

ARTIFICIAL INTELLIGENCE IN NOVEL FOOD INNOVATION: APPLICATIONS AND IMPLICATIONS FOR HALAL COMPLIANCE

^{1*} Noriah Ramli, ² Bilal Hussain

¹ Ahmad Ibrahim Kulliyah of Laws, International Islamic University Malaysia, Jalan Gombak, Kuala Lumpur, Malaysia

² Department of Law, University of Sialkot, Punjab, Pakistan.

*Correspondence:

Noriah Ramli

email: noriahr@iium.edu.my

History:

Received : 17.11.2025

Revised : 23.4.2026

Accepted : 29.4.2026

Published: 30.9.2026

Cite as:

Ramli, N., & Hussain, B. (2026). Artificial intelligence in novel food innovation: Applications and implications for halal compliance. *Journal of Fatwa Management and Research*, 31(3), 1–11. <https://doi.org/10.33102/jfatwa.vol.31no3.785>

Funding

This study is funded by [PRIGS [RMC,IIUM] under Grant Number [2025].

Abstract

Artificial intelligence (AI) supports the development of novel halal foods, including plant-based and cultivated alternatives, offering environmentally sustainable and cost-effective solutions to global food security challenges. While facilitating innovation and strengthening consumer trust, these advancements also raise significant ethical, regulatory, and religious concerns in Muslim contexts where compliance with Shari'ah principles is essential. This study aims to examine how AI-enabled food innovations can align with Shari'ah requirements while safeguarding halal integrity and consumer confidence. Employing a conceptual review methodology, the paper synthesizes Qur'anic and hadith-based principles with contemporary scholarly literature and regulatory frameworks on AI integration, halal certification, and novel food governance. The study addresses a critical research gap concerning the absence of comprehensive Shari'ah-based guidelines and harmonised regulatory standards for AI-driven novel foods, particularly in relation to certification, traceability, and consumer assurance. The analysis yields three key findings: (1) AI technologies enhance halal assurance systems through improved traceability, transparency, and risk management; (2) AI-enabled novel foods may be considered permissible under the concept of bid'ah hasanah (beneficial innovation) when their ingredients and production processes comply with established Shari'ah principles; and (3) inadequate regulatory oversight and the lack of standardised certification frameworks pose risks to halal integrity and may erode consumer trust. The study concludes that responsible integration of AI in novel food innovation requires coupling technological advancement with robust Islamic ethical governance and recommends the development of harmonised standards through collaboration among halal authorities, policymakers, and industry stakeholders.

Keywords: *Artificial Intelligence, Halal Assurance, Shari'ah Compliance, Novel Foods*



© The Author(s). This article is licensed under the Creative Commons Attribution 4.0 International License (CC BY 4.0). Reuse and adaptation are permitted, provided appropriate credit is given to the author(s) and source, a licence link is provided, and any changes made are indicated.

INTRODUCTION

Artificial intelligence (AI) is increasingly transforming the global food industry by enhancing efficiency, sustainability, and innovation across production, processing, and distribution systems. In the context of halal food, AI offers significant potential to strengthen halal assurance through improved traceability, data-driven decision-making, and the development of novel food products such as plant-based and cultivated alternatives. These advancements are particularly relevant to Muslim-majority countries like Malaysia, which aspires to remain a global leader in the halal economy through comprehensive regulatory frameworks, including the Malaysian Halal Standard MS1500:2019 and the Halal Certification Procedure Manual 2020 administered by the Department of Islamic Development Malaysia (JAKIM).

Despite these opportunities, the integration of AI into halal food innovation presents complex ethical, regulatory, and religious challenges. Novel foods generated or facilitated by AI such as cultured meat and plant-based products that mimic non-halal items raise questions regarding ingredient permissibility, processing methods, nomenclature, and the extent to which automated systems can support or replace human religious judgment. Incidents such as halal integrity breaches and the absence of harmonised international standards further highlight the need for robust governance mechanisms to maintain consumer trust and certification credibility.

