İzmir Yönetim Dergisi
İzmir Journal of Management

E-ISSN: 2757-637X **YIL:** 2025 **Cilt:** 6 **Sayı:** Özel Sayı **Sayfa:** 108-121
Geliş Tarihi: 20.03.2025 **Kabul Tarihi:** 30.05.2025 **Online Yayın:** 30.06.2025 **Doi:** 10.56203/iyd.1661652
ÖZGÜN ARAŞTIRMA

Blockchain Technology in the Food Industry: An Application Experience from Inside the Industry

Serkan ALICI[1] Yılmaz GÖKŞEN[2]

Abstract

With the advancement of technology and the widespread adoption of digitalization, societies and businesses are significantly impacted by these developments. Businesses that fail to keep pace with these advancements face challenges in competition. Therefore, it is essential for businesses to continuously evolve by integrating these technological advancements. In recent years, one of the revolutionary technologies that has seen increased usage is blockchain technology, a subset of Web 3.0 technologies. One of the significant application areas of this technology is the food sector. Given the rapid increase in the global population, the importance of food and the food supply chain is becoming increasingly crucial. Consequently, within the scope of this study, an application was developed by integrating an Ethereum-based blockchain network and smart contracts with web technologies. It is believed that this application will prevent waste, increase traceability, enhance transaction speed, and reduce costs by tracking all processes from the producer to the retail store in the food supply chain. Also, it is thought that blockchain technology will play an important role in strategic management by making a significant contribution to the resilience and sustainability goals of businesses through its integration with the food supply chain. This study is expected to serve as a guide for other blockchain-based applications and businesses.

Keywords: Blockchain, Food Sector, Food Supply Chain, Smart Contract, Web 3.0
Jel Codes: O33, Q13, L86

Gıda Sektöründe Blok Zinciri Teknolojisi: Sektörün içinden Bir Uygulama Deneyimi

Özet

Teknolojinin ilerlemesi ve dijitalleşmenin yaygın şekilde benimsenmesi, toplumları ve işletmeleri önemli ölçüde etkilemektedir. Bu gelişmelere ayak uyduramayan işletmeler, rekabet açısından çeşitli zorluklarla karşı karşıya kalmaktadır. Bu nedenle, işletmelerin teknolojik yenilikleri entegre ederek sürekli bir dönüşüm süreci içerisinde olmaları gerekmektedir. Son yıllarda kullanım alanı giderek genişleyen devrim niteliğindeki teknolojilerden biri de Web 3.0 teknolojileri kapsamında değerlendirilen blokzincir teknolojisidir. Bu teknolojinin önemli uygulama alanlarından biri de gıda sektörüdür. Küresel nüfusun hızla artmasıyla birlikte gıda ve gıda tedarik zincirinin önemi giderek artmaktadır. Bu doğrultuda, bu çalışma kapsamında Ethereum tabanlı bir blokzincir ağı ve akıllı sözleşmeler, web teknolojileri ile entegre edilerek bir uygulama geliştirilmiştir. Bu uygulamanın, gıda tedarik zincirinde üreticiden perakende mağazasına kadar tüm süreçleri takip ederek israfı önleyeceği, izlenebilirliği artıracağı, işlem hızını yükselteceği ve maliyetleri azaltacağı öngörülmektedir. Ayrıca, blokzincir teknolojisinin gıda tedarik zinciri ile entegrasyonu sayesinde işletmelerin dayanıklılık ve sürdürülebilirlik hedeflerine önemli bir katkı sağlayarak stratejik yönetimde kritik bir rol oynayacağı düşünülmektedir. Bu çalışmanın, blokzincir tabanlı diğer uygulamalara ve işletmelere rehberlik etmesi beklenmektedir.

Anahtar Kelimeler: Blok Zincir, Gıda Sektörü, Gıda Tedarik Zinciri, Akıllı Kontrat, Web 3.0
Jel Kodu: O33, Q13, L86

ATIF ÖNERİSİ (APA): Alıcı, S., Gökşen, Y. (2025). Blockchain Technology in The Food Industry: An Application Experience from Inside The Industry. *İzmir Yönetim Dergisi*, 6 (Özel Sayı), 108-121. Doi: 10.56203/iyd.1661652

[1] Arş. Gör., Dokuz Eylül Üniversitesi, Sosyal Bilimler Enstitüsü, Buca/İZMİR **EMAİL:** serkan.alici@deu.edu.tr, **ORCID:** 0000-0001-8684-4180

[2] Prof. Dr., Dokuz Eylül Üniversitesi, Yönetim Bilişim Sistemleri Bölümü Enformasyon Teknolojisi Ana Bilim Dalı, Buca/İZMİR, **EMAİL:** yilmaz.goksen@deu.edu.tr, **ORCID:** 0000-0002-2291-2946

1. INTRODUCTION

The rapid developments in technology and the widespread adoption of digitalization from past to present have significantly influenced society, businesses, and supply chain processes. Global epidemics and crises have further underscored the necessity of integrating emerging technologies to enhance efficiency and resilience. In today's technological era, businesses that fail to adapt to digital transformation face challenges in maintaining their competitive advantage. Consequently, organizations must continuously develop new strategies to keep pace with technological advancements. One of the most transformative technologies in recent years has been blockchain, initially introduced to the academic literature by Haber and Stornetta (1991) in their study titled "How to Time-Stamp a Digital Document."

