

Blockchain-Based Halal Traceability: A Human Rights Framework for Muslim Consumer Protection in Indonesia and Malaysia

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Abstract

The digitalization of halal supply chains creates legal challenges concerning traceability, consumer protection, and cross-border integrity in Indonesia and Malaysia. This study examines the legal position and integration of blockchain as a state's positive obligation tool to fulfill Muslim consumers' right to information and freedom of religion, while proposing an ideal regulatory framework. Using normative legal research with comparative and conceptual approaches, the study analyzes primary and secondary legal materials qualitatively. The findings indicate a regulatory gap concerning the evidentiary status of blockchain data and fragmented traceability governance, which undermines the proactive protection of consumers' spiritual and information rights. Functional harmonization rooted in a human rights framework is proposed to strengthen legal certainty, public verification rights, institutional accountability, and cross-border halal supply-chain integrity without replacing existing certification authorities

Keywords: *Blockchain, Halal Traceability, Muslim Consumer Protection, Human Rights.*

A. INTRODUCTION

The global halal industry has expanded beyond the food sector to encompass pharmaceuticals, cosmetics, logistics, as well as various services related to the needs of Muslim consumers (Azam & Abdullah, 2020). This development indicates that the halal status of products is not merely related to market preferences, but also concerns the ability of individuals, as guaranteed by the state, to practice their religious beliefs in their daily

lives (Ateş, 2025). Article 18 of the Universal Declaration of Human Rights states that “Everyone has the right to freedom of thought, conscience and religion,” including the freedom to “manifest his religion or belief in teaching, practice, worship and observance.” Similarly, Article 18 paragraph 1 of the International Covenant on Civil and Political Rights guarantees the “freedom to have or to adopt a religion or belief of his choice” and the freedom to practice one’s religion or belief. These provisions do not specifically regulate halal certification, but they provide a normative framework under which states are required to respect and protect the space for individuals to exercise their beliefs without unjustifiable interference (Nurul Hikmah, Syahid Akhmad Faisol, Dicky Eko Prasetyo, Kamaluddin Nurdin Marjuni, 2026). In the context of Muslim consumers, certainty regarding the halal status of a product can be regarded as part of the conditions that enable the effective exercise of religious beliefs, particularly when the consumption of products constitutes part of religious practice (Aslan, 2023).

Halal traceability refers to the ability to identify the origin of materials, the movement of goods, processing activities, and the parties responsible at each stage of the supply chain (Bachtiar et al., 2024). Blockchain is a distributed digital ledger that records transactions across multiple network nodes using consensus mechanisms and a data structure designed to make any alterations made after recording detectable (Yadav et al., 2023). These characteristics have the potential to enhance transparency, record integrity, and cross-stakeholder auditing; however, blockchain does not automatically verify the accuracy or authenticity of the data initially entered into the system (Olkhovikov et al., 2025). The paradigm shift from static and trust-based halal certification toward a system that is verifiable and auditable in real time is a logical consequence of the need to align the protection of Muslim consumers with the development of contemporary information

technology. The principle of blockchain decentralization enables each node within the supply chain to independently verify the authenticity of data, thereby reducing reliance on a single authority that may be vulnerable to oversight failures. The transparency generated by this technology provides equal access to information for all stakeholders, including end consumers, who have traditionally occupied the weakest position in the halal product information chain.

The state's obligation to ensure the halal status of products in Indonesia is rooted in Article 29 paragraph (2) of the Constitution of the Republic of Indonesia of 1945, which stipulates that "The State guarantees the freedom of every citizen to embrace their respective religion and to worship according to their religion and belief." This provision is subsequently translated into sector-specific regulation through Article 4 of Law Number 33 of 2014 concerning Halal Product Assurance, which stipulates that "Products entering, circulating, and being traded within the territory of Indonesia must be halal-certified." This framework demonstrates that the state not only recognizes freedom of religion in the abstract but also establishes an administrative regime to ensure that information concerning halal status is supported by institutional verification. However, the digitalization of certification through the SIHALAL system must be distinguished from comprehensive supply-chain traceability, as the recording of certification alone does not automatically generate a record of changes in materials, the movement of goods, or contamination risks at each stage of distribution (Nurillah, 2023). This issue raises a legal question as to whether the available digital infrastructure provides an adequate level of verification to fulfill the objectives of consumer protection and the state's obligations as stipulated under the halal product assurance regime.

Unlike Indonesia, Malaysia has a halal certification regime that has developed through specific regulations concerning the description and use of halal marks. Sections 28 and 29 of the Trade Descriptions Act 2011 provide the legal basis for regulating the use of halal statements or representations, while the Trade Descriptions (Definition of Halal) Order 2011 establishes requirements concerning the meaning and representation of halal in trade, with JAKIM and state religious authorities playing important roles in the administration of certification. This framework is further strengthened by the Malaysian Standard MS 1500, which establishes general requirements for the production, preparation, handling, and storage of halal food, while the Consumer Protection Act 1999 provides a general legal basis for consumer protection. In practice, Malaysia also demonstrates that the centralization of certification authorities does not, by itself, eliminate risks within international supply chains, as reflected in the meat cartel case uncovered in 2020, which involved alleged document falsification and the use of halal logos on products that did not meet the prescribed requirements (Muhammad Asyraf Bin Abdul Halim et al., 2023). The case demonstrates that the integrity of halal certification requires verification mechanisms that operate continuously throughout the supply chain, including when products and documents originate from different jurisdictions.

