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# MEMASTIKAN KEAMANAN PANGAN DALAM INDUSTRI DAGING SAPI DI INDONESIA: TINJAUAN LITERATUR TENTANG IMPLEMENTASI SISTEM JAMINAN HALAL, NOMOR KONTROL VETERINER (NKV), DAN HACCP

## *ENSURING FOOD SAFETY IN INDONESIA'S BEEF INDUSTRY: A LITERATURE REVIEW ON THE IMPLEMENTATION OF HALAL ASSURANCE SYSTEM, VETERINARY CONTROL NUMBER (NKV), AND HACCP*

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Abstract. *Indonesia's beef industry encounters significant food safety challenges, primarily due to a high dependency on imported beef (43% of total supply) and the fragmented enforcement of domestic safety regulations. Three key quality assurance systems address these issues: the Halal Assurance System (HAS), the Veterinary Control Number (NKV), and the Hazard Analysis Critical Control Point (HACCP). HAS, mandated by Law No. 33 of 2014, ensures compliance with Islamic dietary laws. NKV, regulated by Government Regulation No. 95 of 2012, certifies hygiene and sanitation standards in meat processing. Based on SNI and Codex Alimentarius guidelines, HACCP enhances food safety in meat handling and processing by identifying and controlling hazards. Specifically, the Codex Alimentarius General Principles of Food Hygiene (CXC 1-1969) and the Codex Code of Hygienic Practice for Meat (CXC 58-2005) outline the application of HACCP principles to ensure meat safety throughout the supply chain. This study employs a literature review to analyze implementation, challenges, and potential improvements. Findings indicate that small and medium slaughterhouses (RPH) face financial and technical barriers in obtaining NKV and HACCP certification. The financial challenges stem from high certification costs, infrastructure upgrades, and the need for continuous compliance with hygiene and sanitation standards. Meanwhile, technical barriers include limited expertise in implementing HACCP, particularly in establishing prerequisite programs such as Good Manufacturing Practices (GMP) and Sanitation Standard Operating Procedures (SSOP), which are essential before HACCP certification. Since NKV certification also mandates compliance with hygiene and sanitation standards, it serves as a foundational requirement for HACCP. Additionally, the Halal Assurance System (HAS) overlaps with NKV and HACCP, as it requires strict hygiene, traceability, and religious compliance, reinforcing the necessity of a comprehensive quality assurance approach.*

***Keywords :*** *Beef safety, Halal Assurance System, Hazard Analysis Critical Control Point (HACCP), Indonesia's beef industry, Veterinary Control Number (NKV)*

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## INTRODUCTION

Indonesia's beef consumption has fluctuated recently, with a notable decline in household consumption. In 2023, the total demand for fresh beef for household consumption was estimated at 139,470 metric tons, reflecting a 7.54% decrease from the previous year (Badan Pusat Statistik, 2023). Despite this decline, the country remains highly dependent on beef imports to meet domestic demand. In 2022, Indonesia imported 225,600 metric tons of beef, marking a 6.7% increase compared to 2021, reaching a record high (BPS, 2022). Further, in 2023, the country recorded its second-highest volume of boxed beef imports, totaling 210,586 tonnes, with Australia being the largest supplier, accounting for 43% of total imports (Meat & Livestock Australia-MLA, 2023). On a per capita basis, weekly beef consumption in Indonesia was only 0.008 kilograms (BPS, 2023), indicating a significant gap between demand and local supply capabilities.