Digital transformation is reshaping industries worldwide, including supply chain operations. The integration of digital technology into supply chain processes fosters innovation, enhances efficiency, and streamlines operations to achieve digital outputs, including improved products and services (Cigdem, 2021). Companies struggle to adapt to these rapid technological shifts and the evolving ecosystem, prompting them to adopt digitalization strategies to reduce costs, enhance customer service, and improve delivery performance and reliability (Daneshvar Kakhki & Gargeya, 2019).

Blockchain technology which operates through decentralized transaction networks provides fundamental changes to supply chain management (SCM). A digital decentralized distributed transactional database represents the definition of blockchain according to Nofer et al., 2017. Blockchain technology brings institutional solutions to the world including digital asset management and supports various industries like food supply chains because it ensures constant tracking and secure handling across the production-to-consumption stages (Mendling et al., 2018). Transaction speeds become more efficient because blockchain uses distributed shared databases which provide real-time secure access to virtually unalterable supply chain records (Kim & Laskowski, 2018).

Research has investigated blockchain technology applications throughout the food supply chain segments with studies by Alıcı et al., 2024; Ozdagoglu et al., 2020. The pork supply chain benefits from a blockchain-based traceability system that tackles traditional traceability problems according to Nassar et al., 2024. The combination of decentralized technology with secure encryption and immutable characteristics and smart contract abilities makes blockchain a delivery system that will boost food management procedures and enhance product traceability (Duan et al., 2020). Traceability models using blockchain for food safety exist in multiple researcher-developed systems which highlight the value of decentralizing data management coupled with consensus mechanisms and mining operations for food product tracking between origin points and end consumers (Tsang et al., 2019). The distributed ledger features of blockchain applications represent a major breakthrough capability which reinvents supply chain systems within food and agricultural industries (Katsikouli et al., 2021).

Blockchain technology moves rapidly into adoption because it develops modern solutions for the food supply chain management. The research developed a blockchain-based web platform which focused on fixing operating issues within Turkey's food supply chain system. Blockchain technology integration stands as a solution for the food supply chain management to address various inefficiencies through this application. The application looks to minimize costs by removing intermediaries and enable easy product traceability which accelerates producer-consumer deals simultaneously providing enhanced system decentralization security along with improved food safety and sustainability measures as well as waste

reduction along with optimized efficiency through smart contracts. The blockchain proposal improves the food supply chain by establishing trust between manufacturers and customers to solve fundamental industry problems.

2. LITERATURE REVİEW

Business organizations must adopt strategic management techniques due to accelerating technology changes which keep them competitive in the market. The digital transformation mandates that businesses revisit their approaches for implementing disruptive technologies successfully. Implementing blockchain technology results in operational efficiency together with better customer satisfaction combined with sustained long-term business success. Strategic management serves as the foundation which allows organizations to address uncertainties by making the most of their resources and technology advancements to reach their targets.

Blockchain technology uses its capabilities to resolve lack of information symmetry problems in food supply chain systems. Traditional supply chain systems fail to deliver transparency so they produce operational inefficiencies along with safety issues (Mao et al., 2018). The system brings transparency through blockchain technology because it delivers real-time food product status and historical data to all supply chain stakeholders for better decision making and improved relationship building (Hasan et al., 2023). Extended visibility through blockchain technology simultaneously drives operational enhancement with better relationships between food producers and distributors and consumers which results in supply chain durability.

Blockchain also goes hand in hand with transparency and traceability and can significantly contribute to efficiently tackling a crucial problem in the food supply chain – food waste. Their observation, according to Hasan et al. (2023), is that blockchain facilitates the exchange of food inventory and distribution data accurately and in a timely manner thus reducing waste. Finally, blockchain can be embedded with devices of the Internet of Things (IoT) to monitor the food condition in real time during transportation or storage to ensure the proper freshness and decrease the spoilage (Kaur et al. 2022, Mukherjee et al. 2021). Blockchain and IoT work in synergy, which contributes to traceability and the sustainability of the entertainment food supply chain in general.

However, blockchain facilitated smart contract adoption is to the advantage of strategic management of the food supply chain. An automated process developed on smart contracts based on predefined conditions, used for settlement and compliance checks autonomously and eliminate the intermediary, reduce the cost of transactions and the time for operations (Marchesi et al., 2022). Additionally, smart contracts also make transactions more accountable as it records each transaction on the blockchain, therefore making accounting and regulatory compliances (Kshetri, 2019). Given the food industry's high level of accountability to safety standards and regulations, this level of accountability is particularly crucial.

In addition, blockchain has a ripple effect on sustainability beyond functional efficiency. Sustainable food production and consumption practices are emphasized in the United Nations' Sustainable Development Goals. These aims can be supported by blockchain technology in line with the transparency and accountability in the food supply chain which leads to enhanced sustainable agricultures and minimizing the environment impact (Chandan et al., 2023; Pakseresht et al., 2022).

Finally, the article suggests that, in conclusion, blockchain technology can have a transformative power in strategic management of the food supply chain. The paper discusses the issues of traceability, transparency, efficiency, and the reduction of food waste while increasing the collaboration

between stakeholders. However, unease with adoption aside, blockchain itself offers a way to build a more resilient and sustainable food supply chain. It is anticipated that as blockchain technology advances, its importance in redefining food retailing management would also increase to a level of a more secure and efficient food system.