While existing studies have examined AI applications in the food industry and the regulatory aspects of novel foods, there remains a significant research gap in the integration of *Sharī'ah* principles with technological and regulatory frameworks governing AI-enabled food innovations. Current literature lacks comprehensive guidance on how Islamic jurisprudential concepts such as *ḥalāl*, *ṭayyib*, *istiḥālah* (transformation), and *bid'ah ḥasanah* (beneficial innovation) can be systematically applied to assess the permissibility of AI-driven food technologies. Moreover, there is limited scholarly attention to the role of AI in reshaping halal certification processes and governance structures.

Problem Statement

The rapid adoption of AI in novel food development has outpaced the evolution of *Sharī'ah*-based guidelines and regulatory standards, creating uncertainty regarding halal compliance, certification integrity, and consumer confidence. Without a coherent framework that integrates Islamic ethical principles with technological governance, AI-enabled food innovations risk undermining the credibility of the halal ecosystem.

Aim and Purpose of the Study

This study aims to examine how AI-enabled food innovations can be aligned with *Sharī'ah* requirements while safeguarding halal integrity and consumer trust. Specifically, the research seeks to (i) synthesise Qur'ānic and ḥadīth-based principles with contemporary regulatory and technological literature, (ii) analyse the implications of AI for halal certification and governance, and (iii) propose a conceptual framework for the responsible integration of AI in halal food innovation.

LITERATURE REVIEW

Artificial Intelligence in the Food Industry

Artificial intelligence (AI) is transforming the global food industry by enhancing efficiency, safety, and sustainability across production and supply chain operations. Nawaz et al. (2025) emphasise that AI optimises logistics, reduces energy consumption, and improves food safety through predictive modelling and real-time monitoring. In addition to operational efficiency, AI supports quality assurance in food production. Balakrishnan et al. (2025) highlight the application of machine learning systems capable of detecting foreign substances and ensuring product safety. Similarly, the American Halal Foundation (2025) notes that AI streamlines operations from sourcing to distribution, thereby minimising risks and enhancing supply chain resilience. Despite these benefits, existing studies predominantly focus on technological and economic advantages, often overlooking the socio-religious dimensions of AI adoption in Muslim contexts.

AI in Halal Verification and Supply Chain Transparency

Halal verification has traditionally relied on human oversight through certification bodies such as the Department of Islamic Development Malaysia (JAKIM), the Islamic Religious Council of Singapore (MUIS), and the Emirates Authority for Standardization and Metrology (ESMA). Recent scholarship indicates a growing shift toward digitalisation, where AI technologies enhance transparency and integrity within halal supply chains. Nawaz et al. (2025) demonstrate how the integration of blockchain and the Internet of Things (IoT) can authenticate product origins and mitigate fraud risks. Al Shamsi (2025) further discusses QR code-based transparency models that enable consumers to verify halal status in real time. The Halal Food Council USA (2024) acknowledges that AI-driven systems can reduce reliance on manual audits and strengthen confidence in certification processes.

Sharī'ah Perspectives on Novel Foods

Novel foods such as cultured meat, plant-based pork, and insect proteins have generated significant academic and juristic debate. Chriki and Hocquette (2024) and Aljahsh (2025) suggest that cultured meat may be considered halal if the source animal is slaughtered according to *zabīḥah* requirements and the production process remains free from *ḥarām* substances. Conversely, plant-based products that mimic non-halal items particularly those labelled as pork remain contentious due to concerns related to imitation (*tashabbuh*) and potential consumer deception. Consumer perception studies further highlight acceptance challenges. Hamdan et al. (2023) report that Muslim consumers in Singapore exhibit reservations toward cultured meat due to perceptions of unnaturalness and uncertainty regarding certification, despite ongoing regulatory considerations by MUIS. These findings underscore the necessity of aligning technological innovation with both *Sharī'ah* principles and societal expectations.