Although Indonesia increasingly relies on beef imports, local cattle farming plays a crucial role in the nation's beef supply. Extensive cattle farming and feedlot operations contribute to domestic production, supporting food security, rural livelihoods, and reducing dependency on imports. However, several challenges such as food safety inconsistencies, hygiene standards, and gaps in halal assurance have restricted local beef from competing effectively in both domestic and international markets. This potential is supported by robust cattle farming and feedlot operations, with slaughtering and processing carried out in local slaughterhouses (Rumah Potong Hewan - RPH). However, the challenge lies in ensuring food safety, hygiene, and religious compliance. To address these concerns, Indonesia has implemented the Halal Assurance System (Sistem Jaminan Produk Halal - SJPH), ensuring that all meat products comply with Islamic dietary laws. Additionally, the Veterinary Control Number (Nomor Kontrol Veteriner - NKV), issued by the Ministry of Agriculture, is certified to ensure hygiene and sanitation standards in meat processing facilities (Lestariningsih *et al.*, 2020). Furthermore, a number of large scale beef producers have adopted Hazard Analysis Critical Control Points (HACCP) to enhance food safety management and meet international market requirements (Tomasevic & Dekic (2017) in Putri *et al.*, 2020).

However, the effective implementation of these quality assurance systems faces several challenges. A study by Lestariningsih *et al.* (2020), Kementerian Dalam Negeri Republik Indonesia (2023), and Direktorat Jenderal Peternakan dan Kesehatan Hewan (2023) report that only 35% of small and medium sized slaughterhouses in Indonesia have successfully obtained NKV certification, with financial constraints and infrastructure limitations cited as the primary barriers. According to Zulfikar (2022), only 27% of meat processing facilities in Indonesia have fully implemented HACCP, primarily due to high costs and lack of technical expertise. In contrast, Malaysia has imple-

mented an integrated Halal Assurance System through Jabatan Kemajuan Islam Malaysia (JAKIM), ensuring traceability across the supply chain (Halal Foundation, 2022). Meanwhile, Australia mandates HACCP as a legal requirement for all meat exports, reinforcing strict quality control measures (MLA, 2023).

To enhance the competitiveness of Indonesia's beef industry, particularly in both domestic and global markets, it is imperative to strengthen quality assurance frameworks. Implementing comprehensive food safety and certification measures, including Halal certification, NKV, and HACCP, is essential to align with international standards, improve consumer confidence, and promote industry sustainability. This paper systematically analyzes these quality management systems, examining their roles, implementation challenges, and the necessary steps to strengthen Indonesia's beef industry. By addressing regulatory gaps, financial barriers, and technical limitations, Indonesia can enhance food safety standards, increase market access, and reduce reliance on imported beef.

## MATERIALS AND METHODS

This study employs a literature review approach to examine the implementation, significance, and challenges of the Halal Assurance System, the Veterinary Control Number (NKV), and Hazard Analysis Critical Control Point (HACCP) in Indonesia's beef industry. The review is based on a comprehensive analysis of scholarly articles, government regulations, industry reports, and official policy documents published in recent years. By synthesizing existing literature, this study aims to provide a structured evaluation of the regulatory frameworks, procedural implementation, and barriers to compliance associated with these quality assurance systems, which are of significant interest to policymakers, industry stakeholders, and regulatory authorities.

This review is based on an analysis of scholarly articles, government regulations, industry reports, and official policy documents published in recent years. The inclusion criteria comprised peer reviewed journal articles, government reports, and industry white papers published between 2015 and 2024, focusing on food safety regulations, quality assurance systems, and their application in the beef industry. Studies addressing Halal certification policies, NKV enforcement, and HACCP adoption in meat production were prioritized.

The analysis follows a thematic categorisation approach, wherein the reviewed literature is classified into three core themes: (1) Regulatory frameworks and policy developments governing Halal, NKV, and HACCP in Indonesia; (2) Challenges and barriers to their implementation, particularly in small and medium sized slaughterhouses ; and (3) Best practices and international comparisons, particularly with Malaysia and Australia, to identify potential strategies for improving Indonesia's beef industry standards. The

findings offer practical insights for policymakers, industry stakeholders, and regulatory authorities to strengthen food safety measures and align Indonesia's beef industry with global market requirements.

