. (2020). Public and private blockchain in construction business process and information integration. *Automation in construction*, 118, 103276

Yu, M., Yan, X. & Wang, J. (2021). Research on the influence of traceability information of fresh agricultural products on consumers' purchasing behavior. *Open Journal of Business and Management*, 9 (5), 2370–2388

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*,

ZEBRA (2020). *Closing the Trust Gap: Technology and the Food Supply Chain*

Zhang, A., Mankad, A. & Ariyawardana, A. (2020). Establishing confidence in food safety: is traceability a solution in consumers' eyes? *Journal of Consumer Protection and Food Safety*, 15 (2), 99–107. https://doi.org/10.1007/s00003-020-01277-y

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*, 109, 83–99

Zhou, X., Pullman, M. & Xu, Z. (2022). The impact of food supply chain traceability on sustainability performance. *Operations Management Research*, 15 (1), 93–115. https://doi.org/10.1007/s12063-021-00189-w

Appendix A: Olive Oil Prices

Product	Contents	Country	Organic Label	Brand	Price SEK/L
	Refined olive oil 80% Extra virgin olive oil 20%	Spain	No	Store (Willys)	80
	Virgin olive oil	Spain	No	Store (COOP)	93
	Extra Virgin olive oil	Spain	No	Store (ICA)	130
	Extra virgin olive oil	Spain	Yes	Store (ICA)	152
	Extra virgin oil Organic raw material	Spain	Yes	Famous	140
	Extra virgin olive oil Organic raw material	Italy	Yes	Famous	148
	Extra virgin olive oil.	Italy	No	Famous	111
	Extra virgin olive oil	Spain	No	Famous	126

Appendix B: Survey Questions

Number	Question	Options
1	Are you based in Sweden?	Yes/No
2	What is your age?	17 or younger/18-24/25-34/35-44/45-54/55-64/65-74/75 and older
3	What is your gender?	Female/Male/Other
4	What is your highest education degree received?	High school/Bachelor's/Master's/Doctor's
5	What is your employment status?	Unemployed/Part-time/Employed/Other
6	What is your monthly income (before tax) in SEK?	Lower than 15,000 SEK/ 15,000-25,000SEK/25,000 – 35,000 SEK/ 35,000 – 45,000SEK/ Higher than 45,000SEK
7	*"It is important for me to have access to accurate information about the safety and authenticity of the food products I purchase."*	Strongly disagree/Disagree/Neutral/Agree/Strongly agree
8	*"It is important for me to have access to accurate information about the sustainability and environmental impact of the food products I purchase."*	Strongly disagree/Disagree/Neutral/Agree/Strongly agree
9	*"I am willing to pay a premium for food products that have been verified for their safety and authenticity."*	Strongly disagree/Disagree/Neutral/Agree/Strongly agree
10	*"I am willing to pay a premium for food products that have been verified to be sustainably produced and have minimal environmental impact."*	Strongly disagree/Disagree/Neutral/Agree/Strongly agree
11	Have you heard of blockchain technology?	Yes/No
Information Block	Blockchain technology can be utilized to trace the journey of food from the farm to the table, ensuring its authenticity and quality throughout the entire food supply chain. This means that at every step of the way, from the moment it was harvested to the moment it arrives on your plate, the journey of the food can be tracked using blockchain technology.	
12	Have you heard about how blockchain can help to ensure the safety and authenticity of the food supply chain before?	Yes/No

Appendix C: Chi-squared Rest Results

Variable	Group	Age							Total	X²	P
		25-34	55-64	18-24	35-44	45-54	65-74	75 and older			
KnowBTC	Yes	42	5	7	10	4	2	0	70	10.912	0.091
	No	15	6	7	4	5	4	1	42		
Total		57	11	14	14	9	6	1	112		
KnowBTC_Food	Yes	15	3	2	6	3	2	0	31	3.542	0.738
	No	42	8	12	8	6	4	1	81		
Total		57	11	14	14	9	6	1	112		

Variable	Group	Education Level					Total	X²	P
		Master's degree	Bachelor's degree	High school	Doctor's degree	Other			
KnowBTC	Yes	26	23	13	7	1	70	1.963	0.743
	No	15	16	5	6	0	42		
Total		41	39	18	13	1	112		
KnowBTC_Food	Yes	14	9	2	5	1	31	7.106	0.130
	No	27	30	16	8	0	81		
Total		41	39	18	13	1	112		