3. METHODOLOGY

Ganache and Truffle frameworks were used for the Ethereum blockchain infrastructure. In blockchain development, smart contracts are stored on this distributed ledger, and these contracts contain snippets of code that check whether a set of conditions are met, monitor data flows, and trigger certain actions. Smart contracts are used to increase trust between contracting parties, automate transactions and execute agreements in a disintermediated manner. Therefore, smart contracts have been used in practice in this study to execute transactions between parties. The solidity language compatible with ethereum was used to develop the smart contract. In the web application part of the study, Html, Css, Bootstrap, Javascript, Python, Django framework technologies were used. As a database, mongodb with nosql database was used. Django was preferred because it is python based and python programming language can be used to develop blockchain applications through the library called web3. Blockchain information was kept with Ganache and smart contract integration was realized with truffle. Blockchain and smart contract integration with the web application was realized with the python web3 library. The technologies used in the study are shown in Figure 1.

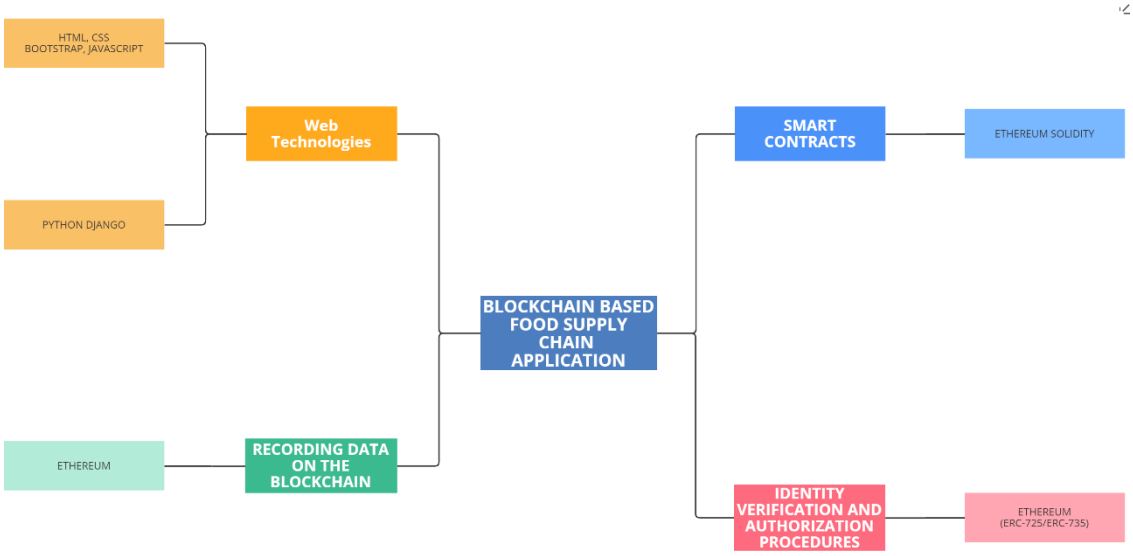

Figure 1: Blockchain Based Food Supply Chain Application Technologies Used

The model used for the food supply chain process in the Blockchain Based Food Supply Chain application in the study is shown in Figure 2. In this model, all stages from the producer-supplier stage to the consumer stage can be managed with the application. The product received from the producer-supplier passes to the processing-packaging stage and then to the logistics and distribution department. At the next stage, transactions related to retail and sales are carried out. Finally, the product reaches the consumer. The conditions and contracts required for the realization of the processes at all these stages are managed by smart contracts.

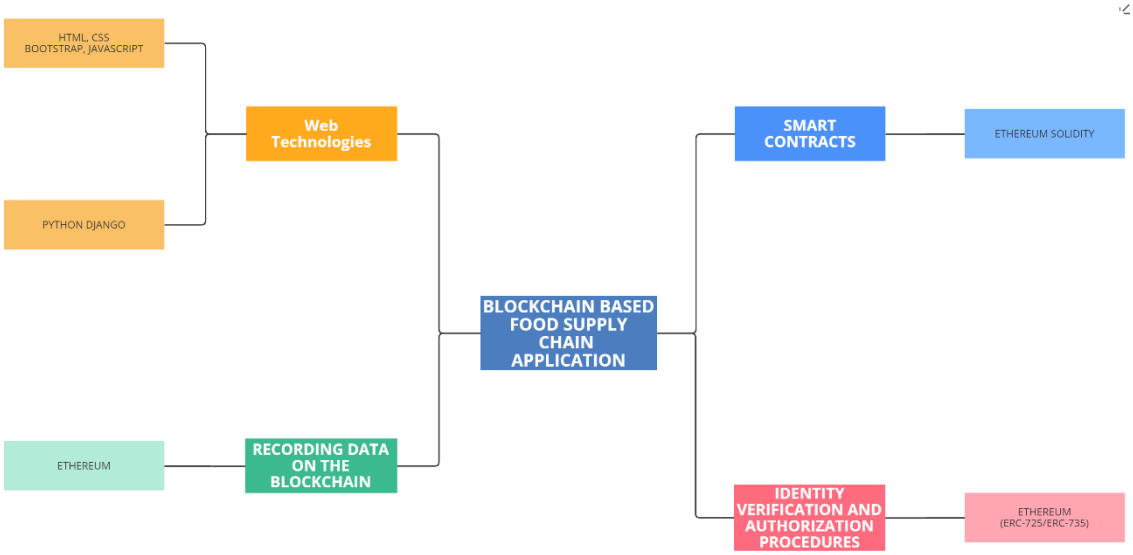

Figure 2: Blockchain Based Food Supply Chain Model

4. APPLICATION AND FINDINGS

The use of blockchain technology in the food supply chain provides significant improvements in critical issues such as food safety, traceability and transparency. The idea behind this project is the need to create a ledger and track each producer's and consumer's journey within the marketplace on the blockchain. The detailed stages of this application and the technologies used in its development is described below.

