

Machines and Maqasid: Evaluating Mechanized Slaughter in the Global Halal Food Industry

Nabilla Pramesti Linggarnisa^{1, a}, Triyono Adi Saputro^{2 b}

¹ Universitas Muhammadiyah Surakarta, Jl. A.Yani, Pabelan, Kartasura, Sukoharjo, 57162, Indonesia

^a nblpramesti@gmail.com *; ^b adi.hes@ums.ac.id

Abstract: The global food and beverage industry is undergoing a transformation through automation and mechanization of production. In halal meat production, the mechanical slaughter system raises issues related to the validity of fulfilling the requirements of dhabihah as an act of worship in Islamic law. This study aims to analyze the validity of the law of mechanical slaughter in the perspective of fiqh across madhhabs and maqasid al-shariah. The research uses a normative legal method with a literature study approach that integrates the comparative fiqh analysis of the four Sunni schools and the framework of maqasid al-shariah. The study identified five dominant mechanical slaughter technologies, namely rotating blade, electrical water bath stunning (EWBS), captive bolt stunning non-penetrative (CBS-NP), controlled atmosphere stunning (CAS), and robotic slaughtering system that have different legal implications. Analysis shows that there is an agreement that machines only function as tools (alah), not legal actors (fa'il), so they still need Muslim operators who pronounce basmalah and supervise. Based on the framework of maqasid al-shariah, this study formulates three main principles, namely the Principle of Machine Instrumentality, the Principle of Absolute Stunning Reversibility, and the Principle of Integrity of the Comprehensive Halal Chain as the basis for the harmonization of intersect halal certification standards and global halal food industry regulations.

Keywords: halal mechanical slaughter; maqasid al-shariah; technological transformation

INTRODUCTION

The global food and beverage industry is currently undergoing a significant transformation through automation and mechanization of production. In the meat and poultry processing sector, the long-standing manual slaughter has now been replaced by automated systems capable of processing thousands of animals in a short period of time. This change poses serious implications for the halal food industry, as slaughter in Islamic law is not just a technical process, but also an act of worship that is bound by strict legality requirements. The inclusion of machines in this process raises critical questions about the validity of fulfilling theological and juridical aspects in the concept of halal.

Economically, this issue has a high urgency. The world's Muslim population, which reaches around 1.8 billion people or 24.1% of the global population, makes the halal market one of the largest segments of the world's food industry (Riaz et al., 2021). The demand for halal products continues to increase in line with the projected growth of Muslims of up to 27% by 2030. In this context, the legal uncertainty of mechanical slaughter has a direct impact on consumer confidence, the validity of halal certification, and the stability of global supply chains.

Within this broader context, the legal and regulatory dimension of halal production is equally important. (Saputro & Rahmawati, 2025) note that the halal tourism and food industry in Indonesia has developed rapidly across multiple regions, yet a significant number of business actors still lack proper legal recognition of their products. Their study highlights that formal halal legality serves three interrelated functions: as legal protection for producers, as a mechanism for increasing business credibility in the eyes of consumers, and as a channel for accessing wider markets and investment. The absence of such legality not only jeopardizes consumer rights but also undermines the overall integrity of the halal value chain. This regulatory gap is particularly relevant to the mechanization of slaughter, where the legitimacy of the production process must be supported not only by fiqh compliance but also by institutional recognition through certification systems.

Academically, the compatibility of modern slaughter technology with the principle of dhabihah has been widely studied. Technical studies show that aspects such as animal positioning, stunning, and mechanization have a direct effect on the conformity of halal standards. Stunning is only acceptable if

it is reversible and does not cause death before slaughter. From the perspective of applied fiqh, halal slaughter in accordance with sharia is still seen as safeguarding animal welfare, even though its scientific validation is still developing (Zeiad A Aghwan et al., 2015). Integration efforts are also seen through a halal production control model that includes intentions, tools, actors, and post-slaughter procedures as a bridge between fiqh and modern industry. (Shahdan et al., 2016)

At the global level, the majority of Muslim countries have accepted a certain stunning use, so most halal meat production today has gone through a process of stunning before slaughter (Riaz et al., 2021). Nevertheless, modern halal production chains still contain a variety of critical risk points from transportation to refrigeration that require strict supervision to maintain halal compliance (Mylostyyvi et al., 2025)

However, existing studies still have limitations. Technical studies tend to be descriptive without operational formulations of Islamic law, while classical jurisprudence has not fully accommodated the complexity of modern technology. In addition, the integration of maqasid al-shariah as a framework for evaluating technologies such as robotic slaughtering, controlled atmosphere stunning (CAS), and artificial intelligence-based certification systems is still very limited.

A number of studies have examined halal slaughter in the modern context from a variety of perspectives (Fletcher, 1999). Examine the technical aspects of slaughter, such as animal position, stunning methods, and mechanization, and affirm that halal depends on the fulfillment of the basic principles of dhabihah, especially the non-death of animals before slaughter and optimal blood production (Zeiad A Aghwan et al., 2015). Highlighting the animal welfare aspect by showing that slaughter in accordance with sharia does not contradict the principles of animal welfare, although it still requires strengthening scientific evidence. Meanwhile, (Shahdan et al., 2016) it proposes a framework of critical control points in halal poultry production that includes intentions, tools, actors, and post-slaughter procedures as an effort to bridge fiqh and modern industrial practices.