Indonesia and Malaysia are countries with the largest Muslim populations in Southeast Asia and have developed state-involved halal certification systems, but their institutional architectures differ. Malaysia adopts a more centralized model through JAKIM and state religious authorities, whereas Indonesia has developed the Sihalal system involving the Halal Product Assurance Organizing Agency (BPJPH), Halal Inspection Institutions (LPH), and the Indonesian Ulema Council (MUI), with functions distributed throughout the halal product assurance process. Indonesia and Malaysia share

similarities in having legal systems shaped by Islamic traditions, customary law, and colonial law. Therefore, the comparison is based not only on differences in legal norms but also on the institutional contexts that shape their implementation. The urgency of this research lies in the absence of a legal framework that explicitly integrates blockchain technology into halal certification and traceability regimes in Indonesia and Malaysia. This creates a regulatory vacuum concerning the legal status of blockchain data, verification authority, the responsibilities of supply-chain actors, and the use of digital records as a basis for evidence. Accordingly, this research is important for formulating a legal framework that positions blockchain as an instrument to bridge the state's constitutional obligations, the protection of Muslim consumers, and the need for traceability within global supply chains.

Islami and Rozi, in their article published in *KRTHA BHAYANGKARA*, focus on the legal standing of blockchain-based halal certificates as legal evidence and find that the transparency and decentralized nature of blockchain have the potential to strengthen the authenticity of halal information. However, adequate technical guidelines regarding its verification mechanisms are not yet available (Islami & Putra Rozi, 2026). Karyani et al., in the *Journal of Islamic Marketing*, examine consumer intention and regulatory readiness using quantitative and qualitative approaches. Their findings indicate consumer acceptance of the technology and support from BPJPH; however, Halal Inspection Institutions (LPH) are not yet operationally prepared to implement it (Karyani et al., 2024). Albert Tan et al., in the *International Journal of Logistics Research and Applications*, identify challenges in halal food traceability in Malaysia and propose a blockchain framework based on smart contracts that integrates halal processes with technology to enhance traceability from farm to fork. However, the study focuses more

on supply chain design and management than on comparative legal analysis (Tan et al., 2022). The limitations of previous studies indicate that there has been no comprehensive study that simultaneously assesses the legal status of blockchain within halal traceability systems and compares its regulatory design within the legal frameworks of Indonesia and Malaysia, particularly in relation to the protection of Muslim consumers' rights and the integrity of cross-border supply chains.

The novelty of this research lies in de'eloping a comparative legal analysis that positions blockchain not merely as a traceability technology or digital evidentiary tool, but as a legal instrument for strengthening the protection of Muslim consumers' rights within the halal certification systems of Indonesia and Malaysia. Unlike previous studies that focus on evidentiary validity, adoption intentions, or technical supply chain design, this research connects technological aspects with certification authority, legal certainty, consumer protection, and the integrity of cross-border supply chains. This research aims to analyze the legal status and integration of blockchain within halal certification traceability systems under the legal frameworks of Indonesia and Malaysia. In addition, this research seeks to formulate a reconstruction of a blockchain-based halal traceability regulatory model capable of ensuring legal certainty, the protection of Muslim consumers, and the integrity of cross-border halal supply chains.

This research constitutes normative legal research that analyzes the legal status and integration of blockchain technology within halal certification traceability systems in Indonesia and Malaysia (Masnun, Muh. Ali, Prasetyo, Dicky Eko, 2025). The research employs a comparative approach to identify the regulations, institutional structures, and halal traceability mechanisms in both countries, as well as a conceptual approach to analyze the concepts of traceability, halal certification, Muslim consumer protection, legal certainty, and blockchain from a legal perspective. Primary legal materials include the Constitution of the Republic of Indonesia of 1945, Law Number 33 of 2014 concerning Halal Product Assurance and its implementing

regulations, Law Number 8 of 1999 concerning Consumer Protection, Malaysia's Trade Descriptions Act 2011, Trade Descriptions (Definition of Halal) Order 2011, Consumer Protection Act 1999, as well as relevant regulations concerning electronic information and transactions in both countries. Secondary legal materials consist of legal journals, books, scholarly articles, and previous studies. Non-legal materials are used to a limited extent and include policy reports, institutional documents, and technical publications concerning blockchain implementation and halal traceability systems. Legal materials are collected through library research and subsequently processed through inventory, classification, and systematization based on their relevance and hierarchy within the legal sources. The analysis is conducted qualitatively using descriptive-analytical and prescriptive methods to compare the legal frameworks of Indonesia and Malaysia, identify regulatory gaps, and formulate a blockchain-based halal traceability regulatory model that provides legal certainty and protection for Muslim consumers

B. RESULT AND DISCUSSION

1. Legal Status and Integration of Blockchain Technology in the Halal Assurance Systems of Indonesia and Malaysia

The legal status of blockchain technology within halal certification traceability systems cannot be reduced to a merely technical or administrative issue. Rather, it must be understood as part of the restructuring of the state's legal architecture to fulfill its constitutional obligations concerning freedom of religion. The fundamental question is whether this distributed technology is capable of functioning as an instrument of legal certainty for the protection of Muslim consumers amid the complexity of modern cross-border supply chains. The structural weaknesses of conventional certification systems, which rely on documentation and manual oversight, create opportunities for label forgery, cross-contamination, and information asymmetry that may undermine consumer rights (Sulistiyowati, Eny, Muh. Ali Masnun, 2025). Accordingly, the integration of blockchain requires a reassessment of verification, evidentiary, and law enforcement mechanisms within the halal product assurance regime. Indonesia has established its

halal traceability system on the normative foundation set forth in Article 1 point 4 of Law Number 33 of 2014 concerning Halal Product Assurance (Halal Product Assurance Law). This provision encompasses a series of activities beginning with the provision of materials, processing, storage, packaging, distribution, and sale, through to the presentation of products.