Regulatory Frameworks Governing Halal and Novel Foods

Regulatory approaches to halal and novel foods vary significantly across jurisdictions, reflecting diverse legal and institutional frameworks. From the Malaysian perspective, the Malaysian Standard MS1500:2019 and the Halal Certification Procedure Manual (2020) serve as the primary benchmarks for ensuring halal compliance under the supervision of the

Department of Islamic Development Malaysia (JAKIM). Although these standards are not specifically designed to address novel foods or AI-enabled food innovations, they incorporate provisions relevant to such products. Notably, the guidelines restrict the certification of products bearing names that resemble *ḥarām* items such as pork even when the products are entirely plant-based. This provision aims to prevent consumer confusion and to safeguard the integrity and public perception of halal certification.

Indonesia's Halal Product Assurance Law (*Undang-Undang Jaminan Produk Halal*, UU JPH 2014, as amended in 2019) similarly mandates halal certification for all food products, including innovative and novel foods, although challenges in its implementation continue to persist.

At the international level, European Union Regulation (EU) 2015/2283 on Novel Foods establishes stringent pre-market authorisation procedures and comprehensive safety assessments to ensure consumer protection. In the United States, the Food and Drug Administration (FDA), in collaboration with the United States Department of Agriculture (USDA), has approved certain cultured meat products from a food safety perspective. These regulatory frameworks primarily emphasise scientific risk assessment and public health considerations. Consequently, both the European Union regulatory regime and the United States oversight mechanisms focus on the safety and quality of food products, without addressing their halal status or compliance with *Sharī'ah* requirements.

Islamic Ethical Principles Guiding Technological Innovation

Islamic ethical principles provide a normative foundation for evaluating AI-enabled food innovations. Zakaria and Shoid (2023) emphasise that concepts such as *isti'mār al-arḍ* (environmental stewardship) and *ḥifẓ al-naḥs* (preservation of life) align closely with the sustainability objectives of novel foods. The broader framework of *maqāṣid al-Sharī'ah* further offers guidance for balancing technological progress with social welfare and ethical responsibility. In addition, jurisprudential principles such as *istiḥālah* (transformation) and *al-ḍarar yuzāl* (the removal of harm) are essential for assessing the permissibility of AI-enabled novel foods within an Islamic legal context.

Despite the expanding body of scholarship on artificial intelligence (AI) in the food industry and halal studies, several critical gaps persist. Existing research predominantly emphasises the technical and economic benefits of AI, with limited integration of *Sharī'ah* jurisprudential principles in evaluating these innovations. Furthermore, there is minimal scholarly exploration of how AI-driven automation may reshape halal governance and certification processes, particularly concerning the authority, accountability, and integrity of existing certification bodies. Additionally, the scope of current regulatory frameworks across various jurisdictions including Malaysia's MS1500:2019, Indonesia's Halal Product Assurance Law (UU JPH 2014, as amended in 2019), the European Union Regulation (EU) 2015/2283 on Novel Foods, and recent approvals by the United States Food and Drug Administration (FDA) should be expanded to address the use of AI in the food and halal industries. Collectively, these gaps underscore the necessity for interdisciplinary research that integrates *Sharī'ah* jurisprudence, statutory law, and technological governance to safeguard halal authenticity and consumer trust in the era of AI-driven food production.

METHODOLOGY

The approach of this paper is conceptual with a focus on qualitative methods intended, by design, to connect Islamic jurisprudence to modern regulatory and technological transformations within AI-machine food production. It does so by drawing on primary and secondary sources, utilizing thematic content analysis to explore areas of intersection and conflict between *Shari'ah* ideologies against prevailing legal-administrative systems whenever is necessary.

The secondary sources are statutory law, regulations and academic writing in addition to journal articles. The study focuses on the Malaysian Standard MS1500:2019 and Halal Certification Procedure Manual (2020) in Malaysia, would be used as a benchmark since they are being adopted by JAKIM's certification regime. A chapter on comparative statutory systems includes a discussion of Indonesia's Halal Product Assurance Law (UU JPH 2014, amended 2019), the European Union's Regulation (EU) 2015/2283 on Novel Foods and approvals by the US Food and Drug Administration (FDA) for cultured meat in 2022–23. Administrative measures and reports on the industry, such as the World Halal Institute's 2025 blockchain halal permit pilot and State of the Global Islamic Economy Report (2024), offer supportive data that add some scope to economic and technological trends.