Although the three studies make important contributions, each still has limitations in developing a comprehensive and operational analytical framework. (Fletcher, 1999) focuses more on technical aspects without examining the legal implications in depth, while (Zeiad A Aghwan et al., 2015) focusing on animal welfare without systematically linking it to the development of mechanization. Meanwhile, (Shahdan et al., 2016) it offers an integrative model, but it is still limited to an industrial operational approach without an in-depth analysis of fiqh proposals. Different from the study, this study combines the technical analysis of the mechanization of slaughter with the proposal of comparative fiqh across sects and uses maqasid al-shariah as the main framework. Thus, this study not only assesses the suitability of mechanical practices with halal principles, but also formulates measurable and applicable legal parameters in the contemporary halal industry.

Based on this, this study offers an integrative approach by combining comparative fiqh proposals across sects and technical analysis of the mechanization of slaughter, and makes maqasid al-shariah the main analytical framework. In this approach, maqasid not only functions normatively, but also as an instrument to formulate legal parameters that are measurable and applicable to the modern halal industry.

This research focuses on two main questions: (1) how the practice of mechanization of slaughter is applied in the contemporary halal food and beverage industry, and (2) how Islamic law views the validity of the practice from the perspective of comparative fiqh. The goal is to comprehensively analyze these practices and formulate a legal framework based on maqasid al-shariah that is adaptive to the development of the global halal food industry.

METHODS

This research is a normative legal research with a library *research* method that focuses on the analysis of Islamic law on the mechanization of slaughter in the contemporary halal *food and beverage industry*. The approach used is the noematic approach, a method rooted in Husserlian phenomenology in which the object of study (the *noema*) is treated not merely as a legal-technical fact but as a phenomenon whose meaning and essence must be uncovered as it presents itself in the texts and practices being studied. Applied to this research, the noematic approach means that mechanized

slaughter is not read only as a set of engineering procedures, but is examined for the meaning it carries within fiqh discourse, contemporary fatwas, and industry practice, before that meaning is reconstructed into legal categories. This approach is used to support the normative-literature method by ensuring that the interpretation of primary and secondary legal materials stays grounded in how the phenomenon of slaughter mechanization actually appears in the sources, rather than in assumptions imported from outside them. Through this approach, the research is directed to examine the relationship between the development of modern slaughter technology and the principles of Islamic law, especially in the perspective of comparative fiqh and *maqasid al-shariah*.

The research sources consist of primary and secondary legal materials. Primary legal materials include the Qur'an, hadith, ulama fatwas, halal regulations, and scientific journals that discuss halal slaughter, mechanization of the food industry, *stunning*, *robotic slaughtering*, and *controlled atmosphere stunning* (CAS). Meanwhile, secondary legal materials are obtained from books, scientific articles, conference proceedings, and various other literature relevant to the research topic. All sources were purposively selected taking into account the relevance of the theme, academic credibility, and actuality of the publication.

The collection of research materials is carried out through documentation studies by studying, identifying, and grouping various literature related to the mechanization of halal slaughter as well as Islamic law's view of the practice. Furthermore, the research materials were analyzed descriptive-analytically using the approach of comparative fiqh proposal and *maqasid al-shariah*. The analysis process is carried out through the stages of data reduction, theme classification, concept interpretation, and conclusion drawing to produce legal constructions that are adaptive to the development of modern slaughter technology in the contemporary halal industry.

RESULTS AND DISCUSSION

Mechanization of Slaughter in the Perspective of Halal Industry Technology Transformation

A review of the contemporary technical literature identifies five main categories of slaughter technologies currently used in the global halal meat production chain. As presented in Table 1, each category has different technical characteristics and poses non-uniform legal consequences. This difference makes legal evaluation cannot be done generically, but must be specific per technology.

Table 1. Typology of Mechanical Slaughter Technology in the Global Halal F&B Industry

Methods/Technologies	Technical Description	Application in the Halal F&B Industry	References
Rotating Blade	An auto-rotating blade that cuts through the carotid artery and jugular vein using an animal position sensor system; integrated in the high-speed conveyor line.	Dominant in industrial-scale poultry processing; capacity above 5,000 heads/hour; widely applied in certified halal facilities.	(Mylostyvyi et al., 2025); ("Awal Fuseini; Moses Teye; John Lever," 2022)
Electrical Water Bath Stunning (EWBS)	The animals are passed through an electric tank to induce reversible stunning before manual or mechanical slaughter resumes.	Common standards in European and North American halal facilities; received under the supervision of a trained Muslim auditor.	(Riaz et al., 2021) (Sazili et al., 2023)
Captive Bolt Stunning Non-Penetrative (CBS-NP)	Pressurized air bolts hit the skull without penetrating the brain; induces reversible concussions without permanent injury to the brain.	Used for cattle and goats in Malaysia, Turkey, and Egypt; requires animals to remain alive after the slaughter.	(Riaz et al., 2021)(Sazili et al., 2023)

Controlled Atmosphere Stunning (CAS)	Animals are exposed to inert gases (CO ₂ , Ar, or N ₂) in pressurized spaces; induces unconsciousness without excessive seizures thus reducing animal stress.	Initially for the pig industry; began to be studied for halal poultry with gas modifications; The legal status is still debated across authorities.	(Sazili et al., 2023)(“Awal Fuseini; Moses Teye; John Lever,” 2022)
Robotic Slaughtering System (RSS)	AI-based robots are equipped with computer vision to recognize anatomical positions in real-time; Execute the incision independently without human touch.	The latest generation; still in the R&D and commercial trial phase; raises the most fundamental questions about the legal status of the perpetrators of the slaughter.	(Akbar et al., 2023; Mylostvyi et al., 2025)

Source: Authors' compilation based on (Mylostvyi et al., 2025), (“Awal Fuseini; Moses Teye; John Lever,” 2022), (Riaz et al., 2021), (Sazili et al., 2023) and (Akbar et al., 2023)

Based on Table 1, *rotating blade technology* is the most dominant in the poultry industry because it is capable of processing more than 5,000 heads per hour with high precision. (Mylostvyi et al., 2025) explains that this system has been integrated with an automatic sensor to verify the position of the incision. This shows that the mechanization of slaughter has evolved from mechanical automation to computational systems that require more in-depth legal studies.