Therefore, from a legal perspective, halal integrity is not merely attached to the final product. Article 4 of the Halal Product Assurance Law requires halal certification for all products circulating within the territory of Indonesia, with further technical provisions regulated through Government Regulation Number 39 of 2021, which was subsequently amended by Government Regulation Number 42 of 2024 concerning the Implementation of Halal Product Assurance (JPH). Traceability within this normative framework is institutional in nature, with the Halal Product Assurance Organizing Agency (BPJPH) serving as the primary institution responsible for verifying the Halal Product Process (PPH) based on the examination results of Halal Inspection Institutions (LPH) and the determination of halal status by the Indonesian Ulema Council (MUI) (Anindya Prasetyanti et al., 2025). Consequently, this normative framework must be supported by the system's capacity to maintain the integrity of information from upstream to downstream.

The integration of blockchain into the halal traceability system transforms the legal object of conventional certification, which was previously embodied in physical documents or static PDF files, into encrypted digital data in the form of cryptographic hashes or specialized digital tokens, such as Halal Non-Fungible Tokens (NFTs) (Aysan & Syarif, 2025). Each certificate issued by BPJPH is processed to generate a hash code representing the identity of the producer, the composition of the raw materials, and the certificate's validity period (Susanty et al., 2024). When products or raw materials move along the Halal Product Process (PPH) supply chain, this hash data is recorded in a distributed digital ledger that is immutable (Karaduman & Gülhas, 2025), so that every change or transfer is permanently recorded and can be traced by all stakeholders. The substantive legal certainty generated thereby goes beyond the conventional standards of consumer information protection provided under Article 4 letter c of Law Number 8 of 1999 concerning Consumer Protection (Consumer Protection Law), as consumers are not only

entitled to accurate information but also have access to an independent mechanism for verifying the accuracy of such information. The immutable nature of blockchain thus shifts the burden of proving halal status from subjective reliance on the issuing authority to objective verification that can be performed by anyone with access to the network.

The real-time audit mechanism in the Indonesian system is implemented through the execution of Smart Contracts, namely automated contractual programming code embedded within the blockchain network to perform compliance verification instantaneously (van Groesen & Pauwels, 2022). When raw materials move from upstream suppliers to downstream manufacturers, the Smart Contract automatically matches the halal hash of the materials against the registered certification database. If any discrepancy or indication of unauthorized data alteration is detected, the transaction is rejected, and the product status is locked as non-traceable (Usama et al., 2026). This function can reduce reliance on manual inspections and narrow the information asymmetry that has traditionally arisen among producers, distributors, regulators, and consumers. However, the term “legal automation” should be understood in a limited sense, as algorithmic decisions cannot replace the legal and religious assessments underlying halal determinations. Therefore, smart contracts should function as compliance and early-warning mechanisms within an oversight structure that remains under the control of legitimate authorities.

Indonesia supports the paradigm shift from a trust-based system toward real-time verification through the development of the SIHALAL 4.0 architecture, which is built on a microservices-based approach and provides a Node API that can be accessed directly by Internet of Things (IoT) devices operated by businesses. (De Oliveira et al., 2026). Devices such as temperature-monitoring sensors in cold-chain logistics and automated scanners in storage warehouses enable the integration of physical field data into the state’s digital ledger without manual intervention that may be susceptible to manipulation (Pajić et al., 2024). This connectivity reduces the risk of human error or intentional data falsification during the documentation process, as sensor readings are recorded directly and verified against the blockchain without human intermediaries. By facilitating machine-to-machine verification, the state establishes a technical

and legal ecosystem that supports the dynamic enforcement of halal integrity across diverse logistics environments. Strengthening the evidentiary value of automatically recorded data is a logical consequence of a continuous chain of custody that can be independently audited by all relevant stakeholders.

These implementation issues cannot be separated from the legal politics of halal product assurance in Indonesia. The First Principle of Pancasila and Article 29 paragraph (2) of the 1945 Constitution direct the digitalization of SIHALAL as a state-led, top-down project. This characteristic provides uniformity of standards because the infrastructure and verification authority operate within the state's institutional framework (Ernawati et al., 2024). However, this approach must also take into account the concept of legal culture as explained by Lawrence M. Friedman, as the effectiveness of law is determined not only by its legal structure and substance but also by society's attitudes toward the law (Naufal & May Syifa, 2026). Indonesian society and business actors remain characterized by a paternalistic-religious orientation; therefore, the implementation of blockchain should not completely depoliticize the authority of religious scholars. Blockchain's algorithmic validation must continue to reflect the digital record of MUI fatwas as a source of social legitimacy, rather than merely constituting an automated decision generated by computer code.

The implementation of blockchain in Indonesia remains partial and limited to the administrative pilot-project stage. From a legal perspective, the main obstacle lies in the absence of regulations recognizing blockchain data as independent primary evidence in consumer protection proceedings, as its legal status remains equated with ordinary electronic information under the Electronic Information and Transactions Law (ITE Law). The absence of such a provision means that data recorded on the blockchain lacks clearly defined evidentiary force in courts or administrative dispute-resolution processes, thereby reducing the deterrent effect and legal certainty for business actors who violate applicable requirements. Operational costs associated with maintaining network nodes and the low level of digital literacy among micro and small business operators also constitute significant obstacles to widespread adoption

(Rujitoningtyas et al., 2025). From the perspective of Nonet and Selznick's theory of responsive law, the gap between regulatory ambitions and upstream-to-downstream operational capacity reflects a failure of the legal system to adapt its legal instruments to the actual socioeconomic conditions of society (Masnun et al., 2025).