4.1. Strategic Decision Making

4.1.1. Manufacturer-Supplier

This stage includes the manner through which products get to the supplier from the manufacturer. With the use of blockchain technology, the following elements are made secure and traceable:

- Product Registration (QR Code): Products are registered and patented in the form of digital property that comes with a single-use QR number. These QR codes augment the tracking number of products on the blockchain system and avoid negativities like fake products.
- Stock Management: This shows records of stock of manufacturers and suppliers in the supply chain since they are recorded on the blockchain platform hence a real time tracking. Therefore, stakeholders can follow stock information securely.
- Supplier Management: Communication of transactions and relationships are captured as well stored within the blockchain. This helps in making sure that each of the arteries in the supply chain conducts business with the other as per agreed conducts.

4.1.2. Processing and Packaging

At this stage, the processing and packaging processes of the products are detailed:

- Processing Steps: The various stages that the products undergo are well captured in the blockchain. This way there is no shadow of doubt as to how a particular step was arrived at, is reached.
- Packaging: The process taken for the packaging of the products is also well documented in the blockchain technology. This facilitates identification of quality and safety of the packaging of the products.
- Quality Control: Quality control processes are recorded on the blockchain, ensuring transparency. The quality control steps of each product can be monitored and verified.
- Smart Contracts: Transaction steps are programmed and automated using smart contracts. This ensures that

transactions are carried out in a secure and error-free manner.

4.1.3. Logistics and Distribution

This stage covers the processes of storing, transporting and distributing products:

- Storage Management: Every activity under the storage process of products is also recorded on the blockchain. This help to make sure that the products are well secured and that there is track and trace of the same.
- Transportation and Logistics: The process of transportation and the logistics trail are documented on the blockchain technique. This makes quite sure that the transportation processes of those products are quite clear and tractable.
- Delivery Management: The delivery processes for the products are logged with the blockchain system, preserving their history. This makes the process of delivery safe and clear from one stage to another.

4.1.4. Retail and Sales

This phase involves selling products in retail stores:

- Product Catalog: Catalogues containing products are registered on the blockchain and displayed in a catalogue including number, name, description, preparation aid, and preparation instructions. This ensures the customers have adequate information about the different product in order to make good choices.
- Order Management: Customer orders are tracked on the blockchain. This ensures that order processes are secure and traceable.
- Payment Transactions: Secure payment transactions are carried out on the blockchain. This ensures that payments are made in a transparent and secure manner.

4.2. Technologies Used in the Development of the Application

4.2.1. Web Technologies

- HTML, CSS, Bootstrap, JavaScript: These technologies were used in the designing and development of the front-end of the application. Basically, the structure and layout of the page are developed through HTML and CSS, and Bootstrap is employed to enable the great responsiveness of the page depending on the user's device they are using; meanwhile, JavaScript is used to produce the dynamic content and control the user's interaction with the page. These technologies allow users to utilise the application to their advantage.
- Python Django: The backend of the application is developed using Django web framework. Django provides quick development and simplicity and reasonable sophistication. This framework supports operations for database, users, and other server functionalities to be done effectively.

4.2.2. Blockchain Technologies

- Ethereum: The Ethereum platforms provide secure storage and a rigour to manage the data on the blockchain. Ethereum can provide tamper-proof records to users of its platform.
- Smart Contracts (Solidity): Smart contracts are programmed on blockchain using a language called Solidity. It is the responsibility of Smart Contracts as to guarantee that the performance of the trades is done automatically and securely.
- Recording Data on the Blockchain: Every transaction like processing, transportation and selling the product is stored in the blockchain. This facilitates the monitoring of processes in order to make certain that they are both clear and easily accountable for.

- Authentication and Authorization (ERC-725/ERC-735): Authentication and authorization processes are performed in accordance with Ethereum standards. This ensures secure and authorized access for users.

This application is believed to make it possible for all activities from the producer to the consumer to be effectively managed safely by enhancing the polling capabilities and other benefits of using blockchain technology in the food chain. Thus, Consumers will be served only safe and high-quality food, while producers or suppliers will benefit from more secure and efficient transaction methods. The snapshots of the application are demonstrated in Figures 3, 4, 5 and 6, respectively.

