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Blockchain-powered traceability systems in high value agri-food supply chains: a systematic literature review featuring insights from the olive oil sector

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ABSTRACT

The olive oil supply chain, faces persistent challenges related to fraud, counterfeiting and lack of transparency, undermining consumer trust and product authenticity. Blockchain technology has emerged as a promising solution to enhance traceability, transparency, and quality assurance. This study examines the adoption of blockchain technology in the olive oil supply chain, organizing the existing literature into four thematic clusters (traceability and consumer trust; quality management; transparency; technological integration). The findings highlight blockchain's potential to improve supply chain integrity, especially when combined with internet of things sensors and smart contracts, while identifying technological, financial and organizational barriers to widespread adoption.

1. Introduction

The olive oil supply chain is one of the most emblematic and economically significant sectors in the Mediterranean region, playing a pivotal role not only in the agricultural landscape but also in the cultural and socio-economic heritage of producing countries (Eurostat, 2023; FAOSTAT, 2023). This sector is characterized by a complex and fragmented supply chain, involving multiple actors ranging from small-scale farmers to large-scale distributors (Kumar & Kansara, 2018; Yurt et al., 2019). Despite its strategic importance, the olive oil supply chain is frequently affected by challenges related to transparency, traceability and quality assurance (Aparicio-Ruiz et al., 2022). These issues might undermine consumer trust, compromise market efficiency, put the competitiveness of authentic, high-quality products at risk.

Ensuring the authenticity and quality of olive oil products is a pressing priority, particularly for high-value extra virgin olive oil (EVOO), which is often subject to counterfeiting, adulteration, and mislabeling (Yan et al., 2019). Fraudulent practices not only pose risks to consumer health and safety, but also damage the reputation of producers and the overall integrity of the market. In this context, the need for robust traceability systems, capable of verifying the origin, quality and production processes of olive oil products, has become increasingly evident (Casadei et al., 2021). Furthermore, consumer acceptance of technological innovations aimed at ensuring product transparency plays a crucial role in the success of this solution. Recent research highlights how consumers' acceptance of innovations in traditional foods, such as EVOO, is strongly influenced by both the type of technology adopted and the socio-demographic profile of consumers (Carlucci et al., 2022; Di Vita et al., 2021). Therefore, there is a need to further debate and explore these aspects. This underscores the necessity of integrating advanced technologies with clear and effective communication strategies that not only explain the technological benefits but also foster trust (Consolaro et al., 2025). This approach can enhance consumers' willingness to pay for higher-quality and more transparently certified products, as it reassures them about the reliability and authenticity of the information provided.

Blockchain technology (BCT) has emerged as a promising solution to address these challenges, offering a decentralized, transparent and immutable system for recording transactions along the supply chain (Zarbà et al., 2024). By enabling secure data sharing among supply chain actors, BCT has the potential to significantly enhance traceability, improve consumer trust and strengthen quality assurance mechanisms

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(Reitano et al., 2024). Such technology could also track many sustainability metrics, such as water usage and carbon footprint, addressing critical gaps identified in traditional olive cultivation systems (Maesano et al., 2021). Moreover, the integration of BCT with complementary technologies as Internet of Things (IoT) devices, smart contracts and digital information tools can further enhance data collection, verification and consumer communication processes. In this regard, previous studies have demonstrated that consumers are willing to pay a premium for products offering additional, easily accessible information on quality and origin, such as QR-code labeled EVOO even though not necessarily based on BCT (Lombardi et al., 2017). This highlights the growing importance of digital solutions in meeting consumer demand for transparency, trust and authenticity.

Table 1 outlines the key stages of the olive oil supply chain and the corresponding actions to implement BCT at each stage.

In addition to the operational stages, the certification and verification of product quality play a fundamental role. Certifications, such as PGI (Protected Geographical Indication) or PDO (Protected Designation of Origin), can be registered and verified on the blockchain to ensure compliance with standards, authenticity, and the origin of the olive oil. In recent years, the growing interest in the digital transformation of agri-food supply chains has spurred a significant body of literature exploring the potential benefits and challenges of BCT adoption. However, despite the increasing attention to this topic, no comprehensive systematic literature review has been conducted to provide an overarching analysis of the adoption of BCT in the olive oil supply chain. Existing studies often focus on isolated applications or technical aspects, lacking a fundamental holistic perspective on the drivers, barriers and broader implications of BCT implementation in this sector.

This paper aims to fill this gap by conducting a rigorous systematic literature review on BCT applications in the olive oil supply chain. The review employs a cluster-based classification approach to organize the existing body of knowledge, categorizing the selected studies into distinct thematic areas, providing a comprehensive understanding of the current research landscape. Specifically, the review examines how BCT is being applied to improve traceability, authenticity, quality management, transparency, and supply chain governance, while also exploring its integration with complementary digital technologies, including the IoT, smart contracts, and digital certification systems. Furthermore, it critically analyzes the technological, organizational, financial, regulatory, and market factors that facilitate or hinder the adoption of blockchain, along with their implications for the sustainability and resilience of the olive oil supply chain.

By synthesizing the available evidence, this review identifies current research trends, highlights knowledge gaps, and proposes directions for future research. Moreover, the results offer practical recommendations for policymakers, industry stakeholders and technology developers, supporting the design of innovative strategies to promote the adoption of BCT and improve the integrity and efficiency of the olive oil supply chain.

Table 1
Architecture of the BCT-traceability system of the olive oil supply chain.

Passage of the supply chain	Description	Passage of the BCT
1. Olive cultivation	Growing olives and agricultural management of the plants.	Record and track crop details (e.g., varieties, pesticide use, farming practices) on an immutable BCT registry that is accessible to all supply chain actors.
2. Olive harvesting	Olives are harvested once they are ripe, either manually or by mechanical means.	Use of the BCT to track the harvest date, location and environmental conditions of the olives, ensuring transparency and authenticity of the process.
3. Olive transport	Olives are transported to the olive mill for processing.	Use of the BCT to monitor and record each stage of transport, including the vehicles used and the route, ensuring real-time traceability.
4. Oil extraction	The process of oil extraction that may include crushing and pressing.	Record details of the extraction process, such as the type of machinery used, temperatures, and extraction times. This ensures that the oil is produced according to established standards.
5. Conservation and storage	Oil is stored in special containers before being packaged.	Track the quantity and quality of oil stored and stored in optimal conditions. Use BCT to monitor storage temperature and humidity.
6. Bottling	Oil is bottled and prepared for sale.	Record each batch of bottled oil in the BCT system, including the number of bottles, bottling date, and quality certificate.
7. Distribution and sale	Oil is distributed to retailers or end consumers.	Every step of distribution and sale can be tracked in real time on the BCT, including points of sale, retailers, and end consumers, providing transparency.
8. Consumption	The final product is consumed by the consumer.	The BCT provide information to the consumer about the origin of the oil, its characteristics, date of production, and certifications, increasing confidence in the product.

2. Methodology

To gain new scientific insights into the adoption of BCT in the olive oil supply chain, a comprehensive literature review was conducted. Scopus® and Web of Science® (WoS) represented the databases of reference to ensure the quality and scientific validity of the cited articles and reviews, as these databases are recognized for their comprehensive and reliable sources. The search through both databases increased the likelihood of capturing all relevant contributions to the central research topic of this study, thereby ensuring a high level of rigor in the search and selection process. The search activity in Scopus and Web of Science happened on January 15, 2025.

The search string was developed to select the most representative keywords to identify relevant scientific contributions in the field of BCT adoption in the olive oil supply chain. Keywords were combined using Boolean operators (AND/OR), with the search expression presented in Table 2. The search was conducted in the fields of "title", "abstract" and "keywords" for Scopus, and in "all fields" for Web of Science.

2.1. Literature search strategy

The adoption of PRISMA method (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) ensured the rigor in the literature review (Page et al., 2021). The flow diagram of the search process, following the steps suggested by PRISMA guidelines, is presented in Fig. 1. This diagram details the number of studies included or excluded at each step. Ultimately, 27 studies were included in the literature

Table 2
Search expressions used in the literature review to query databases.

Database	Search expression
Scopus	TITLE-ABS-KEY ("blockchain" OR "block chain" OR "block-chain") AND ("olive oil" OR "extra virgin olive oil" OR "extra-virgin olive oil" OR "EVOO")
Web of Science	ALL FIELDS ("blockchain" OR "block chain" OR "block-chain") AND ("olive oil" OR "extra virgin olive oil" OR "extra-virgin olive oil" OR "EVOO")