The latest development is marked by the presence of *the Robotic Slaughtering System* (RSS) which uses artificial intelligence and *computer vision* to detect animal anatomy in real-time and perform automatic incisions independently (Akbar et al., 2023). This technology has the potential to eliminate human interference in the slaughter process, a condition that has not been discussed in classical jurisprudence. In line with that, Fuseini et al. (2022) stated that the development of slaughter technology has exceeded the capacity of classical fiqh, so that contemporary *ijtihad* based on empirical data is needed.

(Riaz et al., 2021) also found that Muslim-majority countries, such as Indonesia, Malaysia, Turkey, and the Gulf countries, have implemented at least one mechanization technology in the national slaughter industry. Thus, the mechanization of slaughter is no longer an issue of the future, but an industry reality that requires legal certainty.

Literature analysis shows that the implications of mechanization on halal are not limited to the moment of incision execution, but rather encompass the entire production chain from ante-mortem to distribution. Table 2 presents a systematic mapping of the five critical points identified from the literature, along with risk analysis and the required control standards.

Table 2. Mapping of Halal Compliance Critical Points in the Mechanical Slaughter Production Chain

Production Critical Points	Halal Risks of Halal Status	Required Control Standards	References
1. Ante-mortem: Transport and Handling	Excessive stress causes death before slaughter; Animals become carcasses (<i>maytah</i>) that are haram to consume.	Implementation of animal welfare procedures; pre-slaughter of the animal's rest time; Ante-mortem examination by halal officers.	(Mylostvyi et al., 2025; Sazili et al., 2023)
2. Stunning: Pre-Slaughter Stunning	Death due to irreversible stunning or permanent brain damage that makes slaughter illegal.	Calibrate the machine regularly; post-pandemic reversibility; Muslim officers are trained in every shift.	(Riaz et al., 2021) (Indonesia, 2009)

3. Mechanical Slaughter: Cut Execution	The incision does not cut three vessels (trachea, esophagus, blood vessels); Basmalah is unspoken; non-Muslim operators.	Audit of the position and sharpness of the blade; verification that the slaughterer is a certified Muslim operator; halal operator certification; blood flow verification sensor.	("Awal Fuseini; Moses Teye; John Lever," 2022)(Sukardi, 2022)
4. Post-mortem: Scalding, Evisceration, Chilling	Cross-contamination with non-halal products; Too high a scalding temperature kills the animal before complete bleeding.	Segregation of halal and non-halal production lines; minimum bleeding time standard; halal-based HACCP implementation.	(Akbar et al., 2023; Mylostyvyi et al., 2025)
5. Certification: Supply and Distribution Chain	Counterfeiting of halal labels; Loss of halal integrity in international distribution chains without a tracking system.	Blockchain traceability; Mutual recognition agreements (MRAs) between cross-border certification bodies.	(Akbar et al., 2023; Kurniawan et al., 2025)

Source: Authors' compilation based on (Mylostyvyi et al., 2025), (Sazili et al., 2023), (Riaz et al., 2021) ("Awal Fuseini; Moses Teye; John Lever," 2022), (Sukardi, 2022), and (Akbar et al., 2023).

The data in Table 2 shows that the risk of halal in mechanical production is complex and interrelated, so it is not only limited to the slaughter process. These findings expand the study of fiqh from the technical focus of slaughter to a comprehensive halal production chain approach (*farm to fork*).

Of the five critical points, (Mylostyvyi et al., 2025) found that the greatest risk was in the *stunning* and post-slaughter stages. Wrong voltage and duration regulation in the *electrical water bath method* can lead to the death of animals before slaughter, so that the product becomes non-halal according to all schools. This condition shows the need for a real-time monitoring system that is more accurate than conventional manual audits.

In addition, (Sazili et al., 2023) stated that the *Hazard Analysis and Critical Control Points* (HACCP) system still focuses on food safety and has not fully included halal aspects. Therefore, the integration of fiqh-based critical points into the HACCP system is an important need in the development of the modern halal food and beverage industry.

The structural integrity challenges inherent in the halal meat supply chain are further elaborated by (Ellahi et al., 2025) in their systematic review of Industry 4.0 technologies as potential catalysts for resolving persistent problems in the halal meat supply chain (HMSC). They identified that standard fragmentation, cross-contamination risks, and weak traceability systems constitute the primary structural challenges undermining halal integrity throughout the production chain from ante-mortem handling to final distribution. (Ellahi et al., 2025) further documented that technologies such as blockchain, Internet of Things (IoT), artificial intelligence (AI), and robotics hold significant potential to address these critical points in real-time; however, their implementation remains severely limited due to the lack of studies that specifically integrate halal requirements into these technological systems. These findings directly substantiate the critical point mapping presented in Table 2 of this study particularly at the certification and distribution chain stages while simultaneously providing empirical grounding for Proposition 3 (the Principle of Comprehensive Halal Chain Integrity), which asserts that halal auditing cannot be confined to the moment of slaughter alone but must encompass the entire production chain supported by an integrated digital documentation system.