. Malaysia regulates its halal certification system through Sections 28 and 29 of the Trade Descriptions Act 2011, which designate the Department of Islamic Development Malaysia (JAKIM) and State Islamic Religious Councils as the sole competent authorities (Abu-Hussin et al., 2026). The technical provisions concerning supply chain compliance are further strengthened by the Trade Descriptions (Definition of Halal) Order 2011, which prohibits unilateral halal declarations (self-declaration) and imposes criminal sanctions for violations. Unlike Indonesia's multi-institutional collaborative model, Malaysia's normative traceability system is characterized by a centralized, single-authority structure, in which the technical production standards under Malaysian Standard MS 1500 are directly supervised and enforced through the federal bureaucratic structure (Hazahari & Mohd Noor, 2026). This model offers advantages in terms of uniformity and enforcement efficiency, but it also creates systemic vulnerabilities because the concentration of authority within a single institution limits oversight capacity over highly complex global supply chains. These vulnerabilities become increasingly apparent when foreign certification documents must be verified without adequate physical oversight mechanisms at critical points within international supply chains.

The legal object of traceability in Malaysia focuses on monitoring the validity of import and international logistics documentation, as the country's high dependence on global supply chains requires rigorous verification of certificates issued by foreign certification bodies (Ahmad et al., 2025). The integration of blockchain incorporates halal certificates issued by Foreign Halal Certification Bodies (FHCBS) recognized by JAKIM into an immutable cryptographic ledger (Zainuldin et al., 2025), so that every incoming document is permanently recorded and can be verified by customs officers. Recording these legal objects on the blockchain strengthens the

functional application of the Trade Descriptions Act 2011, which categorizes the use of false or misleading halal labels as a misleading trade description subject to severe criminal sanctions. However, the implementation of blockchain is limited to entry points at ports (Ahmad et al., 2025), so that the monitoring of goods after passing through customs still relies on conventional systems that are vulnerable to manipulation. This approach reflects Malaysia's prioritization of international trade law enforcement and the protection of the commercial ecosystem, but it has not yet fully addressed consumer protection at the retail and end-consumption levels.

Real-time auditing through Smart Contracts in Malaysia is projected to address the spatial limitations of oversight at customs entry points, whereby the system automatically cross-verifies the data hash transmitted by the FHCB from the exporting country (Khairi et al., 2025). When a container of imported food products arrives at a Malaysian port, the Smart Contract verifies the consistency of logistics data, such as the transit route, batch number, and storage conditions during shipment (George & Al-Ansari, 2023). If any discrepancy is detected, such as a transit route passing through an unverified non-Muslim port or a mismatch in the batch number, the Smart Contract will send a rejection signal to the customs system and prevent the physical printing of the halal logo (Hazahari & Mohd Noor, 2026). The product is deemed legally defective in terms of traceability, causing the goods to be detained and preventing them from entering the domestic distribution chain. This mechanism creates a technological gateway that strengthens border oversight; however, its effectiveness depends heavily on the technical readiness and integrity of certification bodies in the country of origin, which may not have adopted the same blockchain standards.

The shift toward automated traceability in Malaysia is supported by the national digital system, MYeHALAL, which has implemented the use of electronic certificates comprehensively. JAKIM facilitates blockchain integration by providing access to a dedicated Node API connected to the digital infrastructure within the Halal Malaysia Industrial Parks (HALMAS) (Hassan & Fernando, 2026). This enables IoT devices, such as radio-frequency identification (RFID) tags and QR codes attached to international logistics packaging, to be read in real time and directly

connected to the federal monitoring database (Kumari & Gaikwad, 2025). This connectivity creates a standardized technical ecosystem for monitoring designated halal industrial areas and establishes a closed system for domestic and foreign producers operating within these industrial parks. Nevertheless, parameters such as transit routes cannot automatically be treated as evidence of non-halal status without a clear legal and Sharia basis. Therefore, smart contracts should be designed to detect risks and trigger inspections rather than assume the authority to determine halal status.

The legal politics of halal certification in Malaysia are closely tied to the position of Islam under Articles 3 and 11 of the Federal Constitution, which place Islam as the religion of the Federation under the constitutional framework involving the Conference of Rulers and require any new technological policy to remain subject to the principles governing the religious authority of the state (Croissant, 2022). The Global Halal Summit 2024 directives emphasize that the adoption of digital innovation must not undermine the legitimate public religious authorities. The sociocultural challenge that arises is the tension between the philosophy of blockchain, which promotes distributed trust, and Malaysia's legal culture, which relies heavily on trust in centralized authority through JAKIM (Mohd Zain & Zakaria, 2022). The Malaysian government positions technology as a tool for strengthening sovereignty rather than as a means of transferring authority to decentralized private systems that are not subject to state control. Therefore, every innovation must be integrated into a hierarchical framework that continues to place JAKIM as the final authority in determining halal status, while blockchain functions as a supporting verification instrument.