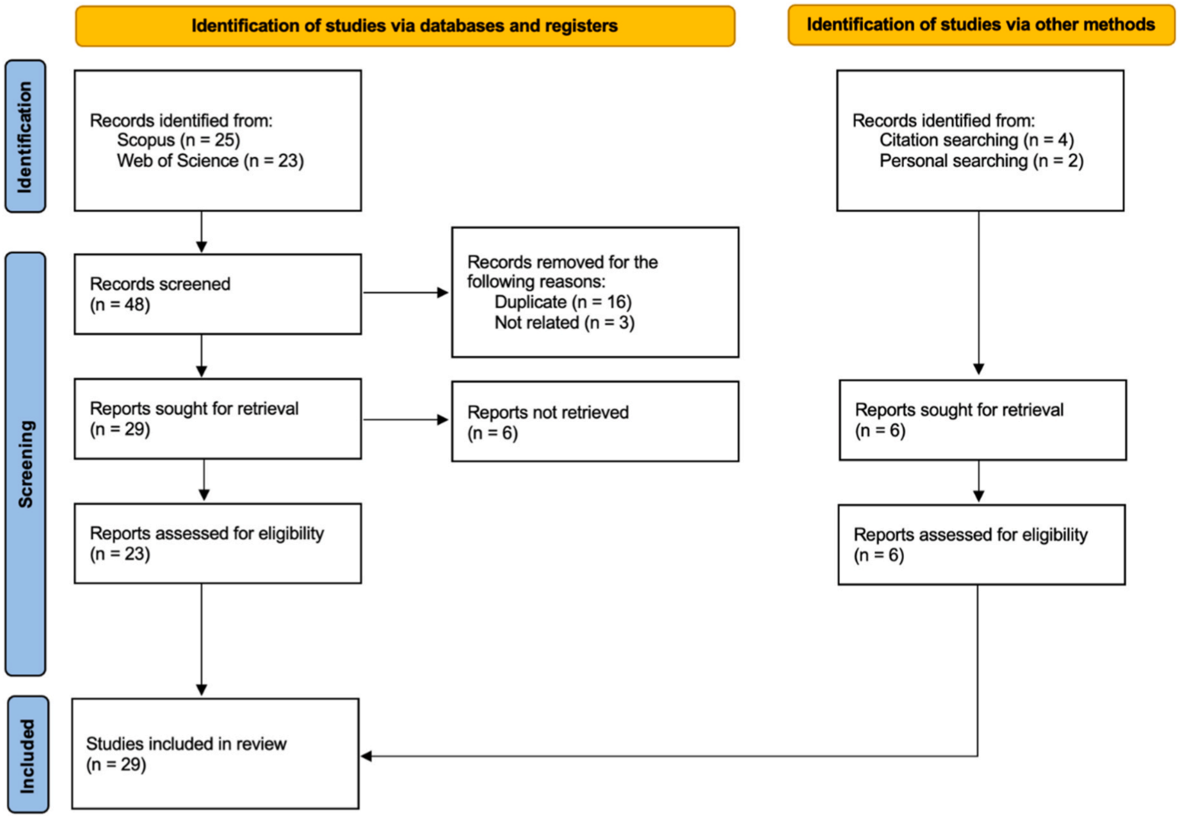

Fig. 1. Flow diagram of the results of the literature search.
Source: Own elaboration following the PRISMA model.

review.

The comprehensive search across the databases yielded a total of 48 results (25 from Scopus and 23 from WoS). Before the formal screening, no publications were excluded due to language, as all retrieved publications were in English. Following this initial refinement, 16 duplicate records were identified and removed. During this phase, 2 additional record was excluded due to its irrelevance to the specific focus of our study (not related to BCT adoption in the olive oil supply chain), resulting in 29 unique publications proceeding to the screening phase. Additionally, 6 records could not be retrieved for full-text analysis.

Finally, 23 reports were deemed relevant and were sought for full-text retrieval. After obtaining the full texts, an in-depth eligibility assessment was performed to ensure the studies' contextual relevance and alignment with the objectives of our study. In addition to database searches, supplementary search strategies were conducted, such as citation searching in the reference lists of the included studies and personal searching to identify potentially relevant publications that were not retrieved by the database search. These complementary approaches are consistent with PRISMA recommendations and were used to minimize the risk of missing relevant studies. 6 additional studies were identified outside the initial search results and were screened and assessed using the same predefined inclusion and exclusion criteria as the database-derived records before being included in the review. The final set of 29 studies was subjected to qualitative analysis to explore the adoption and impact of BCT in the olive oil supply chain.

Although the number of publications may appear relatively limited, it is important to note that, given the specificity of the research focus, such a degree of specialization is both necessary and valuable. This specificity allows for a more targeted and context-relevant analysis, ensuring that the insights generated are directly applicable to the unique characteristics and challenges of this high value agri-food supply chain.

The inclusion and exclusion criteria are detailed in Table 3.

Table 3
Criteria for abstract screening process.

Inclusion criteria	Exclusion criteria
1. Full-text papers published in English language. 2. Research evaluates the implementation, adoption, or perception of BCT within the agri-food sector, with specific reference to the olive oil supply chain.	3. The topic is not about BCT adoption in olive oil supply chain, or related terms. 4. The objective of the publication is only to describe general characteristics of olive oil supply chain without connection to BCT. 5. The publication focuses on BCT but does not focus on olive oil supply chain.

2.2. Clustering and keyword co-occurrence analysis methodology

After conducting a systematic review following the PRISMA protocol, the extracted data, including titles, abstracts and keywords, were processed using *VOS Viewer* software. This software supported in constructing and visualizing bibliometric networks based on scientific publication data, enabling the identification of thematic clusters and the analysis of relationships between different research concepts. The software generates co-occurrence networks by quantifying the frequency and connections between terms appearing across publications, thus creating a visual representation of the research landscape. Each node in the *VOS Viewer* network represents a word or a set of a few words frequently used in the selected publications. The node size reflects the number of occurrences, while the links between nodes indicate co-occurrence relationships, highlighting the interconnectedness of different themes. Keywords belong to different clusters, based on their co-occurrence patterns, and distinguished by a unique color. This visualization facilitates the identification of prominent research themes and the exploration of their interconnections (Kirby, 2023).

The network analysis conducted with *VOS Viewer* revealed the most frequently used terms across the selected publications and their associations, allowing the identification of emerging trends in the field. Specifically, it provided insights into the focal points of research related to BCT adoption in the olive oil supply chain, including supply chain traceability, transparency, consumer perceptions and technological barriers.

2.3. Quality assessment

To assess the quality of the studies included in this review, we referred to the Newcastle-Ottawa Scale (NOS), one of the most widely used and recognized tools recognized for its practicality and adaptability for evaluating observational studies in meta-analyses (Luchini et al., 2017). However, given the specific focus of our systematic review on the adoption of BCT in the olive oil supply chain, the original NOS criteria were adapted to better suit the nature of the included studies.

Four key dimensions were assessed:

1. Selection: Is the sample representative?
2. Comparability: Does the study account for potential confounding variables in the design or analysis?
3. Exposure: Is the main information clearly measured?
4. Outcome: Is the outcome assessed objectively?

Each criterion was scored dichotomously (1 = Yes; 0 = No). Based on the total score (ranging from 0 to 4), studies were classified into three quality levels: Low (score of 0–2), Medium (score of 3), and High (score of 4).

The results of the quality assessment are presented in Appendix A.

3. Results

This section presents the findings from the literature review on the adoption of BCT in the olive oil supply chain. It begins with a bibliographic analysis, followed by reports on the different clusters identified and an analysis of each. The last section gives space for final discussions based on the results of the review.

Figures presented in these sections, unless specified otherwise, were developed using the statistical software R, which enabled the processing and visualization of bibliometric data in a clear and consistent manner.

3.1. Quantitative analysis of the scientific literature

As previously mentioned, given the relatively recent introduction of BCT in the agri-food supply chain (Reitano et al., 2024). This is confirmed by the temporal distribution of the studies included in this review. The first studies on BCT applications in the olive oil supply chain appeared in 2019. Only seven studies were published between 2019 and 2021, whereas twenty were published between 2022 and 2024, demonstrating an increase in scientific interest. The highest number of publications was recorded in 2022 (n = 9), followed by 2024 (n = 6) and 2023 (n = 5).

Fig. 2 illustrates the leading academic journals that have most frequently featured the studies included in this review, offering insight into the key publication venues in the field.

“Proceedings of the IEEE” with five publications ranks as the journal with the most publications published relating to the topic of the present study. “Foods” published four publications, while both “Proceedings of the CISTI” and “Proceedings of the CEUR” published two publications. Finally, each of the other journals published only one article. This distribution indicates a significant tendency to explore this topic in the context of conferences, highlighting a rapid exchange of ideas and early-stage research in these settings.

Fig. 3 shows the author affiliations across different countries for the 27 selected publications.

The geographic distribution of the analyzed publications shows a higher concentration of studies from Italy (13), followed by Tunisia with 4 publications and Portugal and Spain with 2 publications, while the other countries (Brazil, France, Greece, Israel, Malaysia, Netherlands, Saudi Arabia, Turkey) have only one publication each. This distribution, with most contributions originating from Mediterranean countries, aligns with the relevance of olive oil production in this region, as highlighted by FAOSTAT (2023) data (Fig. 4). Indeed, the Mediterranean basin remains the heart of global olive oil production, with countries such as Italy, Spain, Greece, Portugal, and Tunisia playing a leading role in both quantity and tradition. However, the limited contributions from certain other olive oil-producing countries, despite their significant role in production, can be attributed to the slower pace of digitalization in these regions. The lack of digital infrastructure and adoption of advanced technologies, including blockchain, hampers the ability of these countries to contribute to research and innovation in the field. The prominence of Italian research, on the other hand, reflects the country's historical and economic commitment to the olive oil supply chain, as well as its advanced digital and technological landscape, which has positioned Italy at the forefront of innovation within the broader Mediterranean production context (Lombardo et al., 2022; Stempfle et al., 2022).