Variable	Group	Employment				Total	X²	P
		Unemployed	Part-time	Employed	Other			
KnowBTC	Yes	17	13	34	6	70	0.75	0.861
	No	9	6	22	5	42		
Total		26	19	56	11	112		
KnowBTC_Food	Yes	5	8	17	1	31	5.002	0.172
	No	21	11	39	10	81		
Total		26	19	56	11	112		

Variable	Group	Income					Total	X^2	P
		Lower than 15,000 SEK	15,000 SEK - 25,000 SEK	35,000 SEK- 45,000SEK	25,000 SEK - 35,000 SEK	Higher than 45,000 SEK			
KnowBTC	Yes	32	4	10	7	17	70	4.282	0.369
	No	15	6	8	6	7	42		
Total		47	10	18	13	24	112		
KnowBTC_Food	Yes	10	3	3	6	9	31	5.453	0.244
	No	37	7	15	7	15	81		
Total		47	10	18	13	24	112		

Appendix D: One-Way ANOVA Results

Variable	Age Group	Total	Mean	SD	F	P
Safety_info	25-34	57	4	0.756	0.666	0.678
	55-64	11	3.909	1.044		
	18-24	14	4	0.784		
	35-44	14	3.714	1.069		
	45-54	9	3.556	1.333		
	65-74	6	4	0.632		
	75 and older	1	3	0.000		
	Total	112	3.911	0.876		
Sustainability_info	25-34	57	3.912	0.912	0.7	0.650
	55-64	11	3.727	0.905		
	18-24	14	3.786	0.699		
	35-44	14	3.786	1.051		
	45-54	9	4.333	0.707		
	65-74	6	4	0.632		
	75 and older	1	3	0.000		
	Total	112	3.893	0.874		
Pay_safetyinfo	25-34	57	3.596	0.923	0.774	0.592
	55-64	11	3.636	0.809		
	18-24	14	3.286	0.914		
	35-44	14	3.5	1.092		
	45-54	9	3.333	1.225		
	65-74	6	4.167	0.753		
	75 and older	1	3	0.000		
	Total	112	3.554	0.948		
Pay_sustainabilityinfo	25-34	57	3.684	1.152	1.188	0.319
	55-64	11	3.636	0.809		
	18-24	14	3.357	1.008		
	35-44	14	3.429	1.158		
	45-54	9	4.222	0.833		
	65-74	6	4.333	0.516		
	75 and older	1	3	0.000		
	Total	112	3.679	1.067		

Variable	Gender Group	Total	Mean	SD	F	P
Safety_info	Female	56	3.893	0.947	0.782	0.460
	Male	55	3.909	0.8		
	Other	1	5	0.000		
	Total	112	3.911	0.876		
Sustainability_info	Female	56	4.054	0.862	3.079	0.050*
	Male	55	3.709	0.854		
	Other	1	5	0.000		
	Total	112	3.893	0.874		
Pay_safetyinfo	Female	56	3.571	0.988	1.366	0.259
	Male	55	3.564	0.898		
	Other	1	2	0.000		
	Total	112	3.554	0.948		
Pay_sustainabilityinfo	Female	56	3.821	1.011	2.098	0.128
	Male	55	3.564	1.102		
	Other	1	2	0.000		
	Total	112	3.679	1.067		

Variable	Education Group	Total	Mean	SD	F	P
Safety_info	Master's degree	41	3.683	0.934	1.32	0.267
	Bachelor's degree	39	4.128	0.695		
	High school	18	3.944	0.873		
	Doctor's degree	13	3.923	1.115		
	Other	1	4	0.000		
	Total	112	3.911	0.876		
Sustainability_info	Master's degree	41	3.683	0.96	2.331	0.061*
	Bachelor's degree	39	4.154	0.587		
	High school	18	3.611	1.092		
	Doctor's degree	13	4.154	0.801		
	Other	1	4	0.000		
	Total	112	3.893	0.874		
Pay_safetyinfo	Master's degree	41	3.317	0.96	1.573	0.187
	Bachelor's degree	39	3.821	0.914		
	High school	18	3.444	0.856		
	Doctor's degree	13	3.615	1.044		
	Other	1	4	0.000		
	Total	112	3.554	0.948		
Paysustainabilityinfo	Master's degree	41	3.634	1.043	0.224	0.925
	Bachelor's degree	39	3.667	1.132		
	High school	18	3.611	1.092		
	Doctor's degree	13	3.923	1.038		
	Other	1	4	0.000		
	Total	112	3.679	1.067		