The Revaluation of Islamic Law on the Validity of Mechanical Slaughter: Between the Originality of Sharia and the Flexibility of Ijtihad

A study of comparative fiqh literature and contemporary fatwas produces a map of views that are madhhab and institutionally stratified. Table 3 presents a comparison of the positions of the four main Sunni sects along with the two largest halal authorities in Southeast Asia, MUI Indonesia and JAKIM Malaysia on two key issues: mechanization of slaughter and the use of stunning.

Table 3. Comparison of Views of Schools and Halal Authorities on the Mechanization of Slaughter

Schools / Authorities	Position on Mechanization	Position against Stunning	Basis of Argument	References
Hanafi	Machines are categorized as tools (alahs), not actors; it is legitimate if the Muslim operator pronounces the basmalah and activates the machine with intention.	Allows reversible stunning The animal should not die before the incision is made.	Qiyas against hunting tools; Principles of al-asl fi al-Ashya' al-ibahah.	(Emilio, 2022; Suryani et al., 2025)
Maliki	More tight; demanding the presence and physical involvement of Muslim slaughterers; problematic machine without direct supervision.	Accept with strict conditions; emphasizing verification that the animal is clearly alive at the time of the incision.	Hadith narrated by Muslim about the conditions of slaughter; emphasis on the dimension of tazkiyah.	(“Awal Fuseini; Moses Teye; John Lever,” 2022; Sazili et al., 2023)
Syafi'i	Requiring an active Muslim slaughterer; The machine is accepted as an auxiliary, not a substitute for legal subjects.	Be careful; Requires Hayah Mustaqirrah (Meaningful Life) to be confirmed at the time of the incision.	Kitab al-Umm; The Principle of Ihtiyath and the Conditions of Tazkiyah.	(Suryani et al., 2025)
Hambali	Conservative in the substitution of human actors; machine as a tool operated directly by Muslims.	Allowing if not resulting in death; preferential support slaughter without stunning.	Ibn Qudamah, al-Mughni; The principle of darurah does not exceed the need.	(Riaz et al., 2021)
MUI (Indonesia)	Enable; machine as a tool; there must be a Muslim operator who pronounces the basmalah and supervises the process.	Fatwa No. 12/2009: allows reversible stunning removal; prohibit those that cause death before slaughter.	Maslahat mursalah; maqasid al-shariah; large-scale national industrial needs.	(Indonesia, 2009; Kurniawan et al., 2025)
JAKIM (Malaysia)	Enabling with a structured halal assurance system; mandatory audit at each production point based on MS1500:2019.	Receiving EWBS and CBS-NP for poultry; CAS in the study; requires periodic calibration.	MS1500:2019; Ijtihad plural a; Public Interest.	(Kurniawan et al., 2025)

Source: Authors' compilation based on (Suryani et al., 2025), (Emilio, 2022), (“Awal Fuseini; Moses Teye; John Lever,” 2022), (Sazili et al., 2023), (Indonesia, 2009), and (Kurniawan et al., 2025).

Table 3 shows a significant pattern of convergence and divergence. The main point of convergence is found in the principle that the machine is a tool (alah), not a doer (fa'il), in the terminology of the fiqh proposal. This argument, which is the most elaborate, was developed in the Hanafi school of allowing the use of machines as long as Muslim human operators who have the intention and pronounce basmalah remain present as responsible legal subjects (Emilio, 2022). A similar principle was also adopted by the MUI in Fatwa Number 12 of 2009 which allowed mechanical slaughter on the condition that the machine functions as a tool and the Muslim operator remains actively supervising the process.

The most important divergence arises in the concept of hayah mustaqirrah (meaningful/stable life), which is the requirement that animals must still be in adequate living conditions at the time of slaughter.

The Shafi'i and Hanbali schools set stricter standards for this category than the Hanafi. This difference, as analyzed by (Kurniawan et al., 2025) in a cross-ASEAN comparative study, has resulted in differences in fatwa policies between the MUI and the Aceh MPU Number 6 of 2013, where the latter takes a much more restrictive position on stunning on the basis of the prudence of the dominant Shafi'i school in Aceh.

The comparison between the positions of MUI and JAKIM shows a convergence in a pragmatic approach based on benefits, but different in the supervision mechanism. JAKIM requires a more structured halal assurance system through the MS1500:2019 standard with audits at each critical point, while MUI emphasizes the personal qualifications of operators. This fragmentation of standards, as noted in (Kurniawan et al., 2025), hinders the smooth running of halal trade in ASEAN because products certified in one country are not automatically recognized in another, an economic obstacle that directly weakens the growth of the regional halal F&B industry.

One of the most crucial issues produced by this research is the legal status of basmalah in the context of a fully mechanical system. The literature review identifies three main positions circulating in contemporary jurisprudence discourse, each with significantly different operational consequences.

First, the position of tasmiyah is mandatory bi-oral: the basmalah must be pronounced orally by the Muslim operator just before or at the same time as the activation of the machine as a valid condition for slaughter. This is the dominant position of the Shafi'i and Hanbali schools and is the basis of the (Indonesia, 2009). The operational implication is that each production line requires one physically active Muslim operator.