Limitations of the Methodology

While the conceptual qualitative approach adopted in this study provides valuable normative and theoretical insights into the integration of artificial intelligence (AI) within the halal food industry, several methodological limitations should be acknowledged. First, the study lacks empirical validation, as it does not incorporate primary data such as surveys, interviews, or experimental analyses. Consequently, the findings may not fully capture stakeholder perceptions, industry practices, or levels of consumer acceptance of AI-enabled halal foods. Second, the reliance on doctrinal interpretation of *Shari'ah* sources introduces the possibility of juristic subjectivity, given that scholars from different schools of thought may hold divergent opinions regarding the permissibility of novel food technologies. Third, although the research incorporates comparative regulatory perspectives from Malaysia, Indonesia, the European Union, and the United States, it does not aim to conduct an exhaustive comparative legal analysis of these jurisdictions; rather, the comparison is intended to provide contextual understanding of differing regulatory approaches. Finally, the case study component is limited in scope. The methodology is structured in three stages: initially, a textual analysis of primary *Shari'ah* sources is undertaken to identify guiding principles for evaluating technological innovations, particularly *istiḥālah* (transformation) and *bid'ah ḥasanah* (beneficial innovation). This is followed by a comparative review of relevant laws and regulations across selected jurisdictions to examine similarities and differences in the governance of AI-enabled foods. The third stage involves a case-based assessment of real-world halal fraud incidents, including Malaysia's meat cartel scandal (2020) and the United Kingdom's Helim Miah case (2025), to identify regulatory weaknesses and explore the potential of AI-driven safeguards.

Overall, this methodology combines doctrinal *Shari'ah* research with comparative regulatory analysis to develop a conceptual framework for the ethical governance of AI-implicated halal food production. This syncretic approach acknowledges both religious obligations and contemporary institutional contexts, enabling an assessment of whether AI-driven innovations can fulfil the objectives of *maqāṣid al-Shari'ah* while simultaneously upholding consumer confidence in the global halal market.

RESULTS AND DISCUSSION

Alignment of AI-Enabled Food Innovations with Sharī'ah Principles

The findings suggest that AI-enabled food innovations may be regarded as *Sharī'ah-compliant* when their development, deployment, and governance are aligned with the higher objectives of Islamic law (*maqāṣid al-Sharī'ah*). In particular, these innovations advance key principles such as the preservation of life (*ḥifẓ al-nafs*), environmental stewardship (*isti'mār al-arḍ*), and justice in resource distribution ('adl). AI-driven technologies contribute meaningfully to these objectives by minimising food waste, optimising resource utilisation, enhancing energy efficiency, and strengthening the sustainability of food supply chains. Such contributions resonate with the Qur'ānic prohibition against excess and wastefulness, as articulated in Qur'ān 7:31, (O children of Adam: take your adornment at every place of worship; and eat and drink, but commit not excess; God loves not the committers of excess), thereby situating technological advancement within a broader ethical and theological framework.

In relation to emerging food technologies, cultured meat presents a particularly nuanced case. Contemporary scholarly discourse indicates that its permissibility may be conditionally recognised, provided that the originating cells are derived from animals slaughtered in accordance with *zabīḥah* requirements and that the production process remains entirely free from *ḥarām* or *najis* elements. Within these parameters, AI serves not merely as a technical tool but as an enabler of ethically guided innovation, facilitating sustainable food production and enhancing food security in Muslim-majority contexts. Consequently, rather than undermining *Sharī'ah* principles, AI-integrated food systems—when properly regulated—can reinforce and operationalise the *maqāṣid al-Sharī'ah* in addressing contemporary global food challenges.