3.2. Clusters and keyword co-occurrence analysis

VOS Viewer software identified a total of 698 terms; to ensure a focused and meaningful analysis, a minimum keyword occurrence

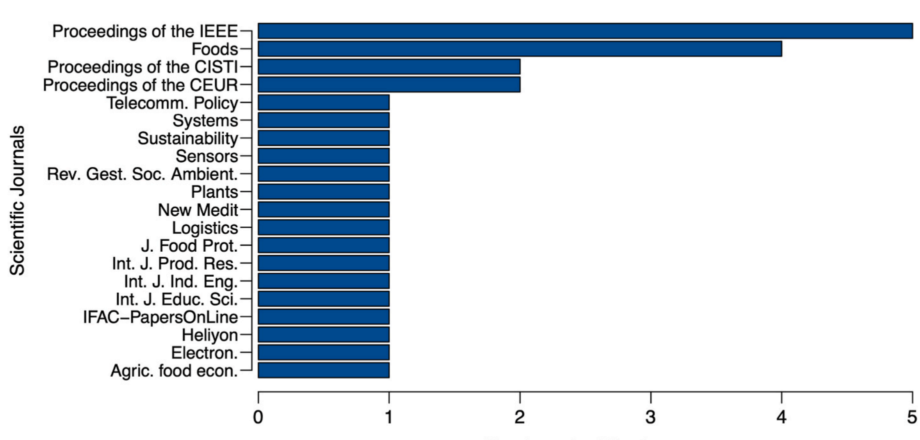

Fig. 2. Publications included by scientific journals in which were published.

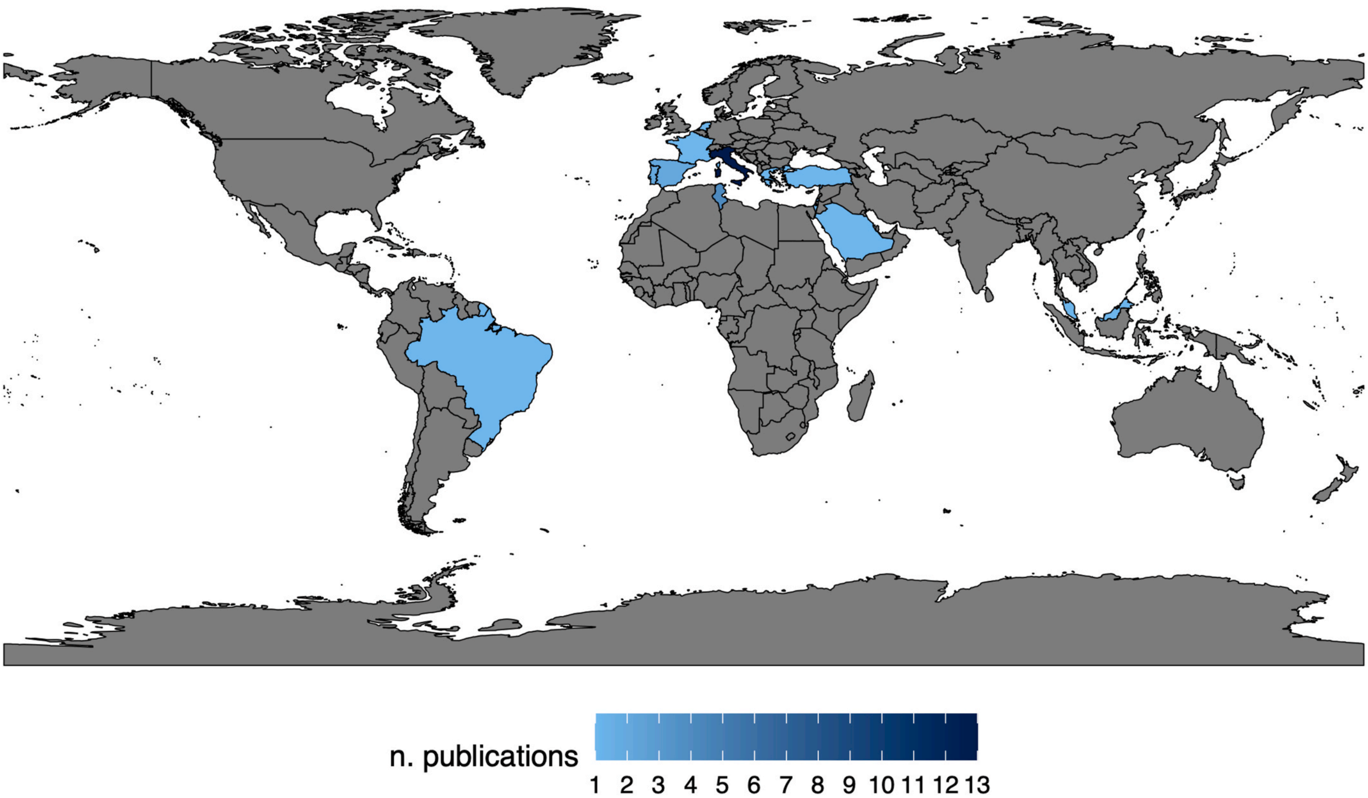

Fig. 3. Geographical distribution of included publications per country.

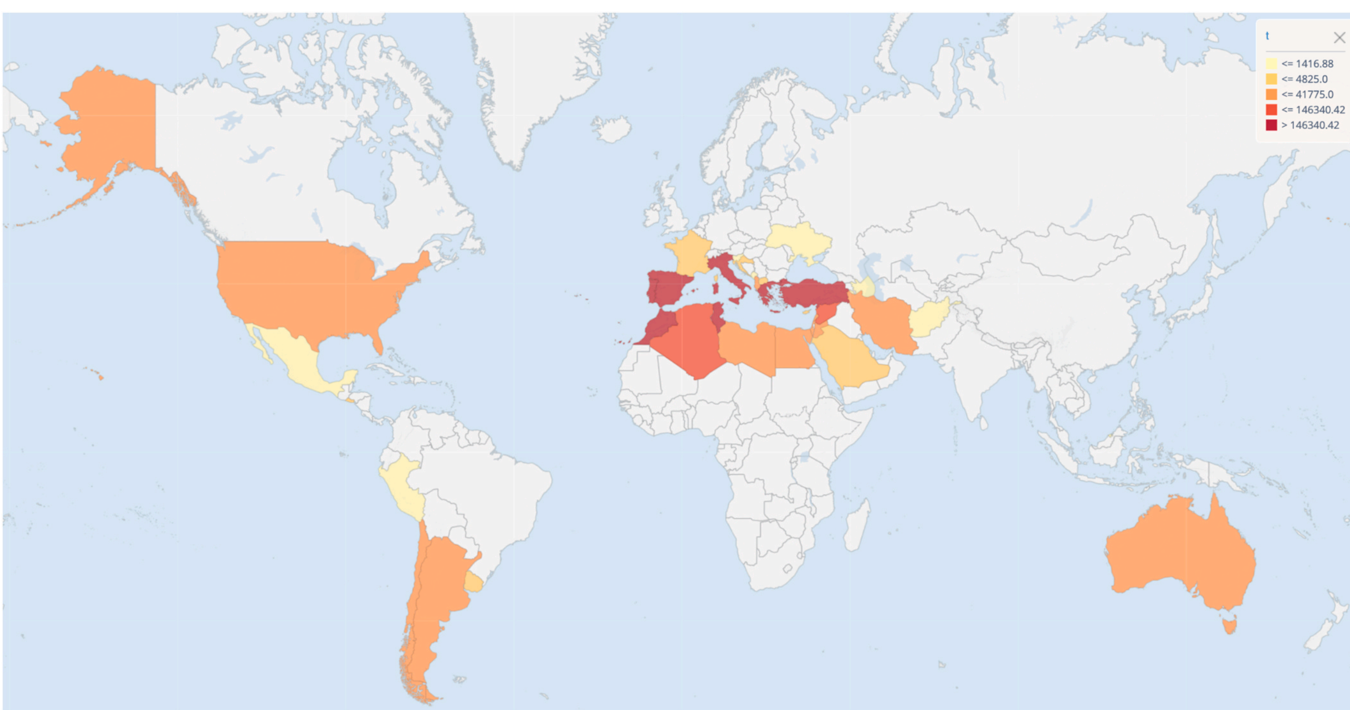

Fig. 4. Production quantities of olive oil by country, average 2019 - 2023.
Source: FAOSTAT (2023), visualize data.

threshold of four appearances was established, resulting in the selection of 60 terms. A further manual refinement process was applied to remove synonyms and irrelevant terms, yielding a final set of 21 significant items for co-occurrence analysis, with a total link strength of 2026. This reduction process, which involved filtering out redundant terms, allowed for a clearer representation of the main research concepts and their interrelationships.

Fig. 5 displays the resulting co-occurrence network, showcasing the connections between the selected keywords. Each cluster represents a distinct thematic area within the literature, revealing the predominant

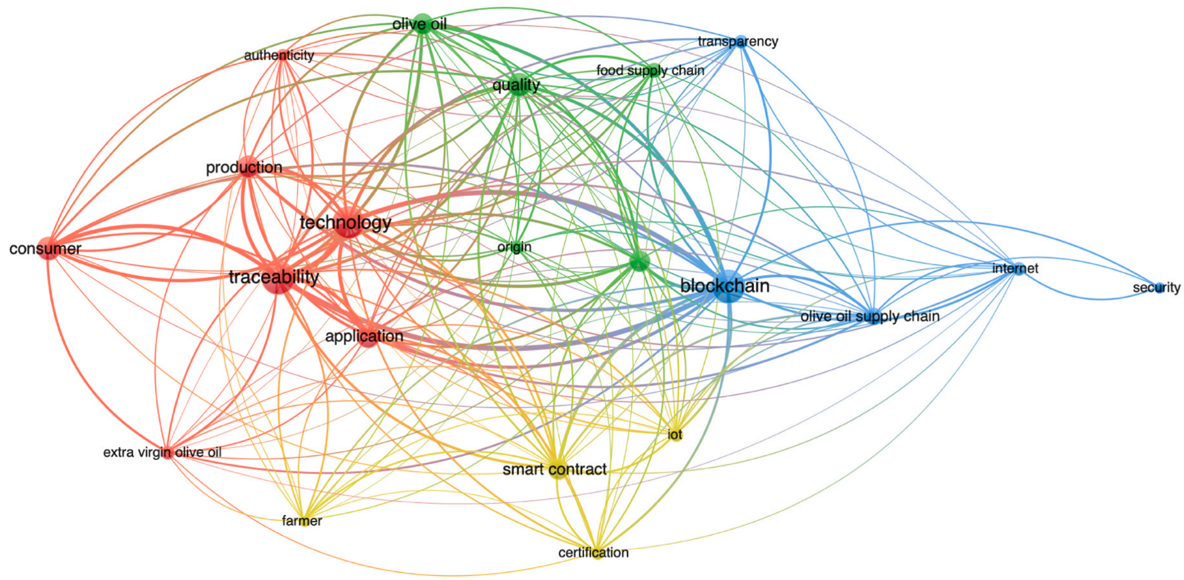

Fig. 5. Co-occurrence map of the main words emerged from the articles.
Source: Own elaboration through the *VOS Viewer* software.

research trends and topics of interest in the context of BCT applications in olive oil supply chain. The visualization provides valuable insights into the thematic structure and development of the research, enabling a comprehensive understanding of the thematic alignment and emerging directions within the field.