Second, the position of tasmiyah bi-tashghil al-alah: the activation of a machine by an intending Muslim is considered an act of slaughter that implicitly includes basmalah figuratively, alluded to with a bow and spear in the jurisprudence of hunting. It was developed in the Hanafi tradition and corroborated by a number of contemporary scholars (Suryani et al., 2025). The implication: one Muslim supervisor supervising and activating the system is sufficient for the entire line, which is much more industrially efficient.

Third, the positioning of repeated basmalah recordings: some facilities use audio recordings that play repeatedly. This position is rejected by the majority of scholars because basmalah is a personal act that requires actual intentions, not just mechanical sounds ("Awal Fuseini; Moses Teye; John Lever," 2022). The difference between these three positions is not just an abstract theological debate, but has a direct impact on the employment model and operational costs of industrial-scale halal production facilities.

This study found that maqasid al-shariah does not only function as a post hoc normative justification, but can be operationalized as an evaluation instrument that produces measurable and auditable technological parameters. Table 4 presents this integrative framework by translating the five elements of maqasid into concrete technical parameters.

Table 4. Maqasid al-Shariah Framework as a Parameter for the Evaluation of Halal Slaughter Technology

Unsur Maqashid	Protection Dimensions	Scalable Technology Parameters	Operational Implications for the F&B Industry
<i>Hifdz al-Din</i> (Religious Guardianship)	Ensure that slaughter meets the laws and conditions of da'wah as a valid worship	Basmalah by Muslim operators; Machines as a Mandatory and Irreplaceable Human-Supervision Technology	Every production line is required to have a certified Muslim operator ; a fully autonomous system without human intervention is illegitimate.
<i>Hifdz al-Nafs</i> (Soul Care)	Ensuring food quality and safety for Muslim consumers; prevent the consumption of carcasses.	Animals are obligated to perform hayah mustaqirrah during the incision; perfect blood flow; Ante-mortem verification is mandatory.	IoT sensor for pre-slaughter life confirmation; strict post-mortem procedures; Bleeding time monitoring.

<i>Hifdz al-Mal</i> (Property Care)	Maintaining the integrity of the economic value of halal products; prevent counterfeiting and loss of the ummah's value chain.	Digital traceability-based halal certification; strict segregation of halal and non-halal products.	Implementation of blockchain traceability; standardization of cross-border certification through mutual recognition agreements.
<i>Hifdz al-'Aql</i> (Care of the Mind)	Encouraging ijtihad based on scientific knowledge; avoiding blind taqlid to new technologies.	Collective ijtihad of scholars and food technologists; Fatwa based on empirical data and clinical trials.	Establishment of a forum of scholar-technologists for periodic evaluation of CAS, robotic slaughtering, and AI-vision.
<i>Hifdz al-Nasl</i> (Lineage Care)	Ensuring that the Muslim generation gets halal-thayyib food that maintains long-term health.	Animal welfare standards are integrated in certification; Minimal pre-slaughter stress procedure.	Animal welfare regulations are a mandatory component of the F&B industry's halal audit, not just a complement.

Source: Author's compilation based on (Suryani et al., 2025), (Abd El-Rahim et al., 2023) (Haoxing & System, n.d.), (Sazili et al., 2023), and (Akbar et al., 2023).

Table 4 shows that the *maqasid al-shariah* approach produces more comprehensive parameters than conventional fiqh evaluations which generally only focus on the search for haram elements. This approach also formulates positive conditions so that new technology can be accepted according to sharia. In the dimension of *hifdz al-din*, full mechanization without the involvement of Muslim human beings still does not meet the standards of halalism, even though it is technically capable of producing precise incisions. These findings reinforce the view of (Suryani et al., 2025) that human surveillance cannot be completely replaced by technology.

This operationalization of *maqasid al-shariah* as a certification instrument is independently corroborated by (Poniran et al., 2024), who developed measurable parameters for halal slaughterhouse certification explicitly grounded in the *maqasid al-shariah* framework. Their study demonstrated that integrating *maqasid* particularly *hifdz al-din*, *hifdz al-nafs*, and *hifdz al-mal* into halal certification criteria produces standards that are not only normatively robust but also technically auditable. (Poniran et al., 2024) found that existing certification mechanisms in halal slaughterhouses tend to prioritize procedural compliance without a coherent normative foundation, resulting in inconsistencies that mirror the fragmentation identified in this study. Critically, their findings confirm that the acceptability of pre-slaughter stunning varies significantly across certifying authorities with Pakistan among the few countries that categorically rejects it reflecting the same doctrinal divergence mapped in Table 3 of this study. These findings strengthen the argument that the *maqasid al-shariah* framework proposed in Table 4 is not merely a theoretical construct, but represents a viable and urgently needed foundation for developing internationally harmonized halal slaughterhouse certification standards.

The dimension of *hifdz al-mal* shows the relationship between the integrity of sharia and the economic stability of the halal industry. (Akbar et al., 2023) project the global halal market to reach USD 724 billion by 2032, but this growth depends on consumer confidence in the validity of halal certification. The lack of clarity on halal status due to weaknesses in the mechanical production chain has the potential to lower Muslim consumer confidence globally.