Risks to Halal Integrity and the Necessity of Human Oversight

Notwithstanding its transformative potential, the integration of AI in halal food production introduces significant risks to halal integrity, particularly when deployed without adequate regulatory and ethical safeguards. While AI systems offer efficiency, scalability, and data-driven precision, they inherently lack the capacity for *ijtihād* (independent juristic reasoning) and the contextual moral discernment required to evaluate compliance with complex *Sharī'ah* principles. Consequently, excessive reliance on automated processes may compromise critical dimensions of halal governance, including the verification of *zabīḥah* procedures, the authentication of ingredient purity, and the interpretation of divergent juristic opinions across schools of thought.

Moreover, the increasing prioritisation of profitability and operational efficiency within technologically driven food systems raises concerns regarding the erosion of ethical accountability. This may heighten the risk of halal fraud, misrepresentation, and procedural negligence, ultimately undermining consumer confidence in halal certification regimes. The Malaysian standard MS1500:2019 explicitly underscores the indispensable role of human oversight in preserving halal integrity, affirming that technological tools while valuable must remain subordinate to qualified religious authorities and regulatory bodies.

These concerns are further compounded by the complexities of globalised supply chains, where disparities in halal standards and enforcement mechanisms across jurisdictions create regulatory gaps and vulnerabilities. In this context, the integration of AI must be accompanied

by robust governance frameworks that harmonise technological innovation with human expertise, institutional accountability, and *Shari'ah*-based oversight. Such a balanced approach is essential to ensure that efficiency gains do not come at the expense of religious compliance, ethical integrity, and public trust.

AI as Bid'ah Hasanah: Ethical Innovation in Halal Governance

The study further indicates that AI-enabled innovations may be conceptually situated within the framework of *bid'ah hasanah* (commendable or beneficial innovation), provided that their application strengthens halal governance and does not contravene the primary sources of Islamic law, namely the Qur'ān and the Sunnah. Within Islamic jurisprudence, innovations are not inherently objectionable; rather, their permissibility is evaluated based on their alignment with *maṣlaḥah* (public interest) and their capacity to advance the higher objectives of *Shari'ah* (*maqāsid al-Shari'ah*). In this regard, AI technologies that enhance transparency, accountability, and efficiency in halal assurance systems may be regarded as not only permissible but also normatively desirable.

Contemporary technological applications such as blockchain-enabled traceability systems, AI-driven contaminant detection, and intelligent logistics platforms exemplify this category of beneficial innovation. These tools contribute to strengthening halal integrity by enabling end-to-end supply chain visibility, improving the accuracy of risk detection, and reducing opportunities for fraud or cross-contamination. In doing so, they reinforce core *Shari'ah* values, including the protection of consumers (*ḥifẓ al-naḥs*), the prevention of harm (*dar' al-mafāsid*), and the promotion of trust and fairness in commercial transactions (*'adl* and *amānah*). Accordingly, AI functions not merely as a technological enhancement but as a mechanism through which ethical and regulatory compliance can be more effectively operationalised within increasingly complex global food systems.

Nevertheless, the classification of AI applications as *bid'ah hasanah* is not absolute and remains subject to substantive *Shari'ah* and regulatory scrutiny. Not all technologically advanced or innovative products satisfy the criteria of permissibility. For instance, products marketed as plant-based pork despite being free from porcine derivatives raise significant concerns within the Malaysian halal regulatory framework. The Manual Procedure for Malaysia Halal Certification (2020) explicitly prohibits the use of terminology, branding, or representations associated with *ḥarām* animals, on the grounds of *tashabbuh* (imitation of the prohibited) and the risk of consumer confusion (*talbīs*). This reflects a broader juristic principle that extends beyond material composition to include symbolic, perceptual, and ethical dimensions of consumption.

This example underscores a critical point: technological feasibility and scientific innovation alone do not determine *Shari'ah* compliance. Rather, permissibility must be assessed holistically, taking into account legal principles, ethical considerations, societal perceptions, and regulatory standards. Consequently, while AI holds significant promise as a form of *bid'ah hasanah*, its legitimacy ultimately depends on its alignment with established *Shari'ah* parameters and its ability to uphold, rather than dilute, the integrity of halal governance systems.