Variable	Education Group	Total	Mean	SD	F	P
Safety_info	Unemployed	26	3.885	0.864	0.047	0.987
	Part-time	19	3.895	0.875		

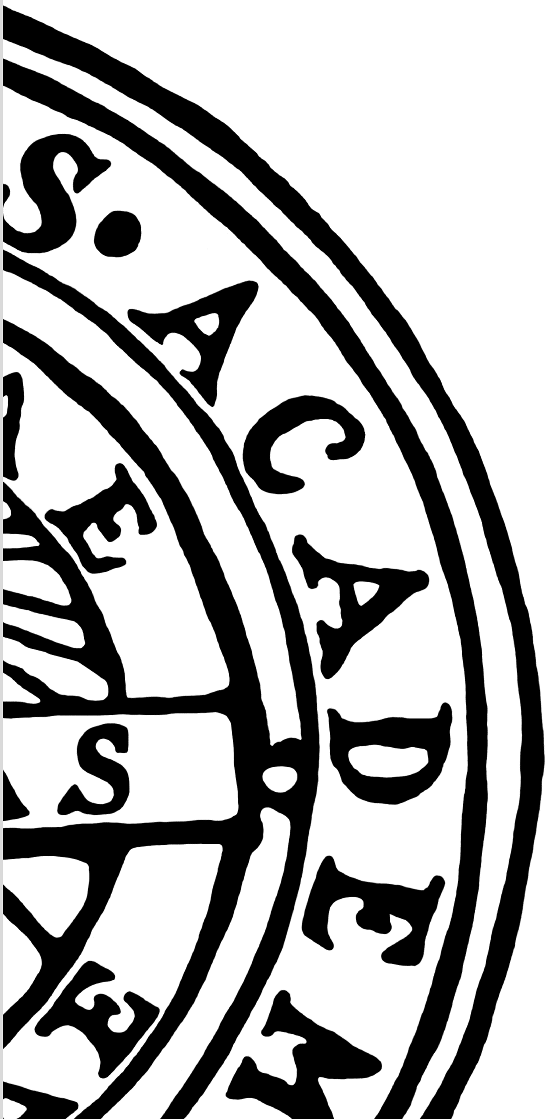
Variable	Education Group	Total	Mean	SD	F	P
	Employed	56	3.911	0.92		
	Other	11	4	0.775		
	Total	112	3.911	0.876		
Sustainability_info	Unemployed	26	3.731	0.778	1.018	0.388
	Part-time	19	3.789	0.918		
	Employed	56	4.036	0.852		
	Other	11	3.727	1.104		
	Total	112	3.893	0.874		
Pay_safetyinfo	Unemployed	26	3.462	0.948	1.891	0.135
	Part-time	19	3.316	1.003		
	Employed	56	3.75	0.939		
	Other	11	3.182	0.751		
	Total	112	3.554	0.948		
Pay_sustainabilityinfo	Unemployed	26	3.577	1.027	1.424	0.240
	Part-time	19	3.368	1.257		
	Employed	56	3.875	1.028		
	Other	11	3.455	0.934		
	Total	112	3.679	1.067		