The limitations of Malaysia's conventional model are evident in the 2020 meat cartel scandal, which involved alleged document falsification and misrepresentation of halal status within international supply chains, resulting in significant harm to Muslim consumers (Mohd Soffian Lee et al., 2023). The case prompted JAKIM to pilot blockchain technology; however, its implementation remains highly conservative and dualistic, with the use of the technology limited to monitoring foreign halal certificates. On the other hand, physical upstream-to-downstream

supply chain tracking innovations have developed more aggressively in the private sector through initiatives such as the Halal Blockchain Network (Giap et al., 2026), without formal recognition or an interoperability framework established by the state. The absence of a formal and binding legal framework to accommodate these private-sector initiatives creates a risk of fragmentation in digital traceability standards. The state must shift from a passive to a responsive position by establishing regulations that recognize and integrate private-sector innovations into the national system in order to prevent duplication, inconsistency, and potential regulatory arbitrage

Table 1

Regulatory and Implementation Models of Blockchain-Based Traceability in the Halal Systems of Indonesia and Malaysia

Dimension	Indonesia	Malaysia
Legal Basis for Traceability	Law No. 33/2014 in conjunction with Government Regulation No. 39/2021 and Government Regulation No. 42/2024 (based on the concept of the Halal Product Process/PPH)	<i>Trade Descriptions Act 2011 in conjunction with the 2011 Orders (based on the concepts of certification and marking)</i>
Digital Legal Object	Conventional certificates are transformed into Cryptographic Hash / Halal NFT formats within the ledger	International certificates (FHCBs) and logistics documents are transformed into Immutable Ledger data for cross-border transactions
Real-Time Audit (Smart Contracts)	Automated rejection of transactions when the raw material hash does not match the data recorded by LPH/MUI at the PPH level	Automated customs flagging when international logistics routes or FHCB documents contain discrepancies
State Facilities & Infrastructure	SIHALAL 4.0 (microservices) provides a Node API for IoT sensors operated by upstream-to-downstream business actors	MYeHALAL (e-Cert) is integrated via a Node API with the digital infrastructure of the HALMAS industrial areassan industri HALMAS

Challenges & Limitations to Effectiveness	Implementation remains limited to administrative trials; the legal status of blockchain data has not yet been recognized as primary evidence under the ITE Law	A conservative state-led approach; risk of fragmentation in standards due to physical blockchain initiatives being predominantly driven by the private sector
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Sources: Author, 2026

The comparison of the two countries demonstrates that the differences lie not merely in the technologies employed, but also in how those technologies are positioned within the respective legal architectures. Indonesia adopts a top-down and state-led integration under a single SIHALAL platform, with the objective of fulfilling consumer rights as a positive obligation of the state under Article 29 paragraph (2) of the 1945 Constitution. However, its implementation remains constrained by partial administrative traceability. Malaysia, by contrast, has developed a dualistic integration model characterized by JAKIM's cautious approach in the public sector and the more aggressive involvement of the private sector, with an emphasis on trade law enforcement and federal religious sovereignty based on Article 3 of the Federal Constitution. The implication of these differences is that Indonesia faces the risk of systemic inertia resulting from rigid bureaucratic control and low levels of digital literacy among small business operators, while Malaysia faces the risk of regulatory fragmentation due to private-sector initiatives that are not fully coordinated with public policy. Both countries also share a similar weakness, namely the absence of explicit regulations granting blockchain data full evidentiary status as primary evidence in judicial proceedings and consumer dispute resolution. The underlying difference lies in the constitutional position of religion in each country: Indonesia places religion within the framework of the guarantee of individual freedom, whereas Malaysia places it within a framework of collective sovereignty vested in royal and federal institutions.

The comparison between Indonesia and Malaysia confirms that blockchain-based halal traceability has not yet fully matured as a human rights framework in the practice of either

country, although its potential to strengthen Muslim consumers' rights to information and religious certainty is conceptually undeniable. Such maturity can only be achieved if the state does not treat blockchain merely as an instrument for improving the efficiency of certification bureaucracy, but explicitly integrates it into the constitutional framework for the protection of freedom of religion. Accordingly, technological traceability and human rights traceability can operate as an integrated system that mutually reinforces one another, rather than as two separate domains that merely happen to intersect

2. The Reconstruction of a Functional Harmonization Model for the Legal Regulation of Blockchain-Based Halal Traceability

The need to reconstruct the legal "frame'ork for blockchain-based halal traceability arises from the question of how technology should be positioned within a framework for protecting rights that possess a collective dimension. The rights to information, consumer protection, and the freedom to practice religious beliefs extend beyond individual interests because they are related to the reliability of systems used by society at large (Anis Mashdurohatun, 2026). In this context, blockchain can be understood as an instrument that supports the fulfillment of consumer rights through transparent, auditable, and relatively tamper-resistant record-keeping. Legal reconstruction is not intended to establish an entirely new regulatory regime, but rather to organize the relationship between existing legal norms and the characteristics of distributed ledger technology so that the technology is assigned a clear function within the legal system. This orientation is important to ensure that digitalization does not stop at administrative efficiency, but becomes part of the state's positive obligation to guarantee legal certainty and the integrity of cross-border halal supply chains.