The analysis resulted in the formation of four distinct clusters, which are red, green, blue and yellow, each characterized by specific elements. The identified clusters are described in Table 4.

By categorizing the literature into these clusters, this systematic review aims to provide a structured understanding of the current landscape of the adoption of BCT in the olive oil supply chain, to underscore the multifaceted nature of technology adoption and to highlight areas for research.

Fig. 6, 7 and 8 present three distinct analyses. The first, a total link strength analysis per keyword by cluster, indicating the cumulative strength of connections between items; the second an occurrence analysis, which highlights the frequency of each keyword; finally, a links analysis per keyword by cluster, showing the number of direct connections between keywords.

Surprisingly, security was the word with the lowest value in terms of links per keyword by cluster. While all the other words had values above 15, security had a value of 3. The keywords with the highest occurrence and total link strength were "blockchain" (link strength of 515 and occurrences 40), "traceability" (link strength of 504 and occurrences 39), "technology" (link strength of 483 and occurrences 37) underscoring the centrality of BCT in its application within the traceability of the olive oil supply chain.

All publications considered for this literature review are for completeness reported in Appendix B.

Table 4
Interpretation of co-occurrence clusters shown in Fig. 5.

Cluster	Name	Color	Items
1	"Applications of BCT for traceability and authenticity in EVOO production and increasing consumer trust"	Red	Application, authenticity, consumer, extra virgin olive oil, production, technology, traceability
2	"Integrated quality and origin management in the EVOO supply chain"	Green	Food supply chain, olive oil, origin, quality, supply chain
3	"BCT revolution: transparency, security, and new business models in the EVOO supply chain"	Blue	Blockchain, internet, olive oil supply chain, security, transparency
4	"Integration of IoT, Smart Contract, Certification and the centralized role of the producer: toward a sustainable and transparent supply chain"	Yellow	Certification, farmer, IoT, smart contract

3.2.1. *Cluster 1. applications of BCT for traceability and authenticity in EVOO production and increasing consumer trust*

The recurring scandals concerning quality and fraud in the olive oil supply chain, where prices are defined based on origin and quality, have led to the consideration of BCT as a solution to ensure the veracity of product information. Several studies propose new BCT-powered configurations for the olive oil supply chain to build visibility across all processes and ensure the detection of adulterations. For instance, Ayan et al., 2022 include olive oil among the major industries studied in detail in agriculture and food supply chain research, highlighting how BCT-powered systems aim to provide consumers with an unchanging and transparent product story from cultivation to the point of sale. Similarly, Lahami and Chaabane (2023), demonstrate how BCT can improve the supply chain management of olive oil by enhancing traceability, transparency and operational efficiency. The application of BCT in the olive oil supply chain is widely reported in the literature as an emerging trend to prevent food scandals, offering benefits such as traceability, provenance and visibility. However, despite the recognized potential of BCT to improve traceability and provide additional assurance on the authenticity, safety, and quality of agri-food products through the supply chain, the study by Martínez-Castañeda and Feijoo (2023) shows that its large-scale deployment and full realization of this value faces significant difficulties, due to, among other things, a lack of understanding of the technology by many actors and the challenge in translating operational benefits into tangible economic benefits for all participants, especially small producers, that justify its implementation and maintenance beyond initial funding. To address these challenges and bridge the gap between potential and practical impact, several BCT-based systems have been developed. Moreover Consolaro et al. (2025), a significant portion of society remains unaware of the value of agribusiness BCT traceability as an additional way to ensure authenticity, safety and quality of various food products through their life cycle processes. Notably, prototypes of BCT-powered systems (Arena

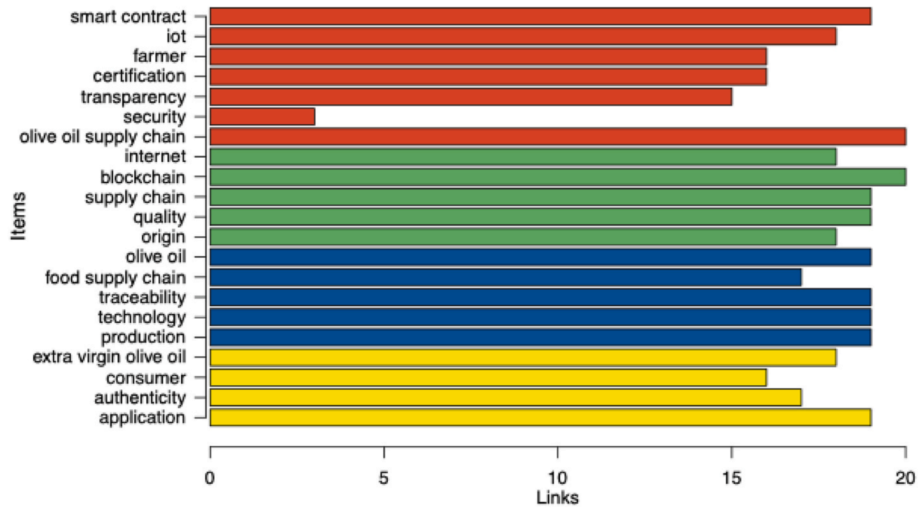

Fig. 6. Links per keyword by cluster.

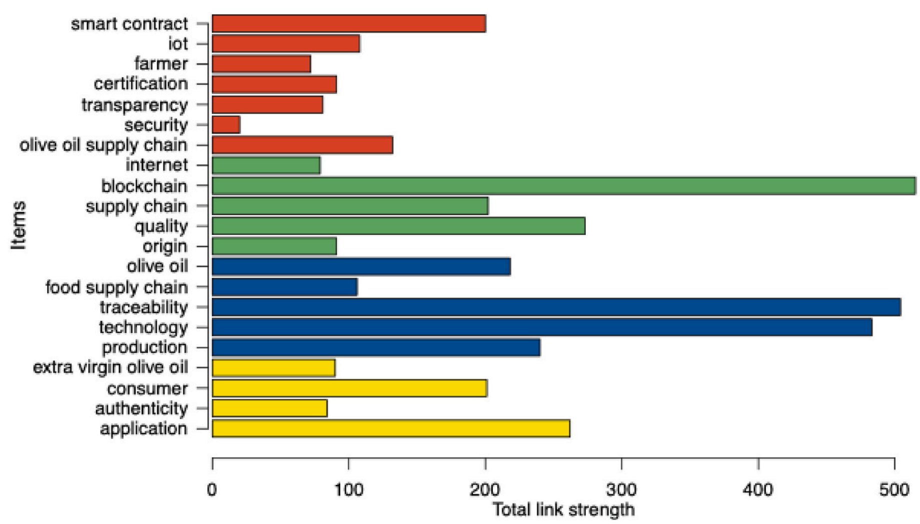

Fig. 7. Total link strength per keyword by cluster.

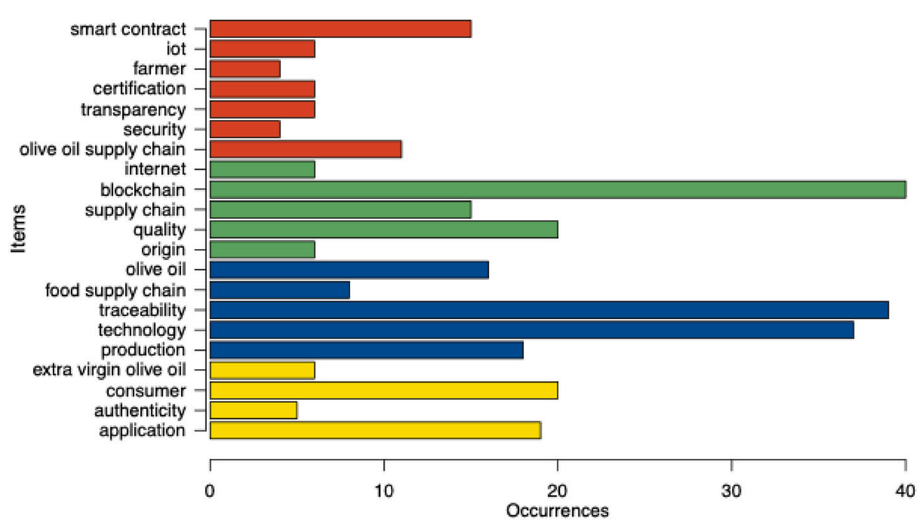

Fig. 8. Occurrences per keyword by cluster.

et al., 2019; Fernandes et al., 2023; Guido et al., 2020) aim to provide consumers with an immutable and transparent product story from cultivation to point of sale, often integrating IoT sensors for data collection (Fernandes et al., 2023) to boost the efficacy. These technologies address the growing consumer demand for evidence about quality and origin information. Consumers showed willingness to pay a premium price for EVOO with guaranteed traceability information (Violino et al., 2019). Therefore, BCT emerges as a fundamental tool to increase consumer trust in the olive oil sector, ensuring authenticity, origin and quality through transparent and secure data management along the entire supply chain (Nyland et al., 2023). In line with these findings, Masmoudi and Gargouri (2021) point out that consumer interest in knowing the origin and production methods of the products they buy is steadily increasing. Their study shows that the trust generated by the use of blockchain has a direct and significant effect on the purchase intention of olive oil products.