Figure 3: Block Information for Saved Product

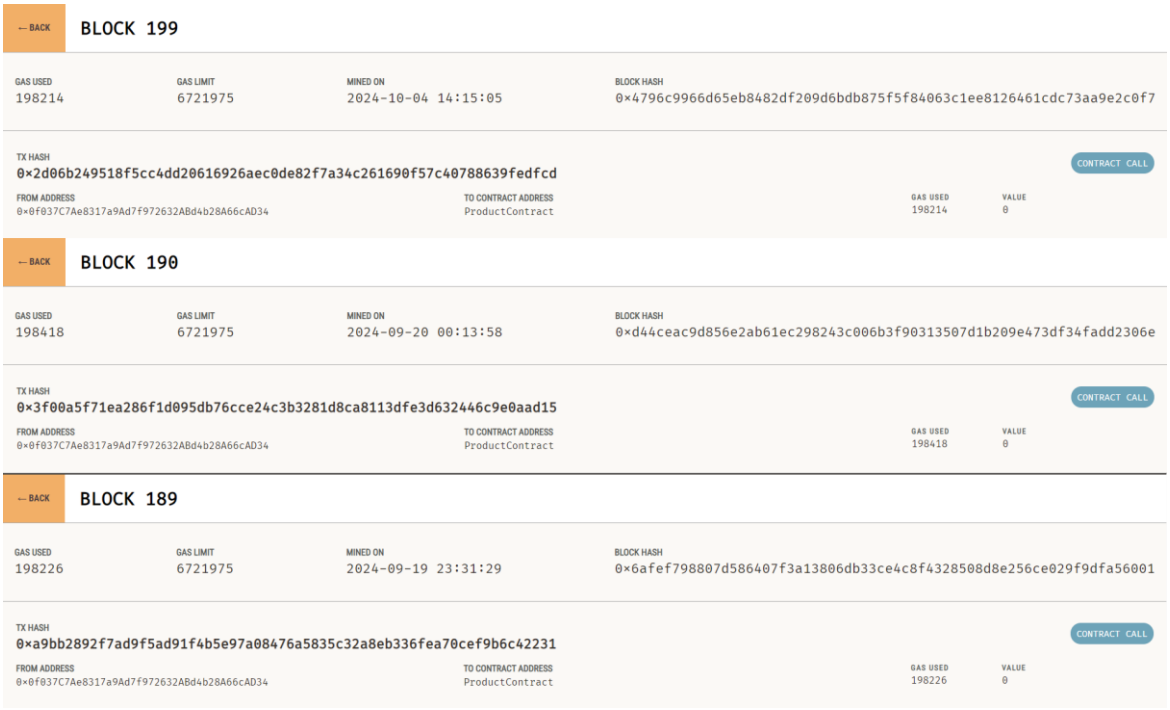

Figure 4: Transaction Information for Saved Product

Figure 5: Smart Contract Information for Products

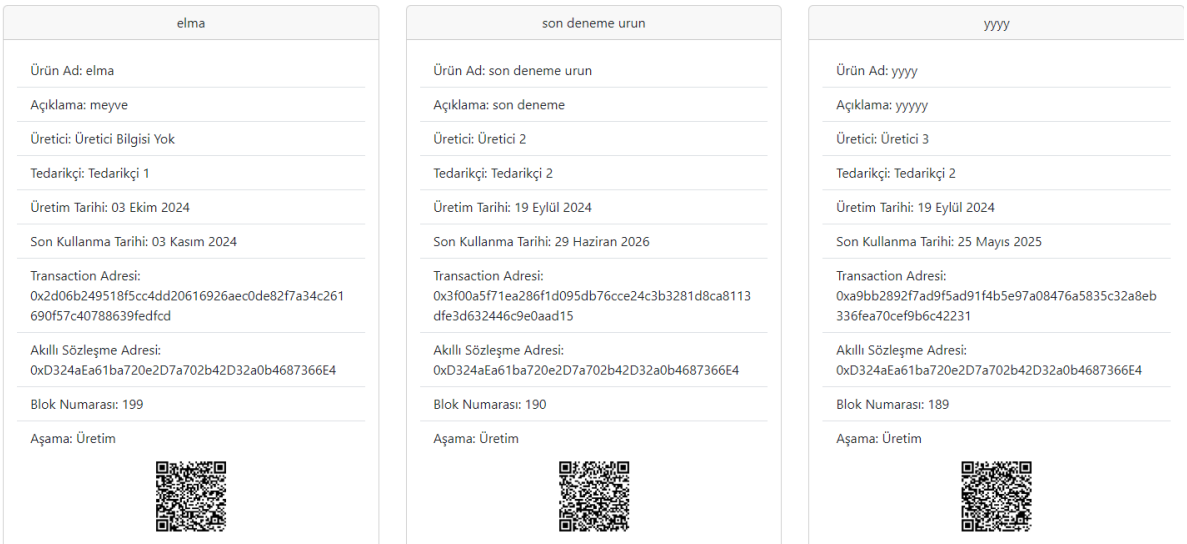

Figure 6: Web Application Product Information

5. CONCLUSION

Food supply chains has gained significant attention for its potential to transform various components of the food supply chain. The use of blockchain in the food supply chains improves transparency, consumer trust, increases the effectiveness of recalls and inspections, and offers cost-saving opportunities (Oriekhoe et al., 2024). This technology enables food product tracking and

supports the establishment of food traceability systems that connect producers and consumers (Elias et al., 2024; Xiong et al., 2020). Blockchain addresses many existing challenges in the food industry by improving supply chain transparency and traceability, which helps reduce disruptions and ensures food safety. In this case, with the help of blockchain solution, such information as products' history, their movements through the supply chain and product safety can be offered to the consumers (Xiong et al., 2020).

Despite growing academic interest, practical implementations of blockchain in the food sector remain scarce, and empirical studies are still limited. Therefore, more focus should be placed on developing a roadmap for implementing the blockchain technology (Vu et al., 2023). However, there are few barriers including the difficulty of implementing blockchain into current systems, data validation, and security, and compatibility with other technologies are some of the challenges that should be well handled (Panghal et al., 2022). Jarka (2019) established that blockchain has solutions that may help in enhancing food safety, traceability and the general supply chain by eliminating the weakness of the current food production system. Moreover, the integration of blockchain and the Internet of Things (IoT) can significantly extend the frontiers of the reformed agri-food industry leading to a dependable and sustainable food chain (Hasan et al., 2023).