Toward a Collaborative and Harmonised Regulatory Framework

The analysis underscores the imperative for a collaborative, adaptive, and harmonised regulatory regime to ensure the responsible integration of AI within halal food innovation ecosystems. Malaysia's halal governance framework anchored by JAKIM through MS1500:2019 and the Manual Procedure for Malaysia Halal Certification (2020) already provides a comprehensive and credible foundation grounded in both *Shari'ah* principles and administrative rigour. This framework can be further enhanced through the strategic incorporation of digital technologies, particularly blockchain-enabled traceability systems and AI-driven monitoring tools, which offer real-time verification, improved data integrity, and end-to-end supply chain transparency. Such integration not only strengthens compliance mechanisms but also aligns halal governance with the demands of increasingly complex and globalised food systems.

Comparative regulatory perspectives further reinforce the necessity of harmonisation across jurisdictions. Indonesia's Halal Product Assurance Law (Law No. 33 of 2014, as amended in 2019) adopts a mandatory approach to halal certification for food products, thereby institutionalising a uniform compliance baseline at the national level. In contrast, the European Union Regulation (EU) 2015/2283 on novel foods emphasises rigorous pre-market authorisation, scientific risk assessment, and consumer protection, particularly in relation to emerging food technologies. While these frameworks arise from distinct legal and cultural contexts, their convergence with *Shari'ah*-based oversight—when complemented by AI-enabled monitoring systems presents a valuable opportunity to promote regulatory interoperability. Such alignment can facilitate cross-border trade, reduce certification redundancies, and enhance global consumer confidence in halal-labelled products.

To operationalise a harmonised and future-ready halal governance model, several strategic measures are proposed. First, targeted capacity-building programmes should be developed for halal certification officers and auditors to strengthen both digital literacy and *Shari'ah* competencies, enabling them to effectively engage with AI-driven systems without compromising juristic oversight. Second, the formulation of AI ethics guidelines tailored to the halal food industry is essential to ensure that technological adoption remains transparent, accountable, and aligned with Islamic ethical values, including *amānah* (trustworthiness) and *'adl* (justice). Third, enhanced interstate and international regulatory cooperation is required to harmonise halal standards, certification procedures, and enforcement mechanisms, thereby addressing inconsistencies that currently undermine supply chain integrity. Finally, sustained scholarly supervision must be institutionalised within the governance framework to ensure that the deployment of AI technologies remains continuously aligned with evolving Islamic jurisprudential principles, particularly in relation to novel and ambiguous food innovations.

Collectively, these measures reflect a holistic governance approach in which technological advancement is not pursued in isolation but is embedded within a robust matrix of legal, ethical, and institutional safeguards. Such an approach is essential to ensure that the integration of AI into halal food systems not only enhances efficiency and innovation but also preserves the integrity, credibility, and spiritual objectives of halal certification in a rapidly evolving global landscape.

CONCLUSION

In conclusion, the rapid integration of artificial intelligence into the global food industry is undeniably transformative, generating novel products, enhancing food safety, and optimising supply chain efficiency. However, within Muslim societies, the evaluation of such technological advancements cannot be confined to utilitarian metrics of efficiency and consumer demand alone. Rather, it must be anchored in the normative framework of *adab*, which emphasises halal integrity, transparency, and the protection of consumers in accordance with *Shari'ah* principles. This study demonstrates that AI-driven innovations—such as cultured meat and blockchain-enabled halal traceability systems—may be legitimately classified as *bid'ah hasanah* (beneficial innovation) when they align with the *maqāsid al-Shari'ah*, particularly in advancing public welfare and preventing harm. Nevertheless, these innovations also introduce significant risks when deployed without adequate regulatory and ethical safeguards, especially where automation displaces essential human oversight in religiously sensitive domains.