Finally, an innovative and highly relevant aspect concerns the reliability of automatic control mechanisms of the supply chain based on smart contracts, which are self-executing digital agreements whose terms are directly written into code and automatically enforced without the need for intermediaries. Bennour et al. (2024) illustrate the use of formal verification to validate smart contracts used within a DApp designed for the olive oil supply chain, thus ensuring the correctness of transactions and further enhancing product security, authenticity, and traceability.

3.2.2. *Cluster 2. integrated quality and origin management in the EVOO supply chain*

The integrated management of quality and origin in the EVOO supply chain significantly benefits from the adoption of innovative technologies. In this context, DNA-based traceability emerges as a promising approach to certify and authenticate products, confirming origin and authenticity through the analysis of genetic markers (Ayed et al., 2022). The effectiveness of such a system requires the registration of varieties and their characteristics in a database, emphasizing the need for a multidisciplinary approach involving molecular biology and genetics (Ayed et al., 2022). At the same time, comprehensive technological systems (Violino et al., 2020) based on Radio Frequency Identification reader (RFID) and QR codes, when integrated with BCT (Fernandes et al., 2022), enable tracking of EVOO productive and distribution activities's from the olive tree to the consumer. Specifically, orchard-level identification is ensured by the use of waterproof RFID tags attached to individual olive trees, recording cultivar type and GPS location, while decentralized applications (dApps) allow farmers to register plots and confirm transactions directly on the blockchain (Ktari et al., 2024; Violino et al., 2020). This guarantees that each tree and its corresponding grove are uniquely registered and linked to the product's provenance. Polenzani et al. (2020) point out that the perceived sustainability of local EVOO is closely linked to local production and certifications, highlighting how consumer behavior toward a local product is linked to the exchange of information between producers and consumers.

Furthermore, BCT-powered platforms focus on collecting and storing information related to sustainability and quality indicators at all stages of the supply chain (Ktari et al., 2024; Vitaskos et al., 2024), aiming to guarantee the provenance, variety and quality of olives, ensuring the authenticity of the final product and responding to the growing consumer demand for reliable information. During the harvest process, additional RFID tags are attached to crates, which are then associated with specific trees, while data such as harvesting date, method, weight, maturity and defect levels are captured through IoT sensors and mobile applications (Violino et al., 2020; Vitaskos et al., 2024). These data are immutably recorded on the blockchain via smart contracts, ensuring full transparency and integrity from field to mill (Alkhudary et al., 2022). Quality management along the supply chain is influenced by factors such as agricultural practices, environmental conditions, processing and olive storage, highlighting the importance of sharing such information transparently through advanced traceability systems (Alkhudary et al., 2022). This comprehensive approach to quality management aligns with the insights of Burgess et al. (2023), who review supply chain quality management practices in sustainable food networks, emphasizing the role of transparency and information sharing in enhancing product quality and consumer trust.

3.2.3. *Cluster 3. BCT revolution: transparency, security, and new business models in the EVOO supply chain*

The adoption of BCT is revolutionizing the EVOO supply chain, bringing significant improvements in transparency and security and paving the way for new business models. Chiaraluce et al. (2024) highlight how BCT, thanks to its intrinsic characteristics of immutability, transparency, distribution, and decentralization, positions itself as a promising tool for secure traceability systems, potentially contributing to the sustainability and profitability of production. Pincheira et al. (2022) provide an in-depth analysis on the integration of BCT for agri-food traceability in EVOO, highlighting how such integration can create decentralized applications for greater integration and transparency and how IoT sensors can become trusted data sources to combine with BCT, contributing to information security. Maritano et al. (2024) emphasize that electronic and data-driven technologies (such as RFID and digital traceability systems) are still in their infancy in food sectors most prone to fraud, suggesting the need to develop innovative technologies to counteract them. This shift towards more efficient and transparent traceability systems can lead to new business models based on consumer trust and the valorization of certified origin and quality (Brusset et al., 2024). The capacity of BCT to optimize processes, improve food safety and reduce fraud can, according to Chiaraluce et al. (2024), translate into improved profits for farmers and the creation of inclusive business models involving various stakeholders along the supply chain.

3.2.4. *Cluster 4. integration of IoT, smart contract, certification, and the centralized role of the producer: toward a sustainable and transparent supply chain*

The integration of IoT and smart contracts emerges as a powerful tool for certification and the promotion of a sustainable and transparent EVOO supply chain, with the producer assuming a central role in guaranteeing quality and origin. In practice, IoT devices, such as sensors and RFID tags, collect real-time data on environmental conditions, production processes, and product quality at various stages of the supply chain. This data is then automatically recorded and processed through smart contracts, which are programmed to verify specific conditions or thresholds (e.g., temperature, humidity) before executing transactions or triggering actions like payments or certifications. However, Lai et al. (2025) highlight that these benefits are often constrained by low automation rates, fragmented systems, and ambiguous stakeholder responsibilities. The use of these technologies ensures the integrity of the supply chain by reducing human error and fraud, enabling automatic and verifiable certification of quality and origin. Several frameworks have been developed for the traceability and quality assurance of unrefined olive oil. Moreover, traceability systems can be implemented for small farms (Conti, 2022), providing them with solutions to monitor the journey of their olive oil. Palocci et al. (2022) propose a search engine concept to improve food traceability and transparency. The digital revolution has impacted the agrifood industry, yet the adoption of advanced technologies is often hampered by suboptimal data management practices. The proposed concept aims to integrate, organize, and optimize the use of "smart data" to establish a foundation for intelligent systems and applications in food chain management.

By adopting such technologies, the producer can centralize the collection of data related to agricultural practices, environmental conditions and processing methods, securely and transparently recording this information via BCT and smart contracts (Bistarelli et al., 2022), thereby contributing to greater sustainability and reliable communication with consumers. The use of IoT sensors can further enrich the data collected directly from producers (Ktari et al., 2022). This technological integration aligns with the approach proposed by Marchesi et al. (2021), who explore the automatic generation of BCT agri-food traceability systems, highlighting how the combination of IoT, BCT, and smart contracts can enhance supply chain transparency and efficiency.

4. Discussion

The olive oil supply chain is a sector characterized by complex pricing dynamics based on origin and quality, but which periodically suffers from scandals related to quality issues or fraud (Alkhudary et al., 2022). The lack of transparency in information sharing among partners in the olive oil supply chain often leaves consumers with no means of verifying labels (Alkhudary et al., 2022). In this context, BCT has emerged as a promising solution for improving visibility, traceability, and provenance throughout the food supply chain (Alkhudary et al., 2022; Arena et al., 2019; Vitaskos et al., 2024).

BCT offers advantages such as traceability, provenance, and visibility, and is widely cited in literature as a new trend for preventing food scandals (Chiaraluce et al., 2024). Specifically for the olive oil supply chain, BCT, combined with IoT devices and smart contracts, has been proposed to improve visibility, prevent fraud in olive oil quality, and provide a competitive advantage (Arena et al., 2019; Bistarelli et al., 2022; Fernandes et al., 2022; Guido et al., 2020; Ktari et al., 2022; Lahami & Chaabane, 2023; Violino et al., 2020; Vitaskos et al., 2024).

However, despite its considerable theoretical advantages, the practical adoption of BCT in the olive oil supply chain and in agri-food supply chains in general faces a number of significant obstacles (Ayan et al., 2022; Chiaraluce et al., 2024; Consolaro et al., 2025; Martínez-Castañeda & Feijoo, 2023; Nyland et al., 2023; Pincheira et al., 2022; Vitaskos et al., 2024). The literature emphasizes that the implementation of BCT is still in its early stages and requires further conceptual and holistic investigation (Ayan et al., 2022; Chiaraluce et al., 2024).

The challenges to adopting BCT in the agri-food supply chain are multifactorial and include technical, organizational, financial, regulatory, and social aspects. Appendix C provides a comparative overview of the main barriers identified in the literature. The analysis shows that the most common difficulties are concentrated, on a technical level, on system scalability and data integrity, while on an organizational level, there are shortcomings in specialist skills and governance issues. From a financial point of view, the crucial issue is the high investment costs and uncertainty of economic returns (Ayan et al., 2022; Chiaraluce et al., 2024; Martínez-Castañeda & Feijoo, 2023; Pincheira et al., 2022; Brusset et al., 2024). These issues are further aggravated by the lack of shared standards and a clear regulatory framework, which is a cross-cutting factor in all categories of challenges (Ayan et al., 2022; Chiaraluce et al., 2024; Martínez-Castañeda & Feijoo, 2023; Vitaskos et al., 2024).