This study explores a blockchain-based food supply chain system that promises improvements in transparency, traceability and product security across all stages. Starting from the manufacturing process itself through distribution channels, each level enjoys the properties of blockchain, which is immutable and decentralised allowing data accuracy and confidence among the chain of consumers. Additionally, incorporating the use of blockchain in the management of inventories and suppliers offers real-time information about the inventory, and the activities of the suppliers. The resulting transparency enhances communication and improves the decision-making processes of supply chain members. Blockchain is also applied in documenting processing steps, packaging procedures, and quality control measures, thus improving company accountability. These processes are managed through smart contracts in the application's backend, minimizing errors and ensuring accurate recording of all transactions. This automation not only helps to improve efficiency but also extends trust to stakeholders because customers can easily cheque the authenticity of the products by personally operating the equipment without intermediaries. In logistics and distribution, blockchain provides reliable solutions to the handling of warehousing, transport and delivery. While these activities are recorded on the blockchain, they give all stakeholders immediate visibility into the product's storage and transportation paths. It enhances the reliability of supply chain making it more efficient because does not expose food products to spoilage or delays. On the consumer side, blockchain handles the safe storage of a product list and consumer order and payment operations. These activities by use of blockchain have an advantage of increased transparency and irreversibility of the transactions. Besides, smart contracts on the blockchain make payment even more secure which makes it much more efficient. Finally, on the consumer side, the use of the blockchain enables the certainty of product information like we have never experienced before. The consumers can retrieve comprehensive information about whence the product was obtained, how it was processed and where it was sold or dispatched. This helps to build confidence between the business and the customers and also assists the buyers make a rational decision. This is most necessary in the food products industry

mainly because only safe foods and beverages are acceptable in the current market.

Blockchain has the potential to transform organisations into platforms for communication and information sharing among stakeholders to support collective decision making and problem solving abilities (Katsikouli et al., 2020; Oriekhoe et al., 2024; A. Sharma et al., 2023) which are necessary to address issues including food insecurity and equitable access to resources. Additionally, blockchain technology can also improve the profitability of such chains. For small and medium enterprises (SMEs) this is a very notable economic benefit, as these enterprises usually face many resource constraints and limited market access(M & Parkhi, 2021; Mohammed et al., 2023; Xu et al., 2022)..

In addition, the blockchain helps food supply chain be resilient as it is easier and faster to respond to disruptions. f a supply chain is trackable through blockchain, organizations can respond more quickly to disruptions such as natural disasters or pandemics. For example, natural or pandemics – if a organisation can still achieve flexibility and quick responses on the ground with that ability to track the supply chain you have. To illustrate, if the organisation uses blockchain during the COVID19 pandemic, there are a higher chance of concentration of the supply chain breaks or running the operations uninterrupted (M. Sharma et al., 2022; Yang et al., 2021). It is essential in an environment of rapidly changing, rapidly globalised environment to assure flow of goods and services. Last, the use of blockchain technology is introduced in food supply chain organizations to increase resilience and sustainability of the organizations, and promote human centred approach. The power it gives stakeholders on the blockchain is to remain compliant with regulations, having enhanced traceability and even better resource management. Besides, the number of economic benefits and innovation capabilities for blockchain are increasing in the food industry. This technology will not only allow organisations to become more operationally agile, but also push the food system in society towards a more sustainable, more equitable food system as organizations adopt this technology.

Finally, blockchain technology has provided significant advantages for the food industry. First, it promotes traceability and tracking; second, it increased transparency and consumer satisfaction; third, it contributed to more sustainable production environment. With the help of enabling characteristics of the selected BC, namely, openness, unchangeability and protection, the food business chain can solve critical concerns linked to food safety, supply chain and consumer trust. However, to achieve disruptive potential of blockchain in the given industry, and numerous other sectors across the globe, there is a need to bring a systematic approach for handling small but crucial issues like, operational compatibility, security of data and expandability. With the application of the proposed solution in the study,the challenges faced by enterprises using blockchain technology in the food supply chain can be effectively addressed. Therefore, it is expected that the shift of enterprises from conventional methods utilised in the food supply chain to an integrated food supply chain coupled with blockchain technology aimed at improving food traceability and safety will gain momentum.

While digital web and blockchain applications are enhancing organisational performance, they are simultaneously enhancing the level of accountability and transparency. Due to heightened consumer awareness and requirements for absolute quality of the consumed products, the role of providing increasingly credible information about the origin and processing of the products is becoming the most crucial and unique advantage. Implementation of blockchain based food supply chain represents a transformative approach to managing supply

chain operations. It benefits all stakeholders by creating a more transparent, secure and efficient supply chain by leveraging the strengths of blockchain technology. The potential of blockchain to revolutionise industry practises and standards is demonstrated in this study and can thus serve as an example of future developments in supply chain management. In addition, future research directions may include the following areas:

Conduct empirical testing in real-world settings.

- In future studies, it is possible to empirically test the developed systems under real-world conditions. Such implementations would provide a more accurate assessment of the system's feasibility and performance.

Simplify smart contracts to lower costs.

- Efforts can be made to simplify the structure of smart contracts in order to reduce transaction costs. This would contribute to making blockchain technology more economical and accessible.

Integrate IoT for automation and real-time data.

- The integration of IoT (Internet of Things) technologies can be considered for real-time data transmission and process automation. Such integration may enhance the system's dynamic control and traceability capabilities.

Improve interoperability with existing ERP systems.

- Integration efforts may be undertaken to improve interoperability with existing ERP systems. This approach can facilitate the adoption of blockchain-based systems in enterprise applications.