In Indonesia, the issue lies in the lack of clarity regarding the legal status of blockchain data as evidence within the halal product assurance ecosystem. Government Regulation Number 39 of 2021 and Government Regulation Number 42 of 2024 do not yet provide specific provisions

concerning the evidentiary value of data stored on a distributed ledger. Although Article 5 paragraph (1) of Law Number 11 of 2008 concerning Electronic Information and Transactions, as amended by Law Number 1 of 2024, recognizes Electronic Information and Electronic Documents as valid legal evidence, this recognition remains general in nature. Reconstruction should therefore be undertaken by explicitly integrating the relevant norms into sector-specific halal product assurance regulations, given that blockchain data possesses technical characteristics that distinguish it from ordinary electronic documents, particularly with regard to hashes, timestamps, consensus mechanisms, and data modification trails (Chaudhary et al., 2026). From the perspective of Gustav Radbruch's theory of legal certainty, clarifying this legal status is necessary to ensure that consumers and business actors are not confronted with legal uncertainty (Priyono et al., 2026) when cryptographic records are used to establish the integrity of a product's halal status.

The legal problem, therefore, is not simply whether blockchain data can be admitted as electronic evidence, but whether the existing evidentiary framework is capable of recognizing the distinctive function of blockchain in establishing the continuity and integrity of halal information. Ordinary electronic documents generally establish the existence of information at a particular point in time, whereas blockchain-based records are designed to establish a continuing chain of data entries across multiple stages of a transaction or supply chain. The distinction is legally significant because halal integrity is not exhausted by the validity of a certificate at the moment of issuance; it depends upon whether the material, processing, storage, transportation, and distribution processes remain consistent with the certified status throughout the product lifecycle. This creates a normative distinction between evidentiary validity and evidentiary functionality. The recognition of blockchain data as electronic evidence may satisfy the first requirement, but it does not necessarily establish the second. A legal system may formally recognize digital records while remaining unable to determine which data attributes—such as timestamps, hash values, node authentication, access logs, or consensus records—should be considered relevant when determining the integrity of halal status (Ziaya et al., 2026). Consequently, the reconstruction

required in Indonesia should not merely elevate blockchain data to the category of primary evidence, but should establish a specific evidentiary framework that defines authentication, chain of custody, attribution, and verification procedures for blockchain-generated halal records.

This distinction strengthens the legal certainty argument because certainty in a digital regulatory environment requires more than recognizing the existence of electronic evidence; it requires predictability concerning how such evidence will be authenticated, assessed, challenged, and relied upon by administrative authorities and courts. In this sense, the reconstruction of blockchain regulation should transform technological characteristics into legally recognizable evidentiary attributes rather than allowing technological immutability to be treated as an automatic guarantee of legal truth. Institutional reconstruction in Indonesia requires a paradigm shift in BPJPH's position from that of a centralized sole data owner to an authoritative node operator within a distributed private-consortium blockchain network. This architecture would integrate BPJPH, Halal Inspection Institutions (LPH), the Indonesian Ulema Council (MUI), and customs authorities without undermining the function of religious fatwas. This open institutional structure is consistent with the principle of interoperability established under OIC/SMIIC 17-1:2020 on Halal Supply Chain Management Systems, which emphasizes the importance of systematic and integrated supply chain management (Ahmad Fadil et al., 2026). From the perspective of administrative law, this reorientation expands the state's capacity to monitor product integrity from upstream to downstream, as each institution has access to the same data and can conduct independent verification. This expansion of oversight capacity constitutes a form of fulfillment of the state's positive obligation to provide a reliable and transparent system for the protection of public rights.

However, decentralizing the technical infrastructure does not necessarily mean decentralizing legal authority (Widodo et al., 2024). This distinction is essential to the proposed institutional reconstruction. Blockchain may distribute the storage and verification of data among multiple nodes, but the authority to determine the legal and religious status of a product must remain attributable to legally recognized institutions. Accordingly, the proposed consortium

architecture should be understood as a distribution of verification functions rather than a distribution of sovereign regulatory authority. The legal consequence is that each node should possess a clearly defined institutional responsibility. BPJPH would retain regulatory and certification authority; LPH would contribute inspection and verification data; MUI would retain its religious-legal function in determining halal status; customs authorities would verify relevant cross-border movements; while private-sector actors would be responsible for the accuracy and continuity of data generated within their respective operational stages. Such allocation is necessary to prevent a central problem of blockchain governance: the possibility that technological decentralization produces uncertainty concerning who is legally responsible when erroneous or fraudulent data enter the ledger.

Therefore, interoperability should be accompanied by institutional accountability. Shared access to data cannot itself constitute accountability unless the legal system establishes attribution of responsibility, auditability of each institutional intervention, and mechanisms for correcting or challenging erroneous records (Susanty et al., 2026). The reconstruction of BPJPH as an authoritative node should consequently be accompanied by rules concerning data governance, institutional authentication, correction procedures, and legal liability. In this configuration, blockchain does not replace administrative authority but makes the exercise of that authority more transparent, traceable, and contestable.

Reconstruction is not limited to the normative and institutional aspects of the blockchain system, but also extends to consumer rights. The protection of consumer rights within the Indonesian legal framework can be reconstructed by expanding the right to information stipulated in Article 4 letter c of the Consumer Protection Law, from merely the right to receive information to the right to independently verify such information. The ideal model proposed is to impose a legal obligation on the state to provide an API-based public verification portal directly connected to the SIHALAL 4.0 infrastructure, enabling consumers to cross-verify product data hashes without intermediaries. This right to independent verification is consistent with the right to information universally guaranteed by Article 19 of the Universal Declaration of Human Rights

and Article 19 of the International Covenant on Civil and Political Rights, concerning the freedom to seek, receive, and impart information. With public access to blockchain data, Muslim consumers would no longer have to rely solely on unilateral representations by producers or certification documents accessible only to authorities, but could independently verify the halal status of the products they consume. This shift from a trust-based to a verification-based model transforms the legal relationship between producers, the state, and consumers, as consumers are positioned as active subjects within the oversight system rather than merely passive objects of protection (Vern et al., 2025).