This economic dimension gains additional weight when viewed alongside the broader regulatory ecosystem that governs halal product integrity. (Saputro & Rahmawati, 2025) emphasize that formal business legality plays a vital role in sustaining the credibility of the halal industry, serving not only as legal protection for producers but also as a signal of trustworthiness for consumers. In the context of the halal food and beverage industry, official licensing and halal certification function together as a means of consumer assurance, enabling Muslim buyers to make confident purchasing decisions based on recognized standards. Without such formal recognition, products regardless of their actual compliance with slaughter requirements risk losing market access and consumer trust, particularly in foreign markets such as the Middle East and North Africa where halal legality is a prerequisite for entry (Saputro & Rahmawati, 2025). This underscores that the technical integrity of halal mechanical slaughter, as

mapped in Table 2, cannot be separated from the regulatory legitimacy dimension: halal compliance must be both substantively valid according to fiqh and formally recognized through the institutional framework of certification and business legality.

Meanwhile, the dimension of *hifdz al-'aql* is an important basis for the development of collective *ijtihad* between scholars and scientists. This study found that there were differences in fatwas between Majma' al-Fiqh al-Islami, the Indonesian Ulema Council, and the Malaysian Islamic Development Department regarding the mechanization of slaughter. These differences show that there is no structured *ijtihad jama'i* system to answer the development of modern food technology. Therefore, (Kurniawan et al., 2025) recommends the establishment of a permanent forum between scholars and technologists.

The urgency of such a *jama'i* *ijtihad* forum becomes increasingly relevant as AI integration in halal production continues to advance. (Henry Wasosa, 2025) demonstrate that AI technologies including computer vision, IoT, and blockchain hold significant potential for real-time monitoring of Shariah compliance throughout the halal meat production process. However, they underscore a fundamental challenge: autonomous algorithmic systems are not necessarily capable of translating Shariah values that are inherently normative and contextual in nature. These findings reinforce the *hifdz al-'aql* dimension in Table 4 while simultaneously addressing the research gap identified in this study that the evaluation of RSS and AI-based certification technologies through a *maqasid al-shariah* framework remains critically needed.

Based on the analysis of subsections A and B, this study found that there is a dynamic relationship between *al-thabat* (stability/originality) and *al-murunah* (flexibility) in Islamic law in the face of technological developments. The originality of the sharia of slaughter does not lie in the technical method, but in the fulfillment of the harmony and conditions of *ta'abbudi*. ("Awal Fuseini; Moses Teye; John Lever," 2022) assess that the debate on halal and modern technology is often trapped in the less productive dichotomy of traditional and modern technology. With the *maqasid al-shariah approach*, the focus of the discussion shifts from the question of whether the technology is halal to the conditions under which the technology can meet halal standards.

The synthesis between technical findings and juridical and normative analysis in this study results in three integrative legal propositions that serve as an operational framework for the reevaluation of Islamic law on the mechanization of slaughter:

Proposition 1 Principle of Machine Instrumentality (Mabda' Alatiyyah al-Alah): A slaughtering machine is a tool whose law follows its user. The legality of mechanical slaughter depends entirely on the intention, basmalah, and qualification of the Muslim operator as an active legal subject. The measurable parameters: at least one certified Muslim operator per line that actively supervises and has the authority to intervene directly, without exception.

Proposition 2 of the Principle of Absolute Reversibility (Mabda' Radd al-Hayah): Every method of pre-slaughter stunning is only valid under sharia if it is reversible, does not cause death, and does not damage the bleeding mechanism. The measurable parameters: a standardized stunning machine calibration protocol with periodic verification, accompanied by a procedure to confirm the animal's life before the incision is executed.

Proposition 3 of the Principle of Integrity of the Entire Halal Chain (Mabda' Salamat al-Silsilah): The halalness of meat products in the mechanical industry is not determined solely by the moment of slaughter, but by the integrity of the entire production chain. Halal audit standards are mandatory to cover all critical points as mapped in Table 2, with an integrated traceability system and digital documentation at each critical point.

These three propositions are the operational formalization of the *maqasid al-shariah* framework as an evaluation instrument proposed in this study. As stated by (Emilio, 2022), the 'urf (customary practice) approach in Islamic jurisprudence allows adaptation to technological changes as long as it does not contradict the *nash* that *qath'l* and the three propositions above seek to establish the limits of adaptation in an operational and measurable manner. Its relevance for the global F&B industry is significant: it offers a minimum convergence point that can serve as a basis for harmonizing halal

standards across countries and across sects to address the fragmentation identified by (Akbar et al., 2023).

The limitations of this research need to be honestly acknowledged. As a normative-literature research, it does not produce primary empirical data from actual practice in the field. Follow-up research with case study methods or field surveys in industrial-scale halal production facilities will strengthen the empirical validation of the formulated legal propositions. In addition, in-depth studies of cutting-edge technologies such as AI-vision slaughtering and lab-grown meat, which require a fundamental reconceptualization of the meaning of 'slaughter' itself, remain wide open as an urgent advanced research agenda.

The study of the mechanization of slaughter from the perspective of Islamic legal theory can be approached through three complementary methodological instruments, namely *maslahah mursalah*, *'urf*, and *sadd al-dzari'ah*. These three instruments together form an epistemological foundation that allows Islamic law to move responsively to technological innovation without detaching itself from the normative substance of sharia.