Appendix E: DCE Regression Result

ID	Extra Virgin	Not Extra Virgin	Italy	Spain	Greece	Organic	No_ Organic	BTC	BTC_No	P_80	P_135	P_168	NONE
1	1,88	-1,88	0,12	0,28	-0,4	1,22	-1,22	2,01	-2,01	3,76	(0,11)	(3,65)	-4,56
2	0,31	-0,31	0,02	0,24	-0,26	2,92	-2,92	1,88	-1,88	1,09	0,64	-1,73	-2,73
3	1,7	-1,7	1,86	-1,3	-0,56	0,45	-0,45	-0,34	0,34	1	-0,28	-0,72	1,15
4	0,81	-0,81	0,27	-0,18	-0,09	2,72	-2,72	2,72	-2,72	3,09	0,32	-3,41	-3,78
5	0,93	-0,93	0,42	-0,62	0,21	1,92	-1,92	0,38	-0,38	3,57	0,02	-3,58	-3,16
6	1,26	-1,26	0,31	-0,28	-0,03	2,64	-2,64	1,76	-1,76	3,29	-0,22	-3,07	-3,69
7	1	-1	0,43	0,06	-0,49	2,19	-2,19	1,35	-1,35	3,67	-1	-2,67	-4,1
8	0,59	-0,59	-0,12	-0,08	0,2	2,54	-2,54	1,81	-1,81	3,64	-0,48	-3,16	-4,03
9	1,32	-1,32	0,28	-0,03	-0,25	2,51	-2,51	2,45	-2,45	3,18	-0,43	-2,75	-4,66
10	-0,08	0,08	-0,31	0,05	0,26	1,28	-1,28	1,6	-1,6	2,83	-0,65	-2,18	-4,22
11	1,24	-1,24	0,21	0,16	-0,37	2,47	-2,47	1,42	-1,42	3,92	-0,79	-3,13	-3,45
12	1,15	-1,15	0,84	-0,09	-0,75	2,65	-2,65	1,21	-1,21	2,55	-0,74	-1,81	-3,61
13	0,3	-0,3	1,09	-1,28	0,19	-0,99	0,99	-1,02	1,02	-0,38	0,01	0,37	0,69
14	0,25	-0,25	-0,36	0,27	0,09	3,45	-3,45	1,94	-1,94	1,97	-0,38	-1,6	-3,34
15	0,46	-0,46	1,2	-1,17	-0,03	-0,25	0,25	0,08	-0,08	3,35	-0,49	-2,87	-2,94
16	1,88	-1,88	1,32	0,15	-1,46	1,89	-1,89	1,54	-1,54	2,99	-0,75	-2,24	-3,67
17	1,07	-1,07	-0,31	-0,13	0,43	2,5	-2,5	2,54	-2,54	3,22	0,02	-3,24	-3,93
18	1	-1	0,94	-1,1	0,15	1,99	-1,99	0,48	-0,48	-1,18	0,19	1	-1,84
19	0,87	-0,87	0,37	-0,92	0,55	0,67	-0,67	0,39	-0,39	4,21	-1,06	-3,16	-3,32
20	0,68	-0,68	0,76	-0,94	0,19	2,28	-2,28	1,85	-1,85	3	0,08	-3,08	-2,17
21	-0,03	0,03	0,76	-0,72	-0,04	3,45	-3,45	1,19	-1,19	1,98	-0,05	-1,93	-0,84
22	1,62	-1,62	-0,01	-0,56	0,57	1,59	-1,59	0,98	-0,98	3,91	-1,11	-2,8	-3,64
23	0,14	-0,14	0,55	0,14	-0,69	3,79	-3,79	1,36	-1,36	1,69	-0,28	-1,4	-2,87
24	0,84	-0,84	0,16	-0,44	0,27	1,38	-1,38	1,54	-1,54	4,03	-0,89	-3,14	-3,64
25	0,67	-0,67	0,15	0,3	-0,45	3,13	-3,13	1,5	-1,5	4,02	-0,25	-3,77	-3,47
26	1,53	-1,53	0,32	-1,91	1,59	-0,52	0,52	-0,53	0,53	1,5	-0,26	-1,23	-2,06
27	2,64	-2,64	0,02	0,13	-0,15	0,14	-0,14	0,64	-0,64	2,01	-0,3	-1,71	-0,3
28	0,16	-0,16	0,41	-1,72	1,31	0,62	-0,62	1,09	-1,09	1,75	1,08	-2,84	-2,42
29	0,78	-0,78	1,47	-1,78	0,3	0,62	-0,62	-1,66	1,66	0,02	-0,33	0,31	1,3
30	0,91	-0,91	0,07	-0,34	0,27	1,36	-1,36	2,1	-2,1	3,71	0,15	-3,86	-3,97
31	1,6	-1,6	0,92	-0,56	-0,36	1,33	-1,33	1,45	-1,45	3,91	-0,98	-2,93	-3,66
32	0,6	-0,6	0,03	0,25	-0,28	3,48	-3,48	2,26	-2,26	3,02	-0,44	-2,58	-1,54
33	0,81	-0,81	0,74	-0,12	-0,62	1,19	-1,19	0,57	-0,57	4,73	-0,98	-3,74	-4,19
34	0,8	-0,8	1,62	-1,46	-0,16	-0,21	0,21	-1,07	1,07	-1,25	-0,79	2,03	-1,37
35	1,07	-1,07	1,04	-0,37	-0,67	2,05	-2,05	1,88	-1,88	2,03	0,62	-2,65	-2,63
36	1,69	-1,69	0,7	-0,28	-0,42	1,28	-1,28	0,59	-0,59	3,8	-1,02	-2,78	-3,07
37	1,71	-1,71	0,03	-0,15	0,12	2,91	-2,91	1,28	-1,28	1,85	-0,48	-1,37	-3