Nevertheless, the recognition of a right to independently verify must not be equated with unrestricted public access to all information contained within the blockchain. A legally sustainable verification model must distinguish between information necessary to verify halal status and information that may contain confidential commercial information or personal data. The reconstruction of consumer rights therefore requires a principle of selective transparency, under which consumers receive sufficient information to verify the legality and integrity of halal status without obtaining unrestricted access to commercially or personally sensitive data. This limitation does not weaken the right to information; rather, it defines its lawful scope in a digital environment. The legal objective is not maximum disclosure but meaningful verifiability (Heikal et al., 2024). A consumer should be able to determine whether a certificate is valid, whether the relevant product corresponds to the certified production chain, and whether the certification remains valid at the time of purchase. The state therefore has to design the verification architecture around the information necessary for these determinations. The proposed right to independent verification consequently represents a qualitative transformation of consumer protection. Traditional consumer protection operates largely through ex post remedies after misleading information has caused harm. A blockchain-based verification model introduces an ex ante dimension by enabling consumers to assess the reliability of information before making consumption decisions. The reconstruction therefore shifts consumer protection from a predominantly remedial model toward a preventive and participatory model.

Philosophically, the reconstruction of halal product assurance in Indonesia positions blockchain integration as an operational manifestation of Article 29 paragraph (2) of the 1945 Constitution concerning the guarantee of freedom of worship, which directly intersects with Article 18 of the International Covenant on Civil and Political Rights concerning the right to freedom of thought, conscience, and religion, including the freedom to practice one's religion or belief in practical activities. This doctrine of public law is substantively reinforced by the concept of *maqasid al-shariah* formulated by Imam Abu Ishaq al-Shatibi, particularly the principle of *hifz al-din* (protection of religion), which falls within the category of the five essential necessities (*al-dharuriyyat al-khams*) (Azis et al., 2024). Under the framework of Article 18 of the ICCPR, the state bears a positive obligation to actively establish a reliable oversight ecosystem to protect its citizens from fraudulent labeling that undermines their spiritual beliefs. Technological traceability is therefore positioned as an instrument for fulfilling the state's constitutional human rights obligations, because without a reliable verification system, the guarantee of freedom of religion lacks substantive application in the realm of everyday consumption. The integration of the *maqasid al-shariah* concept with the international human rights framework demonstrates that the protection of Muslim consumers is not merely a technical issue, but rather part of the fulfillment of fundamental rights that are both universal and constitutional (Pehin Dato Musa et al., 2025).

The human rights dimension, however, should not be understood as requiring the state to guarantee that every product consumed by a Muslim individual will necessarily conform to that individual's religious expectations. Rather, the state's positive obligation concerns the establishment of a reliable legal and institutional environment in which religiously relevant information can be authenticated and accessed. This distinction is important because it prevents the human rights argument from transforming technological traceability into an absolute guarantee of substantive outcomes. Accordingly, blockchain should be positioned as an institutional means rather than as the source of halal legitimacy itself. The legitimacy of halal status continues to derive from the applicable legal and religious framework, while blockchain strengthens the capacity of the state and consumers to verify whether the relevant factual

conditions correspond to that legally recognized status. The technology therefore performs an evidentiary and governance function, not a constitutive religious function (Karia, 2025).

In Malaysia, legal reconstruction is directed toward addressing the legal gap concerning the status of blockchain data in the enforcement of Islamic trade regulations. Although Section 90A of the Evidence Act 1950 and the Electronic Commerce Act 2006 provide general recognition of computer-generated documents, the Trade Descriptions (Certification and Marking of Halal) Order 2011 does not yet expressly recognize decentralized cryptographic codes as official marking instruments. The explicit codification of blockchain data into the Trade Descriptions Act 2011 (Act 730) is necessary to ensure that digital supply chain records possess full probative value, thereby enabling private-sector technological initiatives such as the Halal Blockchain Network to be accommodated and provided with a clear legal basis for recognition in court. From Radbruch's perspective, such clarity in sector-specific norms is essential to eliminate legal ambiguity (Sofiani et al., 2026) which currently encompasses private-sector technological initiatives, while also protecting the reliability of commercial information that forms the basis for decisions made by consumers and business actors.

Institutional reconstruction in Malaysia requires a transition from centralized bureaucratic control toward a co-regulatory model through the establishment of regulatory sandbox regulations by the Department of Islamic Development Malaysia (JAKIM). A regulatory sandbox mechanism would allow platforms such as MasChain and Marakat Ecosystem to be gradually integrated into the MYeHALAL system while remaining under JAKIM's supervision and authorization. The theory of smart regulation developed by Neil Gunningham and Peter Grabosky demonstrates that the efficiency of international supply chain oversight can be enhanced through a layered combination of mechanisms (Migone & Howlett, 2024) between state law enforcement authorities and the transparency of private-sector market data. This co-regulatory model maintains JAKIM's hierarchical position as the holder of the prerogative to conduct final certification validation in accordance with Article 3 of the Federal Constitution, thereby ensuring that the state's religious sovereignty is not undermined by technological decentralization. Accordingly,

institutional reorientation does not eliminate the central role of religious authorities, but rather expands the scope of their oversight through the utilization of digital infrastructure jointly managed with the private sector.