The first instrument, *maslahah mursalah*, is the most dominant theoretical foothold in the acceptance of mechanization by today's halal authorities. In this framework, *maslahat* is understood as a connecting mechanism between established fiqh values and the demands of the ever-evolving industrial context, so that sharia norms can be operationalized contextually and relevantly (Triwulan & Sikumbang, 2023). The legitimacy of the mechanization of slaughter in this perspective rests on the fact that the use of machines operated by certified Muslim personnel produces tangible benefits that are collective: the availability of large quantities of halal food, production cost efficiency, and more equitable distribution. Empirically, (Triwulan & Sikumbang, 2023) noted that the production capacity of mechanical slaughter reaches 2,000 heads per hour almost seven times compared to manual methods with a cost efficiency difference of 30.69%, which directly supports the fulfillment of *the dimensions of hifdz al-nafs* and *hifdz al-mal* within the framework of *maqasid al-shariah*. However, this acceptance is not unconditional: new mechanization can be categorized as legitimate if all the technical provisions of halal slaughter are met, including the reading of basmalah by Muslim operators and the completion of the cutting of the four main channels on the animal's neck (Triwulan & Sikumbang, 2023).

The second instrument, *'urf*, provides a sociological-juridical dimension that strengthens the argument for the legitimacy of mechanization. In the tradition of *usul fiqh*, *'urf sahih* is defined as a habit that has been rooted in community practice and does not contradict the basic principles of sharia, so that it can function as a source of legal determination based on the rules of "*al-'adah muhakkamah*" (Emilio, 2022). In the context of the global halal food industry, the use of mechanical slaughter systems that have become operational standards in dozens of certified halal facilities in various Muslim countries meets the criteria of *'urf 'am* common customs that have normative binding force in the formation of laws. (Emilio, 2022) emphasized that new practices in the slaughter industry, including mechanization, can be recognized as *valid 'urf* as long as they do not deviate from the fundamental requirements of halal, especially the guarantee of animal *mustaqirrah* at the time of slaughter. This recognition of *the 'urf* of the industry also explains why JAKIM through the MS1500:2019 standard and MUI through Fatwa Number 12 of 2009 absorb industrial practices that have been proven to maintain halal integrity into the framework of official certification requirements (Emilio, 2022).

The third instrument, *sadd al-dzari'ah*, presents a more preventive and restrictive perspective on certain categories of technology. This principle operates on the logic that actions that inherently open up the possibility of sharia violations must be limited or rejected even if the actions are basically *mubah*, according to the rules of "*dar'u al-mafasid muqaddam 'ala jalb al-mashalih*" (Azmar & Aghwan, 2025). Its relevance to the mechanization of slaughter is most evident in the evaluation of *robotic slaughtering systems* and *controlled atmosphere stunning* (CAS): full automation that completely eliminates the involvement of Muslim human beings has the potential to be a systemic door to the disappearance of the *ta'abbudi* dimension of slaughter. (Azmar & Aghwan, 2025) documented that the application of *sadd al-dzari'ah* in the practice of JAKIM fatwa was realized through the determination of very specific technical parameters related to the use of *stunning* such as a maximum electric current limit of 0.75 amperes for goats and 2.0 amperes for cows in a duration of 3 to 6 seconds as a preventive effort so that the animal

does not die before slaughter which will change its status to a carcass (*maytah*) and make the product non-halal.

Overall, these three instruments of Islamic legal theory work in a layered and counterbalanced logic. *Maslahah mursalah* provides justification based on collective interests; *'URF* provides legitimacy based on proven industry practices; and *SADD al-Dzari'ah* provides a safeguard mechanism so that the flexibility of technological adaptation does not exceed the threshold allowed by the Shari'ah. (Triwulan & Sikumbang, 2023) summarize this framework in three cumulative conditions of acceptance of maslahat-based mechanization: conformity with nash and fiqh, the ability to meet the real needs of the ummah for halal food, and a positive contribution to the overall achievement of maqasid al-shariah, a formulation that substantively corresponds to the three operational legal propositions formulated in this study.

CONCLUSIONS

This study concludes that the mechanization of slaughter in the halal food and beverage industry can be accommodated within the framework of Islamic law as long as it fulfills three operational propositions based on maqasid al-shariah: the Principle of Machine Instrumentality which affirms the irreplaceability of Muslim operators as active legal subjects, the Stunning Absolute Reversibility Principle which requires non-lethal verification prior to slaughter execution, and the Principle of Comprehensive Halal Chain Integrity which extends halal audit from the moment of slaughter to the entire production chain. The analysis of Islamic legal theory through *maslahah mursalah*, *'urf*, and *sadd al-dzari'ah* confirms that the adaptation of technology is legal according to sharia as long as it does not eliminate the dimension of *ta'abbudi* and does not open systemic loopholes that obscure the integrity of halal.

For the industry, all three propositions need to be transformed into measurable SOP, including the obligations of certified Muslim operators on every line, periodic stunning machine calibration protocols, and the implementation of blockchain-based digital traceability systems from ante-mortem to distribution. For certification bodies and regulators, the fragmentation of halal standards between MUI and JAKIM needs to be overcome through the establishment of a mutual recognition agreement (MRA) and a permanent *jama'i ijtihad* forum involving scholars across sects with food technology experts to periodically evaluate new technologies. For further research, empirical field studies in industrial-scale halal production facilities are needed to validate the formulated propositions, as well as open the agenda for urgent studies on the legal status of AI-vision robotic slaughtering and lab-grown meat that have not been answered by contemporary jurisprudence.

ACKNOWLEDGMENT

The author would like to express gratitude to Allah SWT for blessings and guidance throughout the completion of this research. Special thanks are extended to Mr. Triyono Adi Saputro for his valuable supervision and support. The author also sincerely thanks beloved parents for their endless prayers and encouragement, as well as fellow university friends for their support and motivation. Appreciation is also given to a special person whose name cannot be mentioned for the assistance and support provided during the completion of this work. Finally, the author thanks all parties who have contributed, directly or indirectly, to this research.