## RESULTS AND DISCUSSION

Beef consumption in Indonesia reached 2.4 kg per capita annually in 2015 and has shown steady growth recently (Survei Sosial Ekonomi Nasional (SUSENAS) in Raifah, 2018). This growth trend presents a promising opportunity for the domestic beef industry. However, much of the beef supplied to supermarkets and restaurants is imported, mainly due to lower operational costs and the availability of established food safety certifications such as HACCP in exporting countries like Australia (Lestariningsih *et al.*, 2020; Zulfikar, 2022). This growing reliance on imported beef, mainly from Australia and Brazil, highlights the gap in quality assurance between local and imported beef products. The Indonesian beef industry must strengthen domestic food safety standards to compete effectively in local and international markets. With the right strategies and investments, the domestic beef industry has the potential to meet the growing demand and reduce the reliance on imports, fostering a sense of optimism about the future. Implementing Nomor Kontrol Veteriner (NKV) and Hazard Analysis Critical Control Point (HACCP) is crucial in ensuring food safety and quality in Indonesia's meat processing industry. A study conducted in Denpasar examined NKV implementation across five meat processing companies, ranging from small to large scale enterprises, and found that most companies successfully adhered to NKV standards, ensuring compliance with hygiene and sanitation requirements essential for food safety (Mandari *et al.*, 2022). Similarly, a study assessed HACCP implementation in PT's rendang (beef jerky) production. PT. X demonstrated that strict temperature and time control significantly reduced microbial growth, producing a safer final product (Wicaksani & Adriyani, 2018). These case studies emphasize the importance of structured food safety management systems in mitigating contamination risks and enhancing the quality of beef products in Indonesia. For SMEs, adopting NKV and HACCP standards can lead to improved product quality, increased consumer confidence, and better market competitiveness. Expanding NKV and HACCP adoption across all meat processing facilities, particularly among SMEs, is critical to increasing consumer confidence and competitiveness in domestic and international markets.

Indonesia's beef consumption continues to rise, yet domestic production struggles to meet demand. Currently, national beef production fulfils only 45% of total demand, necessitating substantial imports to cover the deficit (Agus & Widi, 2018; Burrow, 2019). The country's beef supply is primarily sourced from smallholder farmers, who account for 90% of national production. However, these small scale farms rely

on traditional livestock management practices, making it difficult to ensure consistent food safety and hygiene standards throughout the supply chain. It's crucial to note that many abattoirs in Indonesia lack HACCP compliance, primarily due to limited financial resources and inadequate technical knowledge (Raihanah & Norazmir, 2021). HACCP implementation requires prerequisite programs, namely Good Manufacturing Practices (GMP) and Sanitation Standard Operating Procedures (SSOP), which serve as the foundation for food safety management in meat handling (Codex Alimentarius Commission, 1997; FAO/WHO, 2023). GMP ensures proper facility design, equipment maintenance, and hygiene protocols, while SSOP focuses on sanitation measures such as cleaning procedures, water quality, and pest control. Without these prerequisite programs, achieving HACCP certification in abattoirs becomes challenging due to the lack of a structured hygiene and safety framework (Indriani *et al.*, 2021). This lack of compliance is a pressing issue that needs to be addressed urgently. In addition, HACCP requires long term investment in infrastructure, equipment, and training, making it inaccessible to many small-scale slaughterhouses. Consequently, carcass contamination, improper handling, and inconsistent enforcement of food safety regulations remain persistent challenges in Indonesia's beef industry (Raifah, 2018).

## 1. Quality Assurance Systems in Indonesia's Beef Industry

This section presents an analysis of implementing the Halal Assurance System, the Veterinary Control Number (NKV), and Hazard Analysis Critical Control Point (HACCP) in Indonesia's beef industry. Each system ensures food safety, hygiene, and religious and health standards compliance.