The adoption of BCT therefore has profound implications at the organizational level, which are reflected in three main dimensions: regulatory, financial, and managerial. At the regulatory level, the integration of BCT is closely linked to the need to ensure compliance with existing regulations, such as Regulation (EC) No 178/2002, and certification standards such as protected designations of origin (PDOs) and protected geographical indications (PGIs), which are crucial tools for preserving the authenticity of olive oil (Chiaraluce et al., 2024; Lai et al., 2025; Vitaskos et al., 2024). BCT can strengthen these certifications, but the absence of legally recognized standards and the coexistence of non-uniform market-oriented applications risk limiting its effectiveness (Martínez-Castañeda & Feijoo, 2023). Furthermore, the use of technology must comply with data protection regulations, such as the GDPR, which require careful and responsible management of personal information (Martínez-Castañeda & Feijoo, 2023; Nyland et al., 2023). In this context, institutional support through economic incentives, tax credits, and regulatory adjustments can promote the spread of BCT, although the lack of a clear regulatory framework remains a critical obstacle (Ayan et al., 2022; Vitaskos et al., 2024).

From a financial perspective, the most obvious barrier is the high initial costs required for hardware, software, IoT infrastructure, and staff training (Ayan et al., 2022; Chiaraluce et al., 2024; Lai et al., 2025; Polenzani et al., 2020; Violino et al., 2019; Vitaskos et al., 2024; Brusset et al., 2024). This challenge is particularly critical for small and medium-sized enterprises, which often lack the resources to sustain such an investment (Chiaraluce et al., 2024; Vitaskos et al., 2024). Added to this is the uncertainty about the return on investment, which is rarely addressed systematically in the literature, and the tendency for pilot projects to end when public funding ceases (Alkhudary et al., 2022; Brusset et al., 2024; Martínez-Castañeda & Feijoo, 2023). Maintenance and upgrade costs also represent a significant burden, making it difficult to balance the potential benefits in terms of efficiency and counterfeit reduction with the actual costs of implementation (Chiaraluce et al., 2024; Pincheira et al., 2022).

In terms of internal policies, the introduction of BCT involves a review of operational flows and the standardization of processes, often encountering resistance to change from the actors involved (Chiaraluce et al., 2024). Effective adoption requires new technical skills, including not only data experts but also managers capable of integrating technology into existing business models (Alkhudary et al., 2022; Lai et al., 2025; Martínez-Castañeda & Feijoo, 2023). Data governance becomes a central issue, as the implementation of decentralized systems involves the need to define who owns, accesses, and manages information, requiring the achievement of a shared consensus among often heterogeneous actors (Ayan et al., 2022; Brusset et al., 2024). Finally, although BCT can strengthen collaboration and mutual trust between supply chain partners, its success depends on the ability to build solid relationships, supported by adequate coordination mechanisms and clear communication of the benefits to consumers (Burgess et al., 2023; Masmoudi & Gargouri, 2021).

The introduction of BCT in the olive oil supply chain, therefore, goes far beyond the technological dimension and must be understood as a transformative process that touches on strategic, organizational, and regulatory aspects. To achieve the expected benefits in terms of transparency, authenticity, and consumer confidence, a holistic approach is needed that includes targeted investments, regulatory support, and coordinated commitment from all stakeholders. Without these conditions, projects risk remaining at the experimental stage, unable to generate a lasting and systemic impact (Brusset et al., 2024; Martínez-Castañeda & Feijoo, 2023).

5. Conclusions

The findings of this review underscore the transformative potential of BCT in enhancing transparency, traceability and consumer trust in the olive oil supply chain. By offering immutable and transparent data recording systems, BCT can significantly improve product authenticity and quality assurance, particularly for high-value products such as EVOO. Despite its promise, the widespread adoption of BCT remains hindered by technological complexity, high implementation costs and the fragmented structure of the olive oil supply chain. Addressing these barriers requires collaborative efforts among producers, technology providers and policymakers to develop accessible, cost-effective and interoperable systems. Therefore, future research should focus on the scalability of BCT applications, the integration of emerging technologies such as IoT and artificial intelligence and the assessment of the economic and environmental impacts of BCT-powered traceability systems. This study contributes to the ongoing debate on digital transformation in agri-food supply chains, offering a structured framework to guide further investigations and support the transition toward more transparent and sustainable production systems.

CRediT authorship contribution statement

Matilde Reitano: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Visualization, Writing – original draft, Writing – review & editing. **Roberta Selvaggi:** Funding acquisition, Validation, Writing – original draft, Writing – review & editing. **Carla Zarbà:** Validation, Writing – original draft, Writing – review & editing. **Marcella Bucca:** Validation, Writing – review & editing. **Gaetano Chinnici:** Methodology, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Quality assessment

Authors	Selection	Comparability	Exposure	Outcome	Score	Level
Alkhudary et al.	Yes	Yes	No	Yes	3	Medium
Arena et al.	Yes	Yes	Yes	Yes	4	High
Ayan et al.	Yes	Yes	Yes	Yes	4	High
Ayed et al.	Yes	Yes	Yes	Yes	4	High
Bennour et al.	Yes	Yes	Yes	Yes	4	High
Bistarelli et al.	Yes	Yes	Yes	Yes	4	High
Brusset et al.	Yes	Yes	No	Yes	3	Medium
Burgess et al.	Yes	Yes	Yes	Yes	4	High
Chiaraluce et al.	Yes	Yes	Yes	Yes	4	High
Consolaro et al.	No	Yes	Yes	Yes	3	Medium
Conti M.	No	Yes	No	Yes	2	Low
Fernandes et al.	No	Yes	No	No	1	Low
Fernandes et al.	No	Yes	Yes	Yes	3	Medium
Guido et al.	No	Yes	Yes	No	2	Low
Ktari et al.	Yes	Yes	Yes	No	3	Medium
Ktari et al.	Yes	Yes	No	No	2	Low
Lahami & Chaabane	Yes	Yes	No	No	2	Low
Lai et al.	Yes	Yes	Yes	Yes	4	High
Marchesi et al.	Yes	Yes	Yes	Yes	4	High
Maritano et al.	No	No	Yes	Yes	2	Low
Martínez-Castañeda & Feijoo	No	Yes	Yes	Yes	3	Medium
Masmoudi & Gargouri	No	Yes	Yes	Yes	3	Medium
Nyland et al.	Yes	Yes	Yes	No	3	Medium
Palocci et al.	No	Yes	No	Yes	2	Low
Pincheira et al.	Yes	Yes	Yes	Yes	4	High
Polenzani et al.	No	Yes	Yes	Yes	3	Medium
Violino et al.	Yes	Yes	Yes	Yes	4	High
Violino et al.	No	Yes	Yes	Yes	3	Medium
Vitaskos et al.	No	Yes	Yes	Yes	3	Medium

Appendix B. Included publications' key information

Cluster	Author	Title	Country	Thematic area	Approach
Cluster 1	Ayan et al., 2022	Blockchain technology and sustainability in supply chains and a closer look at different industries: a mixed method approach	Turkey	Business, Management and Accounting	Conceptual
	Lahami and Chaabane (2023)	Improving the supply chain management via Blockchain: an olive oil case study	Tunisia	Computer science	Case Study
	Consolaro et al. (2025)	Enhancing olive oil communication by blockchain agri-food traceability	Spain	Business, Management and Accounting	Proposed Framework
	Martínez-Castañeda and Feijoo (2023)	Use of blockchain in the agri-food value chain: State of the art in Spain and some lessons from the perspective of public support	Spain	Business, Management and Accounting	Case Study
	Arena et al. (2019)	BRUSCHETTA: An IoT blockchain-based framework for certifying extra virgin olive oil supply chain	Italy	Engineering	Case Study
	Fernandes et al. (2023)	A Blockchain-based Solution for Traceability in the Olive Oil Production Chain: A Demonstration Case	Portugal	Computer science	Case Study
	Guido et al. (2020)	A framework for food traceability: Case study-Italian extra-virgin olive oil supply chain	Italy	Engineering	Case Study
	Violino et al. (2019)	Are the innovative electronic labels for extra virgin olive oil sustainable, traceable, and accepted by consumers?	Italy	Agricultural and Biological Sciences	Case Study
	Nyland et al. (2023)	Blockchain application for traceability and olive oil production in Brazil	Brazil	Environmental Science	Conceptual
	Masmoudi and Gargouri (2021)	“Does blockchain technology matter?”: Understanding consumer purchase intention in a blockchain technology for olive oil context.	Tunisia	Business, Management and Accounting	Case Study
	Bennour et al. (2024)	Enhancing DApp Supply Chain with Verified Smart Contracts: A Case Study on the Olive-Oil Industry.	Tunisia	Computer Science	Case Study