38	0,93	-0,93	0,08	-0,38	0,3	1,38	-1,38	0,6	-0,6	4	-0,89	-3,11	-3,67
39	1,23	-1,23	0,05	0,71	-0,76	2,16	-2,16	2,21	-2,21	3,5	0,23	-3,73	-3,61
40	0,9	-0,9	0,81	-0,58	-0,23	0,87	-0,87	2,41	-2,41	3,24	0,28	-3,52	-4,18
41	1,23	-1,23	0,31	0,31	-0,62	2,51	-2,51	1,49	-1,49	3,55	-0,73	-2,81	-3,69
42	1,98	-1,98	0,26	-0,24	-0,02	0,87	-0,87	1,7	-1,7	3,93	-0,54	-3,39	-3,99
43	0,99	-0,99	-0,65	0,67	-0,03	3,11	-3,11	2,27	-2,27	3,56	-0,1	-3,46	-3,76
44	0,62	-0,62	0,12	0,02	-0,13	2,37	-2,37	1,58	-1,58	3,07	-0,21	-2,86	-3,18
45	0,75	-0,75	0,28	-0,86	0,58	1,9	-1,9	1,4	-1,4	2,32	-0,05	-2,27	-2,94
46	-0,98	0,98	0,94	-1,61	0,67	0,18	-0,18	1,27	-1,27	-1,35	1,34	0,01	0,33
47	1,07	-1,07	0,65	-0,23	-0,42	1,48	-1,48	1,3	-1,3	4,79	-0,92	-3,87	-3,85
48	0,84	-0,84	-0,09	-0,43	0,52	1,69	-1,69	0,5	-0,5	4,14	-0,16	-3,98	-3,39
49	0,84	-0,84	-0,24	-0,06	0,3	0,21	-0,21	1,85	-1,85	4,45	-0,54	-3,91	-4,3
50	0,25	-0,25	1,67	-1,13	-0,54	0,61	-0,61	1,75	-1,75	1,71	-0,32	-1,4	-3,4
51	1,68	-1,68	0,73	-0,56	-0,17	0,97	-0,97	0,93	-0,93	3,96	-0,77	-3,19	-3,88
52	2,06	-2,06	1,09	-0,46	-0,63	1,85	-1,85	-0,31	0,31	2,14	-0,42	-1,72	-1,03
53	0,61	-0,61	1,24	-0,16	-1,08	3,09	-3,09	1,5	-1,5	1,06	0	-1,05	-2,18
54	1,47	-1,47	-0,19	-0,51	0,7	0,1	-0,1	0,82	-0,82	4,11	-0,42	-3,7	-4
55	0,93	-0,93	0,48	-0,42	-0,06	2,55	-2,55	2,28	-2,28	4,07	-0,81	-3,26	-4,37
56	0,56	-0,56	-0,62	-0,36	0,97	0,66	-0,66	1,48	-1,48	3,39	-0,11	-3,29	-3,45
57	0,13	-0,13	1,29	-1,43	0,15	-0,6	0,6	1,8	-1,8	0,32	0,41	-0,73	-1,04
58	2,12	-2,12	0,82	-0,45	-0,37	1,25	-1,25	1,4	-1,4	1,65	-0,23	-1,41	-0,99
59	-0,06	0,06	0,93	-0,93	0	3,19	-3,19	1,19	-1,19	0	0,17	-0,17	0,27