From a regulatory perspective, Malaysia's MS1500:2019 and the Manual Procedure for Malaysia Halal Certification (2020) provide a robust and credible framework for managing halal compliance, including in the context of emerging food technologies. However, the increasing complexity of AI-enabled food systems necessitates further adaptation and refinement of these standards to address issues such as algorithmic accountability, data integrity, and automated decision-making. Comparative analysis reveals that Indonesia's Halal Product Assurance Law (2014, amended 2019), the European Union Regulation (EU) 2015/2283 on novel foods, and the United States Food and Drug Administration (FDA) approvals of cultured meat between 2022 and 2023 reflect differing regulatory philosophies and thresholds. These divergences, while contextually grounded, pose challenges for transnational halal trade and underscore the urgency of regulatory harmonisation.

The distinct contribution of this paper lies in its interdisciplinary synthesis of Islamic jurisprudence, statutory frameworks, and emerging technological trends to propose a forward-looking governance model for AI-driven halal food systems. In operationalising this model, several key recommendations are advanced. First, there is a need for the formulation of AI-specific halal certification guidelines by qualified religious scholars, ensuring that technological applications are assessed within a coherent juristic framework. Second, efforts toward harmonisation of halal standards across jurisdictions should be strengthened through international platforms such as the Organisation of Islamic Cooperation (OIC) and the Standards and Metrology Institute for Islamic Countries (SMIIC), thereby facilitating consistency and mutual recognition. Third, the adoption of blockchain and machine learning tools should be encouraged to enhance traceability and compliance, provided they operate under clear ethical and regulatory oversight. Finally, sustained fatwa deliberation is essential to address emerging issues, including the permissibility of cultured meat, plant-based analogues, and the role of automation in halal certification processes.

Ultimately, the integration of AI into halal food systems should not be viewed as a disruption to *Shari'ah* principles, but as an opportunity to operationalise them more effectively in a technologically advanced context. A balanced approach one that harmonises innovation with ethical responsibility, and automation with human and scholarly oversight is essential to ensure that the future of halal governance remains both credible and resilient in an increasingly digitalised global economy.

DECLARATIONS

Acknowledgements This study is funded by [PRIGS [RMC,IIUM] under Grant Number [2025].	Competing Interest The author(s) declare that they have no competing interests
Authors' contributions All author(s) read and approved the final manuscript	Ethics Approval Ethics approval was not required for this study because it did not involve human participants, animals, or identifiable personal data
Data Availability The data supporting the findings of this study are available from the corresponding author upon reasonable request	Use of Artificial Intelligence All content, analysis, arguments, and conclusions were reviewed, verified, and approved by the author(s), who remain fully responsible for the final manuscript.

REFERENCES

- Al-Ashmawy, M. (2024). Ethics of artificial intelligence: A purposeful and foundational study from the perspective of the Sunnah. *Religions*, 15(11), 1300. <https://doi.org/10.3390/rel15111300>
- Aljahsh, M. A. I. (2025). Cultured meat and halal: A comprehensive analysis from jurisprudence, biology, and ethics. *Halalsphere*, 5(1). <https://doi.org/10.31436/hs.v5i1.122>
- Amer, A., & Ibrahim, I. (2025). Artificial intelligence in marketing for halal supply chain management: Leveraging technology for strategic growth in Malaysia. *International Journal of Research and Innovation in Social Science*, 9(1), 3115–3124. <https://dx.doi.org/10.47772/IJRISS.2025.9010253>
- American Halal Foundation. (2025). Artificial intelligence (AI) in food industry: Opportunities & implications. <https://halalfoundation.org/ai-in-foodindustry/>
- Balakrishnan, P., Leema, A. A., Jothiaruna, N., Assudani, P. J., Sankar, K., Kulkarni, M. B., & Bhaiyya, M. (2025). Artificial intelligence for food safety: From predictive models to real-world safeguards. *Trends in Food Science & Technology*, 149, 104289. <https://doi.org/10.1016/j.tifs.2025.104289>
- Bilbao Foodtech Food Summit. (2024). AI in future food industry. Expo Food Tech. <https://www.expofoodtech.com/smart-foods-ai-future-foodindustry/>
- Cameron, Iqbal. (2020). Assessing creativity and innovation in Islam. In *Creativity and Innovation in Religion* (pp. xx–xx). IntechOpen. <https://doi.org/10.5772/intechopen.94110>
- Chriki, S., & Hocquette, J. F. (2024). A review of the discussions on cultivated meat from the Islamic perspective. *Frontiers in Nutrition*, 11, 1352816. <https://doi.org/10.3389/fnut.2024.1352816>
- Hamdan, M. N., Lim, S. H., & Post, M. J. (2023). Halal or not? Exploring Muslim perceptions of cultured meat in Singapore. *Frontiers in Sustainable Food Systems*, 7, 1127164. <https://doi.org/10.3389/fsufs.2023.1127164>
- Hamdan, M. N., Post, M. J., Ramli, M. A., & Mustafa, A. R. (2018). Cultured meat in Islamic perspective. *Journal of Religion and Health*, 57(6), 2193–2206. <https://doi.org/10.1007/s10943-017-0403-9>
- Hamdan, M. N., Ramli, M. A., & Post, M. J. (2023). Will plant-based pork meat substitutes receive halal certification? *Food Research*, 7(6), 112–118. [https://doi.org/10.26656/fr.2023.7\(6\).066](https://doi.org/10.26656/fr.2023.7(6).066)