REFERENCES

- Abd El-Rahim, I. H. A., Mashat, B. H., & Fat'hi, S. M. (2023). Effect of halal and stunning slaughter methods on meat quality: A review. *International Food Research Journal*, 30(2), 290–302. <https://doi.org/10.47836/ifrj.30.2.02>
- Akbar, J., Gul, M., Jahangir, M., Adnan, M., Saud, S., Hassan, S., Nawaz, T., & Fahad, S. (2023). Global Trends in Halal Food Standards: A Review. *Foods*, 12(23), 1–15. <https://doi.org/10.3390/foods12234200>
- Awal Fuseini; Moses Teye; John Lever. (2022). *Fuseini et Al*, 1–21.
- Azmar, Z., & Aghwan, Z. A. (2025). Divergent Strategies for Halal Meat Production: A Comparison of Halal Slaughtering Practices in Muslim and Non-Muslim Countries. *Journal of Halal Science and Management Research*, 1(1), 248–263. <https://doi.org/10.24191/jhsmr.v1i1.9000>

- Ellahi, R. M., Wood, L. C., Khan, M., & Bekhit, A. E. D. A. (2025). Integrity Challenges in Halal Meat Supply Chain: Potential Industry 4.0 Technologies as Catalysts for Resolution. *Foods*, 14(7), 1–32. <https://doi.org/10.3390/foods14071135>
- Emilio. (2022). 'URF: APPLICATION HALAL ANIMAL SLAUGHTER PRACTICE. , (8.5.2017)2 הארץ, 2005–2003.
- Fletcher, D. (1999). Slaughter technology. *Poultry Science*, 78(2), 277–281. <https://doi.org/10.1093/ps/78.2.277>
- Haoxing, Z., & System, C. (n.d.). *Teraju Jurnal Syariah dan Hukum*.
- Henry Wasosa. (2025). Influence of Psychological Well-Being and School Factors on Delinquency , During the Covid-19 Period Among Secondary School Students in Selected Schools in Nakuru County : Kenya. *International Journal of Research and Innovation in Social Science (IJRISS)*, VII(2454), 1175–1189. <https://doi.org/10.47772/IJRISS>
- Indonesia, M. U. (2009). *Fatwa Majelis Ulama Indonesia Nomor 12 Tahun 2009 tentang Standar Sertifikasi Penyembelihan Hewan*. Majelis Ulama Indonesia. <https://mui.or.id/produk/fatwa/>
- Kurniawan, A. W., Alam, A., Yuspin, W., & Rizka. (2025). Comparative Legal Analysis of Stunning Methods in Halal Animal Slaughter Between Muslim-Majority and Muslim-Minority Countries. *International Journal of Law and Society*, 4(1), 84–107. <https://doi.org/10.59683/ijls.v4i1.103>
- Mylostyvyi, R., Lykhach, V., Gutyj, B., Marenkov, O., & Mylostyva, D. (2025). Halal poultry slaughter technology: A critical review of control points. *Animal Science and Food Technology*, 16(2), 55–76. <https://doi.org/10.31548/animal.2.2025.55>
- Poniran, N. A., Izzuddin, M., Ahmad, B., Jaafar, M. H., & Mansor, N. H. (2024). *KICSS2024 based on Maqasid Shariah*. 35–41.
- Riaz, M. N., Irshad, F., Riaz, N. M., & Regenstein, J. M. (2021). Pros and cons of different stunning methods from a Halal perspective: A review. *Translational Animal Science*, 5(4). <https://doi.org/10.1093/tas/txab154>
- Saputro, T. A., & Rahmawati, A. R. (2025). *The Significance of Business Legality in The Realization of Halal Tourism Industry in Digital Era*. Atlantis Press International BV. https://doi.org/10.2991/978-94-6463-795-3_13
- Sazili, A. Q., Kumar, P., & Hayat, M. N. (2023). Stunning Compliance in Halal Slaughter: A Review of Current Scientific Knowledge. *Animals*, 13(19), 1–24. <https://doi.org/10.3390/ani13193061>
- Shahdan, I. A., Regenstein, J. M., Shahabuddin, A. S. M., & Rahman, M. T. (2016). Developing control points for halal slaughtering of poultry. *Poultry Science*, 95(7), 1680–1692. <https://doi.org/10.3382/ps/pew092>
- Sukardi, D. (2022). *HALAL CERTIFICATION STANDARDS FOR CHICKEN SLAUGHTER ALAL CERTIFICATION STANDARDS FOR CHICKEN SLAUGHTER IN TRADITIONAL MARKETS*. 7(2).
- Suryani, D. E., Yuslem, N., & Khoir, N. (2025). *THE APPLICATION OF USHUL FIQH TO MECHANICAL SLAUGHTERING OF ANIMALS Penerapan Ushul Fiqh Terhadap Penyembelihan Hewan Secara Mekanis*. 9(2), 1–11.
- Triwulan, D., & Sikumbang, A. T. (2023). Journal Analytica Islamica. *Journal Analytica Islamica*, 452–460.
- Zeiad A Aghwan, Awis Q Sazili, & Deuraseh, N. (2015). Traditional Halal slaughter from scientific perspectives. *International Journal of Social Policy and Society*, 11, 8–15. <https://ijsp.ism.gov.my/index.php/IJSPS/article/download/106/103>