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Cluster	Author	Title	Country	Thematic area	Approach
Cluster 2	Ayed et al. (2022)	Integration of Innovative Technologies in the Agri-Food Sector: The Fundamentals and Practical Case of DNA-Based Traceability of Olives from Fruit to Oil	Malaysia	Agricultural and Biological Sciences	Case Study
	Violino et al. (2020)	A full technological traceability system for extra virgin olive oil	Italy	Agricultural and Biological Sciences	Case Study
	Fernandes et al. (2022)	Smart Contract and Web DApp for Traceability in the Olive Oil Production chain	Portugal	Computer science	Case Study
	Polenzani et al. (2020)	Sustainability Perception of local extra virgin olive oil and Consumers' attitude: a new Italian perspective.	Italy	Business, Management and Accounting	Case Study
	Ktari et al. (2024)	Development of a Decentralized Application for Managing Food Supply Chain Based on Blockchain	Tunisia	Computer science	Proposed Framework
	Vitaskos et al. (2024)	Blockchain and Internet of Things Technologies for Food Traceability in Olive Oil Supply Chains	Greece	Engineering	Proposed Framework
	Alkhudary et al. (2022)	Enhancing the competitive advantage via Blockchain: An olive oil case study	Israel	Engineering	Case Study
	Burgess et al. (2023)	A review of supply chain quality management practices in sustainable food networks	Netherlands	Business, Management and Accounting	Conceptual
Cluster 3	Chiaraluce et al. (2024)	Exploring the role of blockchain technology in modern high-value food supply chains: global trends and future research directions	Italy	Agricultural and Biological Sciences	Conceptual
	Pincheira et al. (2022)	Characterization and Costs of Integrating Blockchain and IoT for Agri-Food Traceability Systems	Italy	Computer science	Case Study
	Maritano et al. (2024)	Anticounterfeiting and Fraud Mitigation Solutions for High-value Food Products	Italy	Computer science	Conceptual
	Brusset et al. (2024)	Increasing willingness to pay in the food supply chain: a blockchain-oriented trust approach	France	Business, Management and Accounting	Conceptual
Cluster 4	Lai et al. (2025)	Food Supply Chain: A framework for the governance of digital Traceability	Italy	Business, Management and Accounting	Proposed Framework
	Conti (2022)	EVO-NFC: Extra Virgin Olive Oil Traceability Using NFC Suitable for Small-Medium Farms	Italy	Computer science	Case Study
	Palocci et al. (2022)	A Search Engine Concept to Improve Food Traceability and Transparency: Preliminary Results	Italy	Computer science	Proposed Framework
	Bistarelli et al. (2022)	Olive Oil as Case Study for the *-Chain Platform	Italy	Computer science	Proposed Framework
	Ktari et al. (2022)	Agricultural Lightweight Embedded Blockchain System: A Case Study in Olive Oil	Saudi Arabia	Engineering	Proposed Framework
	Marchesi et al. (2021)	Automatic Generation of Blockchain Agri-food Traceability Systems	Italy	Computer science	Proposed Framework

Appendix C. Main challenges to adopting BCT

Challenge category	Prevailing and critical challenges	Secondary challenges
Techniques	• Scalability: limitations in the number of transactions per second, high computational requirements, block size, transaction speed (Ayan et al., 2022; Ayed et al., 2022; Chiaraluce et al., 2024; Martínez-Castañeda & Feijoo, 2023; Pincheira et al., 2022; Vitaskos et al., 2024). • Data integrity/quality: ensuring that uploaded data is correct and has not been tampered with (e.g., sensor tampering), verification of external inputs and sensors (Alkhudary et al., 2022; Brusset et al., 2024; Chiaraluce et al., 2024; Martínez-Castañeda & Feijoo, 2023; Nyland et al., 2023; Vitaskos et al., 2024). • Technological immaturity: the technology is in its early stages, development takes time, lack of ready-to-use solutions (Ayan et al., 2022; Ktari et al., 2022; Martínez-Castañeda & Feijoo, 2023).	• Interoperability: difficulties in integrating different BCT systems and existing software systems (Ayan et al., 2022; Lai et al., 2025; Martínez-Castañeda & Feijoo, 2023). • Security/privacy: risks of external attacks, confidential data management (need for off-chain storage for sensitive data), compatibility with data protection regulations (Ayan et al., 2022; Ayed et al., 2022; Chiaraluce et al., 2024; Lahami & Chaabane, 2023; Martínez-Castañeda & Feijoo, 2023; Nyland et al., 2023; Vitaskos et al., 2024). • Infrastructure/connectivity: internet availability and capacity, especially in rural areas and developing countries, and the need for improvements to physical infrastructure (Ayan et al., 2022; Ayed et al., 2022; Martínez-Castañeda & Feijoo, 2023; Polenzani et al., 2020).
Organizational	• Lack of skills/training: scarcity of technical skills, training resources, need for multidisciplinary skills for implementation and maintenance (Alkhudary et al., 2022; Ayan et al., 2022; Brusset et al., 2024; Chiaraluce et al., 2024; Lai et al., 2025; Martínez-Castañeda & Feijoo, 2023; Polenzani et al., 2020). • Governance and coordination: lack of clear data policies, need for consensus on platforms and data formats, reduced stakeholder control, need for ex ante governance mechanisms (Ayan et al., 2022; Chiaraluce et al., 2024; Lai et al., 2025; Martínez-Castañeda & Feijoo, 2023; Brusset et al., 2024).	• Resistance to change: fear of the new, resistance from old business models and managers, reluctance to share data (Ayan et al., 2022; Brusset et al., 2024; Martínez-Castañeda & Feijoo, 2023; Lai et al., 2025). • Sector heterogeneity: no single solution for different types of actors (small and medium-sized enterprises vs. large enterprises), complexity due to multiple industrial parties with often conflicting objectives (Arena et al., 2019; Brusset et al., 2024; Lai et al., 2025).
Financial	• High investment costs: high initial costs for hardware, software, and training, implementation costs not always offset by price increases (Ayan et al., 2022; Chiaraluce et al., 2024; Lai et al., 2025; Martínez-Castañeda & Feijoo, 2023; Pincheira et al., 2022; Polenzani et al., 2020; Violino et al., 2019; Vitaskos et al., 2024; Brusset et al., 2024).	• Low ROI and lack of obvious financial gain: ROI is rarely addressed, managers are unaware of the benefits, uncertainty about expected benefits, and abandonment of pilot projects at the end of public funding (Ayan et al., 2022; Brusset et al., 2024; Chiaraluce et al., 2024; Lai et al., 2025; Martínez-Castañeda & Feijoo, 2023; Pincheira et al., 2022). • Ongoing maintenance costs: significant costs for ongoing training, software updates, and maintenance of IoT sensors (Brusset et al., 2024; Martínez-Castañeda & Feijoo, 2023; Vitaskos et al., 2024).

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Challenge category	Prevailing and critical challenges	Secondary challenges
Regulations	• Lack of regulation and standards: absence of legally recognized standards, compatibility with existing regulations (e.g., GDPR), lack of an updated legal-administrative framework (Ayan et al., 2022; Chiaraluce et al., 2024; Martínez-Castañeda & Feijoo, 2023; Nyland et al., 2023; Vitaskos et al., 2024).	• Government support: the role of government authorities in promoting adoption and providing incentives (Ayan et al., 2022; Chiaraluce et al., 2024; Martínez-Castañeda & Feijoo, 2023; Vitaskos et al., 2024).
Social/Market	• Consumer awareness and acceptance: poor knowledge of BCT, difficulty in understanding the value of labels and BCT-based traceability (Ayan et al., 2022; Consolaro et al., 2025; Nyland et al., 2023; Chiaraluce et al., 2024; Martínez-Castañeda & Feijoo, 2023).	• Information asymmetry: difficulty in clearly communicating the benefits of BCT to differentiate products and build trust (Brusset et al., 2024; Consolaro et al., 2025; Masmoudi & Gargouri, 2021).

Data availability

Data will be made available on request.

References

Alkhudary, R., Brusset, X., Naseraldin, H., & Féniès, P. (2022). Enhancing the competitive advantage via blockchain: An olive oil case study. *IFAC-PapersOnLine, 55*(2), 469–474. https://doi.org/10.1016/j.ifacol.2022.04.238

Aparicio-Ruiz, R., Tena, N., & García-González, D. L. (2022). An international survey on olive oils quality and traceability: Opinions from the involved actors. *Foods, 11*(7), 1045. https://doi.org/10.3390/foods11071045

Arena, A., Bianchini, A., Perazzo, P., Vallati, C., & Dini, G. (2019). BRUSCHETTA: An IoT blockchain-based framework for certifying extra virgin olive oil supply chain. In *Proceedings - 2019 IEEE international conference on smart computing* (pp. 173–179). SMARTCOMP 2019. https://doi.org/10.1109/smartcomp.2019.00049.

Ayan, B., Güner, E., & Son-Turan, S. (2022). Blockchain technology and sustainability in supply chains and a closer look at different industries: a mixed method approach. *Logistics, 6*(4), 85. https://doi.org/10.3390/logistics6040085

Ayed, R. B., Hanana, M., Ercisli, S., Karunakaran, R., Rebai, A., & Moreau, F. (2022). Integration of innovative technologies in the agri-food sector: The fundamentals and practical case of DNA-based traceability of olives from fruit to oil. *Plants, 11*(9), 1230. https://doi.org/10.3390/plants11091230

Bennour, I. E., Wannes, M. H., Ghiss, M., Braham, M., Lahbib, A., Habib, N., & Ribeiro, H. (2024). Enhancing DApp supply chain with verified smart contracts: A case study on the olive-oil industry. In *IEEE/ACS 21st international conference on computer systems and applications (AICCSA)*. https://doi.org/10.1109/aiccsa63423.2024.10912547

Bistarelli, S., Faloci, F., Mori, P., & Taticchi, C. (2022). Olive oil as case study for the *-Chain platform. *CEUR Workshop Proceedings, 3166*, 94–102. https://ceur-ws.org/Vol-3166/paper07.pdf. (Accessed 3 May 2025).