Strengthen data privacy through cryptography.

- To enhance data privacy, more advanced cryptographic methods can be applied. In this context, techniques such as homomorphic encryption or zero-knowledge proofs may be considered in future studies.

REFERENCES

Adamashvili, N., State, R., Tricase, C., & Fiore, M. (2021). Blockchain-Based Wine Supply Chain for the Industry Advancement. Sustainability, 13(23), 13070. https://doi.org/10.3390/su132313070

Alıcı, S., Damar, M., & Gökşen, Y. (2024). Blok Zincir Teknolojisine Akademik Yönden Ne Kadar Hazırız: Türkiye Adresli Blok Zincir Konusundaki Uluslararası Yayınların Analizi ve Alanın Gelişimine Yönelik Öneriler. Journal of Information Systems and Management Research, 6(1), 40-62. https://doi.org/10.59940/jismar.1483935

Cigdem, Ş. (2021). From EDI to Blockchain: A Bibliometric Analysis of Digitalization in Supply Chains. Gaziantep University Journal of Social Sciences, 20(2), 657-677. https://doi.org/10.21547/jss.861065

Chandan, A., John, M., & Potdar, V. (2023). Achieving UN SDGs in Food Supply Chain Using Blockchain Technology. Sustainability, 15(3), 2109. https://doi.org/10.3390/su15032109

Daneshvar Kakhki, M., & Gargeya, V. B. (2019). Information systems for supply chain management: a systematic literature analysis. International Journal of Production Research, C. 57, pp. 5318-5339. https://doi.org/10.1080/00207543.2019.1570376

Duan, J., Zhang, C., Gong, Y., Brown, S., & Li, Z. (2020). A content-analysis based literature review in blockchain adoption within food supply chain. International Journal of Environmental Research and Public Health, C. 17. https://doi.org/10.3390/ijerph17051784

Elias, S. K. N. H., Usman, S., & Chuprat, S. (2024). Discovering the Global Landscape of Agri-Food and Blockchain: A Bibliometric Review. International Journal of Advanced Computer Science and Applications, 15(4). https://doi.org/10.14569/IJACSA.2024.0150458

Ellahi, R. M., Wood, L. C., & Bekhit, A. E. D. A. (2023). Blockchain-Based Frameworks for Food Traceability: A Systematic Review. Foods, C. 12. https://doi.org/10.3390/foods12163026

Gunasekera, D., & Valenzuela, E. (2020). Adoption of Blockchain Technology in the Australian Grains Trade: An Assessment of Potential Economic Effects. Economic Papers: A Journal of Applied Economics and Policy, 39(2), 152–161. https://doi.org/https://doi.org/10.1111/1759-3441.12274

Haber, S., & Stornetta, W. S. (1991). How to time-stamp a digital document. Journal of Cryptology, 3(2). https://doi.org/10.1007/BF00196791

Hasan, I., Habib, Md. M., & Mohamed, Z. (2023). Blockchain Database and IoT: A Technology driven Agri-Food Supply Chain. International Supply Chain Technology Journal, 9(3), 40-45. https://doi.org/10.20545/isctj.v09.i03.01

Jarka, S. (2019). Food Safety in the Supply Chain Using Blockchain Technology. Acta Scientiarum Polonorum. Oeconomia, 18(4), 41-48. https://doi.org/10.22630/aspe.2019.18.4.43

Katsikouli, P., Wilde, A. S., Dragoni, N., & Høgh-Jensen, H. (2021). On the benefits and challenges of blockchains for managing food supply chains. Journal of the Science of Food and Agriculture, 101(6), 2175-2181. https://doi.org/10.1002/jsfa.10883

Kaur, A., Singh, G., Kukreja, V., Sharma, S., Singh, S., & Yoon, B. (2022). Adaptation of IoT With Blockchain in Food Supply Chain Management: An Analysis-Based Review in Development, Benefits and Potential Applications. Sensors, 22(21), 8174. https://doi.org/10.3390/s22218174

Kim, H. M., & Laskowski, M. (2018). Toward an ontology-driven blockchain design for supply-chain provenance. Intelligent Systems in Accounting, Finance and Management, 25(1), 18-27. https://doi.org/10.1002/isaf.1424

Kshetri, N. (2019). Blockchain and the Economics of Food Safety. It Professional, 21(3), 63–66. https://doi.org/10.1109/mitp.2019.2906761

Li, K., Lee, J. Y., & Gharehgozli, A. (2023). Blockchain in food supply chains: a literature review and synthesis analysis of platforms, benefits and challenges. International Journal of Production Research, 61(11), 3527-3546. https://doi.org/10.1080/00207543.2021.1970849

Liu, Q., & Zou, X. (2019). Research on trust mechanism of cooperation innovation with big data processing based on blockchain. Eurasip Journal on Wireless Communications and Networking, 2019(1), 1-11. https://doi.org/10.1186/s13638-019-1340-5

M, K., & Parkhi, S. (2021). Blockchain enabled technology platform for enhancing supply chain financing for SME's. Psychology and Education Journal, 57(9). https://doi.org/10.17762/pae.v57i9.2689

Mao, D., Wang, F., Hao, Z., & Li, H. (2018). Credit evaluation system based on blockchain for multiple stakeholders in the food supply chain. International Journal of Environmental Research and Public Health, 15(8), 1627. https://doi.org/10.3390/ijerph15081627

Marchesi, L., Mannaro, K., Marchesi, M., & Tonelli, R. (2022). Automatic Generation of Ethereum-Based Smart Contracts for Agri-