- Halal Food Council USA. (2024). The future of halal certification: Innovations and advancements. <https://halalfoodcouncilusa.com/the-future-of-halal-certification-innovations-and-advancements/>
- Halal World Institute. (2025). Malaysia mulls on-chain halal permit; China boosts AI prowess. <https://halalworldinstitute.org/en/news/institutenews/item/141-malaysia-mulls-on-chain-halal-permit-china-boosts-ai-prowess.html>
- Hemendra Singh. (2025). AI in the food industry: 10 powerful applications. <https://theninehertz.com/blog/ai-in-food-industry>
- ISA Halal. (2021). Is 'Impossible Pork' halal? <https://www.isahalal.com/newsevents/isa-news-events/isas-first-exposure-washington-times-nonmeat-pork-dish-too-far-for-observant-jews-muslims>
- Malaysian Halal Certification Procedure Manual. (2020). Jabatan Kemajuan Islam Malaysia (JAKIM). <https://www.halal.gov.my/v4/>
- Malaysian Standard MS1500:2019. (2019). Halal food – Production, preparation, handling and storage – General guidelines. Putrajaya: Department of Standards Malaysia. <https://www.jsm.gov.my/ms15002019-halal-food>
- Madhura Rao. (2024). Novel food. European Commission. https://food.ec.europa.eu/safety/novel-food_en
- Malaysia External Trade Development Corporation (MATRADE). (2025). Exploring halal innovation in Malaysia: A 2025 perspective. <https://expo2025-malaysia.miti.gov.my/exploring-halal-innovation-in-malaysia-a-2025-perspective/>
- Nawaz, A., Afzal, A., Khatibi, A., Shankar, A., Madan, H., Faisal, H. S., ... Islam, F. (2025). Role of artificial intelligence in halal authentication and traceability: A concurrent review. Trends in Food Science & Technology, 145, 104720. <https://doi.org/10.1016/j.tifs.2024.104720>
- Omar, N., Hashim, N., Muda, Z., Embong, R., & Yaakob, R. (2024). Parameters for determining halal compliance of technology-driven innovations in the food industry: Advancing SDG 2 on food security. Journal of Lifestyle and SDGs Review, 5(1), e03577. <https://doi.org/10.47172/2965-730X.SDGsReview.v5.n01.pe03577>
- Sahih Muslim, Book 34, Hadith Number 6466. Sunnah.com. <https://sunnah.com/muslim:1017a>
- Sunan Ibn Majah, Hadith 46. Sunnah.com. <https://sunnah.com/ibnmajah:46>
- Tribune International. (2024). The role of artificial intelligence in the halal industry. <https://tribune-intl.com/the-role-of-artificial-intelligence-in-the-halal-industry/>