Brusset, X., Kinra, A., Naseraldin, H., & Alkhudary, R. (2024). Increasing willingness to pay in the food supply chain: A blockchain-oriented trust approach. *International Journal of Production Research, 62*(24), 8858–8879. https://doi.org/10.1080/00207543.2024.2352763

Burgess, P. R., Sunmola, F. T., & Wertheim-Heck, S. (2023). A review of supply chain quality management practices in sustainable food networks. *Heliyon, 9*(11), Article e21179. https://doi.org/10.1016/j.heliyon.2023.e21179

Carlucci, D., Roselli, L., Giannoccaro, G., Cavallo, C., Del Giudice, T., Vecchio, R., Cicia, G., & De Gennaro, B. C. (2022). Consumer acceptance of innovations in traditional foods: The case of extra-virgin olive oil. *British Food Journal, 125*(1), 1–17. https://doi.org/10.1108/bfj-05-2021-0570

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

Chiaraluce, G., Bentivoglio, D., Finco, A., Fiore, M., Contò, F., & Galati, A. (2024). Exploring the role of blockchain technology in modern high-value food supply chains: Global trends and future research directions. *Agricultural and Food Economics, 12*(1). https://doi.org/10.1186/s40100-024-00301-1

Consolaro, D. M., Uclés, D. F., & Oya, J. V. (2025). Enhancing olive oil communication by blockchain agri-food. *New Medit, Mediterranean Journal of Economics, Agriculture, Environment and Food, 1*. https://doi.org/10.30682/nm2501f

Conti, M. (2022). EVO-NFC: Extra virgin olive oil traceability using NFC suitable for small-medium farms. *IEEE Access, 10*, 20345–20356. https://doi.org/10.1109/access.2022.3151795

Di Vita, G., Zanchini, R., Gulisano, G., Mancuso, T., Chinnici, G., & D'Amico, M. (2021). 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

Eurostat. (2023). Olives by production. https://doi.org/10.2908/TAG00122.

FAOSTAT. (2023). *Crops and livestock products*. https://www.fao.org/faostat/en/#data/QCL.

Fernandes, M. A., Cruz, E. F., & Da Cruz, A. M. (2023). A blockchain-based solution for traceability in the olive oil production chain: A demonstration case. In *2023 18th iberian conference on information systems and technologies (CISTI)* (pp. 1–6). https://doi.org/10.23919/cisti58278.2023.10211683

Fernandes, M. A., Cruz, E. F., & Da Cruz, A. M. R. (2022). Smart contract and web DApp for traceability in the olive oil production chain. In *2022 17th iberian conference on information systems and technologies (CISTI)* (pp. 1–6). https://doi.org/10.23919/cisti54924.2022.9820169

Guido, R., Mirabelli, G., Palermo, E., & Solina, V. (2020). A framework for food traceability: Case study – Italian extra-virgin olive oil supply chain. *International Journal of Industrial Engineering and Management, 11*(1), 50–60. https://doi.org/10.24867/ijiem-2020-1-252

Kirby, A. (2023). Exploratory Bibliometrics: using VOSViewer as a preliminary research tool. *Publications, 11*(1), 10. https://doi.org/10.3390/publications11010010

Ktari, J., Frikha, T., Chaabane, F., Hamdi, M., & Hamam, H. (2022). Agricultural lightweight embedded blockchain system: A case study in olive oil. *Electronics, 11*(20), 3394. https://doi.org/10.3390/electronics11203394

Ktari, J., Frikha, T., Hsairi, M. M., Lakhal, I. B., Naifar, F., Bouaziz, A., & Amor, N. B. (2024). Development of a decentralized application for managing food supply chain based on blockchain. In *2024 IEEE 4th international Maghreb meeting of the conference on sciences and techniques of automatic control and computer engineering, MI-STA 2024 - Proceeding* (pp. 36–40). https://doi.org/10.1109/mi-sta61267.2024.10599659

Kumar, R., & Kansara, S. (2018). Supply chain process of olive oil industry. *International Journal of Management Practice, 11*(2), 141. https://doi.org/10.1504/ijmp.2018.090829

Lahami, M., & Chaabane, F. (2023). Improving the supply chain management via blockchain: An olive oil case study. *CEUR Workshop Proceedings, 3642*, 182–193. https://ceur-ws.org/Vol-3642/paper16.pdf.

Lai, M. B., Vergamini, D., & Brunori, G. (2025). Food supply chain: A framework for the governance of digital traceability. *Foods, 14*(12), 2032. https://doi.org/10.3390/foods14122032

Lombardi, A., Carfora, V., Cicia, G., Del Giudice, T., Lombardi, P., & Panico, T. (2017). Exploring willingness to pay for QR code labeled extra-virgin olive oil: An application of the theory of planned behavior. *International Journal on Food System Dynamics, 8*(1), 14–31. https://doi.org/10.18461/ijfsd.v8i1.812

Lombardo, L., Farolfi, C., Tombesi, S., Novelli, E., & Capri, E. (2022). Development of a sustainability technical guide for the Italian olive oil supply chain. *The Science of the Total Environment, 820*, Article 153332. https://doi.org/10.1016/j.scitotenv.2022.153332

Luchini, C., Stubbs, B., Solmi, M., & Veronese, N. (2017). Assessing the quality of studies in meta-analyses: Advantages and limitations of the Newcastle Ottawa scale. *World Journal of Meta-Analysis, 5*(4), 80. https://doi.org/10.13105/wjma.v5.i4.80

Maesano, G., Chinnici, G., Falcone, G., Bellia, C., Raimondo, M., & D'Amico, M. (2021). Economic and environmental sustainability of olive production: A case study. *Agronomy, 11*(9), 1753. https://doi.org/10.3390/agronomy11091753

Marchesi, L., Mannaro, K., & Porcu, R. (2021). Automatic generation of blockchain agri-food traceability systems. In *Proceedings - 2021 IEEE/ACM 4th international workshop on emerging trends in software engineering for blockchain (WETSEB)* (pp. 41–48). https://doi.org/10.1109/wetseb52558.2021.00013

Maritano, V., Barge, P., Biglia, A., Comba, L., Aimonino, D. R., Tortia, C., & Gay, P. (2024). Anticounterfeiting and fraud mitigation solutions for high-value food products. *Journal of Food Protection, 87*(4), Article 100251. https://doi.org/10.1016/j.jfp.2024.100251

Martínez-Castañeda, M., & Feijoo, C. (2023). Use of blockchain in the agri-food value chain: State of the art in Spain and some lessons from the perspective of public support. *Telecommunications Policy, 47*(6), Article 102574. https://doi.org/10.1016/j.telpol.2023.102574

Masmoudi, H. M., & Gargouri, F. (2021). "does blockchain technology matter?": Understanding consumer purchase intention in a blockchain technology for olive oil context. *International Journal of Education and Science, 4*(3–4). https://doi.org/10.26697/ijes.2021.3.4

Nyland, J. J.a. O. L., Badejo, M. S., & De Faria Corrêa, R. G. (2023). Blockchain application for traceability and olive oil production in Brazil. *Revista de Gestão Social e Ambiental, 17*(8), Article e03988. https://doi.org/10.24857/rgsa.v17n8-002

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ, 372*, n71. https://doi.org/10.1136/bmj.n71.

Palocci, C., Presser, K., Kabza, A., Pucci, E., & Zoani, C. (2022). A search engine concept to improve food traceability and transparency: Preliminary results. *Foods, 11*(7), 989. https://doi.org/10.3390/foods11070989

Pincheira, M., Vecchio, M., & Giaffreda, R. (2022). Characterization and costs of integrating blockchain and IoT for agri-food traceability systems. *Systems, 10*(3), 57. https://doi.org/10.3390/systems10030057

Polenzani, B., Riganelli, C., & Marchini, A. (2020). Sustainability perception of local extra virgin olive oil and consumers' attitude: A new Italian perspective. *Sustainability, 12*(3), 920. https://doi.org/10.3390/su12030920

Regulation (EC) No 178/2002 of the european parliament and of the council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European food safety authority and laying down procedures in matters of food safety. http://data.europa.eu/eli/reg/2002/178/oj.

Reitano, M., Pappalardo, G., Selvaggi, R., Zarbà, C., & Chinnici, G. (2024). Factors influencing consumer perceptions of food tracked with blockchain technology. A systematic literature review. *Applied Food Research, 4*(2), Article 100455. https://doi.org/10.1016/j.afres.2024.100455

Stempfle, S., Roselli, L., Carlucci, D., Leone, A., De Gennaro, B. C., & Giannoccaro, G. (2022). Toward the circular economy into the olive oil supply chain: A case study analysis of a vertically integrated firm. *Frontiers in Sustainable Food Systems, 6*. https://doi.org/10.3389/fsufs.2022.1005604

Violino, S., Pallottino, F., Sperandio, G., Figorilli, S., Antonucci, F., Ioannoni, V., Fappiano, D., & Costa, C. (2019). Are the innovative electronic labels for extra virgin olive oil sustainable, traceable, and accepted by consumers? *Foods, 8*(11), 529. https://doi.org/10.3390/foods8110529

Violino, S., Pallottino, F., Sperandio, G., Figorilli, S., Ortenzi, L., Tocci, F., Vasta, S., Imperi, G., & Costa, C. (2020). A full technological traceability system for extra virgin olive oil. *Foods, 9*(5), 624. https://doi.org/10.3390/foods9050624

Vitaskos, V., Demestichas, K., Karetsos, S., & Costopoulou, C. (2024). Blockchain and Internet of things technologies for food traceability in olive oil supply chains. *Sensors, 24*(24), 8189. https://doi.org/10.3390/s24248189

Yan, J., Erasmus, S. W., Toro, M. A., Huang, H., & Van Ruth, S. M. (2019). Food fraud: Assessing fraud vulnerability in the extra virgin olive oil supply chain. *Food Control, 111*, Article 107081. https://doi.org/10.1016/j.foodcont.2019.107081

Yurt, O., Kato, L., Jarmai, K., & Aglamaz, E. (2019). Analysis and optimization of an olive oil supply chain: A case from Turkey. *International Journal of Sustainable Agricultural Management and Informatics, 5*(1), 59–79. https://doi.org/10.1504/IJSAMI.2019.101379

Zarbà, C., Chinnici, G., Matarazzo, A., Privitera, D., & Scuderi, A. (2024). The innovative role of blockchain in agri-food systems: A literature analysis. *Food Control, 164*, Article 110603. https://doi.org/10.1016/j.foodcont.2024.110603