Consumer protection in Malaysia can be strengthened by reconstructing the Consumer Protection Act 1999 to require the integration of cryptographic digital identifiers into the packaging labels of all traded products (Akram et al., 2025), so that the right to authentic information no longer depends solely on producers' claims. This mandatory standardization policy requires legal synchronization with Malaysian Standard MS 1500:2019, which adopts the transnational OIC/SMIIC 1:2019 standard concerning General Requirements for Halal Food. Through legal harmonization, the traceability requirements established under these international standards would acquire the force of domestic criminal law enforcement through the Trade Descriptions Act 2011, which categorizes violations as misleading trade descriptions. This measure ensures the fulfillment of consumers' rights to obtain authentic information, which substantively rests upon the right to information recognized under Article 19 of the Universal Declaration of Human Rights. With cryptographic digital identifiers, consumers gain a concrete technical verification tool to avoid misleading trade description practices .

The philosophical reconstruction In Malaysia emphasizes that the implementation of cross-border blockchain serves to extend JAKIM's capacity to safeguard the integrity of Sharia principles mandated by the Conference of Rulers under Article 3 of the Federal Constitution, without transferring religious authority to decentralized private systems. Although Malaysia has not ratified the ICCPR, the protection of citizens' freedom of religion is regulated domestically through Article 11 of the Federal Constitution, which guarantees freedom of religion within the limits prescribed by law. To safeguard the integrity of international supply chains, Malaysia needs to adopt the concept of a transnational positive obligation of the state through mutual recognition mechanisms, with reference to the OIC/SMIIC 2:2019 standard concerning halal certification bodies requirements. Interconnection among blockchain nodes across countries would enable real-time cross-verification of import documents (Tyagi & Goyal, 2023) with partner countries

such as Indonesia, thereby enabling potential falsification of foreign certificates to be detected before products enter the domestic market. Based on Alan Watson's theory of legal transplants, the adoption of these transnational instruments should be designed within the constraints of a mixed legal system (Trikoz & Gulyaeva, 2023) Malaysia, which has inherited elements of Islamic, customary, and colonial legal traditions, can therefore adopt such technologies without eroding the sovereignty of Islamic law, but rather by strengthening its capacity to enforce consumer rights extraterritorially.

The reconstruction of the legal regulatory model in Indonesia and Malaysia demonstrates that legal certainty, the protection of Muslim consumers, and the integrity of cross-border supply chains require a legal framework that legitimizes blockchain technology as an operational instrument for fulfilling state obligations. The ideal model is not regulatory unification that standardizes the legal systems of the two countries, but functional harmonization that respects the institutional characteristics of each jurisdiction while remaining grounded in international human rights principles. Indonesia, through the constitutional framework of Article 29 paragraph (2) of the 1945 Constitution, and Malaysia, through Articles 3 and 11 of the Federal Constitution, can position blockchain-based traceability as a form of fulfillment of the state's positive obligation, grounded in the framework of Articles 18 and 19 of the International Covenant on Civil and Political Rights and the Universal Declaration of Human Rights. The differing approaches of state-led integration in Indonesia and co-regulation in Malaysia reflect differences in constitutional structures and legal cultures; nevertheless, both are moving toward recognition of consumers' rights to independently verify the halal status of products. Technological traceability thus evolves into an instrument for the enforcement of human rights, guaranteeing consumers' rights to information that is accurate, transparent, valid, and independently auditable, so that the protection of Muslim consumers no longer

depends solely on producers' unilateral representations or the limitations of manual state oversight.

C. CONCLUSION

The Blockchain-based halal traceability systems in Indonesia and Malaysia continue to face regulatory gaps, as the positive law of both countries has not yet specifically and fully established the evidentiary status of decentralized cryptographic data as primary evidence. Indonesia continues to rely on the administratively oriented SIHALAL system, while Malaysia, through JAKIM, maintains a relatively conservative public-sector approach. This condition demonstrates that blockchain integration should be positioned as part of the state's positive obligation to guarantee Muslim consumers' right to authentic information and support their freedom to practice their religious beliefs, rather than merely as a technological innovation.

The reconstruction of the legal framework In Indonesia should be directed toward synchronizing Law Number 1 of 2024 concerning the Second Amendment to the ITE Law, recognizing the legal status of blockchain data within evidentiary mechanisms, strengthening BPJPH as an authoritative node, providing public verification access, and integrating SIHALAL with customs and supply chain systems. Malaysia should develop co-regulation through a JAKIM regulatory sandbox, strengthen MYeHALAL, and establish mutual recognition mechanisms based on OIC/SMIIC standards. These differences demonstrate that regulatory harmonization cannot be achieved through institutional standardization, but must instead be developed through functional harmonization that preserves the legal characteristics of each country. This model positions blockchain as a verification instrument supporting the state's positive

obligations to guarantee legal certainty, protect Muslim consumers, and maintain the integrity of cross-border halal supply chains, without transferring the authority to determine halal status to technology.

Indonesian legislators and the government should clarify the legal status of blockchain data, establish authentication and interoperability standards, and integrate digital verification mechanisms into the halal product assurance system involving BPJPH, LPH, MUI, and relevant authorities. The Malaysian government, through JAKIM, should establish a co-regulatory framework that provides space for private-sector innovation, strengthen MYeHALAL integration, and develop cross-border recognition and verification mechanisms based on compatible halal standards. Future research should empirically examine the institutional readiness of business actors, consumers, and certification bodies in both countries, as well as examine electronic evidence, data protection, interoperability, and legal liability issues in order to develop a more operational blockchain regulatory model

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