60	0,92	-0,92	-0,27	0,13	0,13	3,39	-3,39	0,93	-0,93	2,53	-0,29	-2,24	-2,08
61	2,35	-2,35	0,67	-0,25	-0,42	1,61	-1,61	-0,37	0,37	2,26	-1,08	-1,17	-2,62
62	2,23	-2,23	0,89	-0,49	-0,4	-0,74	0,74	0,7	-0,7	1,12	-0,21	-0,9	-3,18
63	0,8	-0,8	0,57	-0,84	0,27	3,24	-3,24	1,04	-1,04	1,75	0,31	-2,06	0,37
64	0,75	-0,75	0,42	0,22	-0,64	3,14	-3,14	1,74	-1,74	2,81	-0,16	-2,66	-3,11
65	1,88	-1,88	1,33	0,01	-1,34	1,35	-1,35	1,27	-1,27	0,97	-0,71	-0,26	-2,74
66	1,41	-1,41	0,27	-0,05	-0,21	3,24	-3,24	-0,58	0,58	1,89	-0,75	-1,14	-0,61
67	-0,79	0,79	0,37	-0,51	0,14	2,82	-2,82	-0,28	0,28	0,89	-0,41	-0,48	-1,69
68	1,19	-1,19	0,57	0,02	-0,59	1,1	-1,1	-0,81	0,81	3,24	-1,11	-2,13	-2,58
69	0,51	-0,51	1,38	-2,49	1,1	-2,02	2,02	-1,57	1,57	-1,01	-0,09	1,1	1,08
70	0,87	-0,87	0,24	-0,85	0,61	1,26	-1,26	-1,84	1,84	0,55	-0,83	0,28	0,15
71	-0,35	0,35	1,13	-0,55	-0,58	1,93	-1,93	-0,47	0,47	-0,44	-0,86	1,3	-1,57
72	0,47	-0,47	1,33	-1,37	0,04	1,06	-1,06	-2,4	2,4	0,43	-0,97	0,54	-0,09
73	0,98	-0,98	0,89	-0,6	-0,3	2,81	-2,81	-0,16	0,16	3,02	-0,81	-2,21	-0,8
74	0,03	-0,03	0,15	-0,15	0	0,93	-0,93	-1	1	1,97	-0,08	-1,89	0,48
75	0	0	-0,01	0,51	-0,5	3,74	-3,74	2,22	-2,22	1,65	-0,44	-1,21	-3,62
76	1,32	-1,32	1,35	-0,54	-0,81	-1,23	1,23	-1,78	1,78	1,78	-1,1	-0,69	0,19
77	0,04	-0,04	1,61	-1,43	-0,18	1,79	-1,79	0,71	-0,71	-0,23	-0,46	0,69	-1,84
78	1,35	-1,35	2,13	-1,98	-0,15	-0,45	0,45	-1,48	1,48	-0,45	-0,82	1,27	0,35
79	0,24	-0,24	0,5	-0,45	-0,06	3,46	-3,46	1,15	-1,15	0,67	-0,15	-0,52	-0,56
80	-0,45	0,45	1,45	-2,27	0,82	1,25	-1,25	-0,14	0,14	-0,01	-0,45	0,47	-2,09
81	-0,88	0,88	-0,79	-0,19	0,98	1,98	-1,98	2,76	-2,76	1,17	0,69	-1,86	-3,1