Food Traceability System. Ieee Access, 10, 50363–50383. https://doi.org/10.1109/access.2022.3171045

Mendling, J., Weber, I., Van Der Aalst, W., Brocke, J. Vom, Cabanillas, C., Daniel, F., … Zhu, L. (2018). Blockchains for business process management - Challenges and opportunities. ACM Transactions on Management Information Systems, 9(1), 1-16. https://doi.org/10.1145/3183367

Mohammed, A., Potdar, V., Quaddus, M., & Hui, W. (2023). Blockchain Adoption in Food Supply Chains: A Systematic Literature Review on Enablers, Benefits, and Barriers. Ieee Access, 11, 14236–14255. https://doi.org/10.1109/access.2023.3236666

Mukherjee, U., Dutta, S., & Bandyopadhyay, S. K. (2021). Assembling Blockchain and IoT for Smart Food-Supply Chain. Asian Journal of Advances in Agricultural Research, 16(3), 49-58. https://doi.org/10.9734/ajaar/2021/v16i330177

Nassar, A., EA Fathimath, S., Mohammed, F., KN, H. M., & KS, F. (2024). A Review on Blockchain Based Traceability in Organic Food Supply Chain. International Research Journal of Modernization in Engineering Technology and Science, 6(2), 782-785. https://doi.org/10.56726/irjmets49315

Nofer, M., Gomber, P., Hinz, O., & Schiereck, D. (2017). Blockchain. Business and Information Systems Engineering, 59(3), 183-187. https://doi.org/10.1007/S12599-017-0467-3

Oriekhoe, O. I., Ilugbusi, B. S., & Adisa, O. (2024). Ensuring global food safety: integrating blockchain technology into food supply chains. Engineering Science & Technology Journal, 5(3), 811-820. https://doi.org/10.51594/ESTJ.V5I3.905

Ozdagoglu, G., Damar, M., & Ozdagoglu, A. (2020). The State of the Art in Blockchain Research (2013–2018): Scientometrics of the Related Papers in Web of Science and Scopus. In Contributions to Management Science (pp. 569-599). https://doi.org/10.1007/978-3-030-29739-8_27

Pakseresht, A., Kaliji, S. A., & Xhakollari, V. (2022). How Blockchain Facilitates the Transition Toward Circular Economy in the Food Chain? Sustainability, 14(18), 11754. https://doi.org/10.3390/su141811754

Panghal, A., Sindhu, S., Dahiya, S., Dahiya, B., & Mor, R. S. (2022). Benchmarking the Interactions among Challenges for Blockchain Technology Adoption: A Circular Economy Perspective. International Journal of Mathematical, Engineering and Management Sciences, 7(6), 859-872. https://doi.org/10.33889/IJMEMS.2022.7.6.054

Rana, S. (2020). Blockchain-based Traceability and Transparency in Agricultural Supply Chains: Challenges and Opportunities. Turkish Journal of Computer and Mathematics Education (TURCOMAT), 11(3), 1948–1956. https://doi.org/10.17762/turcomat.v11i3.13591

Sharma, A., Sharma, A., Singh, R., & Bhatia, T. (2023). Blockchain Adoption in Agri-Food Supply Chain Management: An Empirical Study of the Main Drivers Using Extended UTAUT. Business Process Management Journal, 29(3), 737–756. https://doi.org/10.1108/bpmj-10-2022-0543

Sharma, M., Joshi, S., Luthra, S., & Kumar, A. (2022). Managing disruptions and risks amidst COVID-19 outbreaks: role of blockchain technology in developing resilient food supply chains. Operations Management Research, 15(1),268–281. https://doi.org/10.1007/s12063-021-00198-9

Tsang, Y. P., Choy, K. L., Wu, C. H., Ho, G. T. S., & Lam, H. Y. (2019). Blockchain-Driven IoT for Food Traceability with an Integrated Consensus Mechanism. IEEE Access, 7,

129000-129017. https://doi.org/10.1109/ACCESS.2019.2940227

Van Hilten, M., Ongena, G., & Ravesteijn, P. (2020). Blockchain for Organic Food Traceability: Case Studies on Drivers and Challenges. Frontiers in Blockchain, C. 3. https://doi.org/10.3389/fbloc.2020.567175

Vu, N., Ghadge, A., & Bourlakis, M. (2023). Blockchain adoption in food supply chains: a review and implementation framework. Production Planning and Control, 34(6), 506-523. https://doi.org/10.1080/09537287.2021.1939902

Xiong, H., Dalhaus, T., Wang, P., & Huang, J. (2020). Blockchain Technology for Agriculture: Applications and Rationale. Frontiers in Blockchain, C. 3. https://doi.org/10.3389/fbloc.2020.00007

Xu, M., Ma, S., & Wang, G. (2022). Differential Game Model of Information Sharing among Supply Chain Finance Based on Blockchain Technology. Sustainability (Switzerland), 14(12), 7139. https://doi.org/10.3390/su14127139

Xueting, H. (2023). Blockchain-Enabled Smart Packaging: Enhancing Food Traceability and Consumer Confidence in the Chinese Food Industry. The Frontiers of Society, Science and Technology, 5(12), 1-7.

Yang, L., Zhang, J., & Shi, X. (2021). Can blockchain help food supply chains with platform operations during the COVID-19 outbreak? Electronic Commerce Research and Applications, 49, 101093. https://doi.org/https://doi.org/10.1016/j.elerap.2021.101093