82	0,4	-0,4	1,12	-0,2	-0,92	3,17	-3,17	-0,4	0,4	1,94	-0,23	-1,71	-0,44
83	-0,9	0,9	-0,02	-1,09	1,11	1,2	-1,2	1,5	-1,5	0,17	0,19	-0,35	-2,17
84	-0,07	0,07	-0,39	-0,45	0,84	-0,47	0,47	1,39	-1,39	1,98	-0,69	-1,29	-3,71
85	0,33	-0,33	1,36	-1,85	0,49	-1	1	-1,35	1,35	1,12	-0,21	-0,91	-1,57
86	0,61	-0,61	0,43	0,57	-0,99	3,45	-3,45	1,06	-1,06	2,86	-0,35	-2,51	-3,35
87	-0,46	0,46	0,69	-0,8	0,11	2,41	-2,41	1,33	-1,33	0,51	0,73	-1,24	1,69
88	0,66	-0,66	0,4	-0,45	0,05	2,99	-2,99	2,36	-2,36	2,43	0,23	-2,66	-3,54
89	0,82	-0,82	0,84	-0,98	0,14	2,25	-2,25	2,28	-2,28	1,95	0,05	-2	-3,06
90	0,07	-0,07	-0,26	0,21	0,04	3,1	-3,1	2,8	-2,8	1,94	-0,29	-1,65	-3,37
91	0,63	-0,63	1,02	0,15	-1,17	3,02	-3,02	0,78	-0,78	2,67	-1,1	-1,57	-2,89
92	-0,11	0,11	-0,23	0,6	-0,38	1,13	-1,13	1,69	-1,69	4,49	-0,76	-3,73	-5,19
93	0,97	-0,97	1,06	-0,24	-0,82	0,36	-0,36	2,59	-2,59	3,01	0,11	-3,12	-3,94
94	-0,21	0,21	-0,21	-0,41	0,62	1,36	-1,36	3,01	-3,01	1,64	1,48	-3,12	-2,81
95	0,72	-0,72	2,28	-1,29	-0,99	0,52	-0,52	0,01	-0,01	1,45	-0,92	-0,53	-2,19
96	0,68	-0,68	1,2	-1,48	0,28	0,15	-0,15	1,73	-1,73	2,8	-0,17	-2,64	-3,38
97	0,51	-0,51	-0,27	-0,54	0,81	2,55	-2,55	0	0	1,93	0,28	-2,21	-0,11
98	1,3	-1,3	0,26	-0,2	-0,07	2,1	-2,1	1,03	-1,03	4,01	-0,75	-3,27	-3,57
99	1,59	-1,59	0,1	-1,54	1,43	-0,19	0,19	-0,14	0,14	-0,33	-0,16	0,49	-1,66
100	1,25	-1,25	0,25	-1,5	1,24	0,13	-0,13	0,42	-0,42	1,16	0,1	-1,26	-2,36
101	0,76	-0,76	0,15	-0,12	-0,03	3,36	-3,36	1,02	-1,02	2,51	-0,81	-1,69	-2,78
102	2,32	-2,32	0,66	0,2	-0,86	1,22	-1,22	0,22	-0,22	2,91	-0,78	-2,13	-2,71
103	0,81	-0,81	0,04	-0,24	0,2	1,85	-1,85	1,75	-1,75	3,64	-0,24	-3,4	-3,84
104	1,26	-1,26	1,05	-0,45	-0,59	1,58	-1,58	1	-1	2,62	-0,94	-1,67	-3,51
105	2,54	-2,54	0,84	-0,73	-0,11	1,35	-1,35	0,48	-0,48	1,06	-0,03	-1,02	-1,63
106	0,32	-0,32	2,56	-1,66	-0,9	-0,25	0,25	-0,22	0,22	0,18	0,18	-0,35	-1,66
107	0,57	-0,57	1,42	-0,86	-0,56	1,14	-1,14	1,17	-1,17	-0,65	0,44	0,21	-1,89
108	1,4	-1,4	0,79	-0,52	-0,27	3,06	-3,06	1,41	-1,41	2,07	0,45	-2,51	-2,3
109	1,45	-1,45	-0,01	0,27	-0,26	1,23	-1,23	2,21	-2,21	3,71	-0,06	-3,65	-4,22
110	0,59	-0,59	0,5	-0,77	0,26	0,13	-0,13	1,49	-1,49	1,85	0,23	-2,08	-3,03
111	0,98	-0,98	-0,01	-0,15	0,16	-0,25	0,25	0,87	-0,87	1,89	-1,09	-0,79	-3,28
112	2,07	-2,07	-0,32	-0,11	0,43	0,93	-0,93	0,17	-0,17	1,79	-0,65	-1,14	-2,66
Sum	95	-95	61,76	-56,29	-5,47	176,27	-176,27	105,96	-105,96	321,19	101,35	-39,54	-277,85
Average	0,85	-0,85	0,55	-0,5	-0,05	1,57	-1,57	0,95	-0,95	2,87	0,9	-0,35	-2,48
Total Utility							11,96						
Importance		14%		9%		26%		16%			34%		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