### 1.1 The Veterinary Control Number

The Veterinary Control Number (Nomor Kontrol Veteriner – NKV) is an official certification that verifies compliance with hygiene and sanitation standards in livestock business units, ensuring the safety of animal based food products such as meat, milk, and eggs (Mandari *et al.*, 2022). This certification is mandated by Indonesian regulations, particularly Law No. 18/2009 and its amendment Law No. 41/2014, as well as Government Regulation No. 95/2012, which governs animal husbandry and public veterinary health. To further streamline the certification process and reinforce food safety, Minister of Agriculture Regulation No. 11/2020 provides comprehensive guidelines on the issuance and implementation of NKV in animal based food businesses (Permentan No. 11/2020). The primary objective of NKV is to ensure that food products originating from animals meet stringent hygiene and sanitation standards, thereby minimizing microbial contamination risks. Research by Raifah (2018) highlights the significance of Good Manufacturing Practices (GMP) and Sanitation Standard Opera-

ting Procedures (SSOP) in slaughterhouses, which play a crucial role in reducing the presence of foodborne pathogens such as *Salmonella* and *Escherichia coli*. In the scope of NKV, GMP and SSOP serve as fundamental requirements that ensure hygiene and sanitation, forming the basis for HACCP implementation in meat processing facilities.Moreover, NKV certification enhances consumer confidence by guaranteeing that certified products adhere to food safety regulations, essential for domestic consumption and international market access (Lestariningsih *et al.*, 2020; Indriani *et a.l*, 2021).

Obtaining NKV certification requires businesses to comply with various regulatory and technical requirements. As stipulated in Government Regulation No. 95/2012, every unit handling animal based food products must apply to the Provincial Veterinary Authority under the jurisdiction of the Governor's office (Mandari *et al.*, 2022). The certification process involves on-site audits conducted by NKV Auditors, who assess compliance with veterinary public health regulations and determine whether a business meets the necessary hygiene and safety standards (Permentan No. 11/2020). Once certified, businesses must ensure NKV labels are prominently displayed on product packaging to provide traceability and inform consumers of the certification status. However, maintaining NKV certification requires continuous adherence to hygiene standards, as businesses are subject to routine surveillance audits. The frequency of these audits depends on compliance levels, with Level 1 businesses undergoing annual audits, Level 2 businesses being audited every six months, and Level 3 businesses requiring audits every four months (Permentan No. 11/2020). If a business fails to maintain these standards, authorities may issue warnings, impose temporary suspensions, or revoke the NKV certification altogether.

Despite its critical role in food safety, NKV implementation in Indonesia faces significant challenges. One of the primary obstacles is the limited awareness among small and medium enterprises (SMEs) regarding the importance of NKV certification. Many small-scale producers lack knowledge about the certification process and its benefits, resulting in low adoption rates (Raifah, 2018; Mandari *et al.*, 2022).

The absence of NKV certification for animal based food products can have serious consequences. Without proper certification, food safety risks increase due to potential contamination from biological, chemical, or physical hazards. This can lead to foodborne illnessses, reduced consumer trust, and market limitations for producers. Additionally, non-certified products may face restrictions in distribution, particularly in modern retail markets that require strict food safety compliance. Compliance costs pose a significant barrier, as businesses are often required to upgrade infrastructure and implement stricter hygiene protocols, which can be financially burdensome, particularly for SMEs (Lestariningsih *et al.*, 2020). Another major challenge is

inconsistent regulatory enforcement across different regions, leading to disparities in the application of NKV standards and undermining the overall effectiveness of the certification. Addressing these issues requires a uniform regulatory approach, increased government support, and financial assistance for small businesses to facilitate compliance. Enhancing education campaigns and providing incentives for certification could encourage wider adoption of NKV, ultimately strengthening food safety and consumer protection across Indonesia.

In conclusion, NKV certification is a fundamental requirement for ensuring the safety of animal-based food products in Indonesia. Establishing strict hygiene and sanitation protocols significantly reduces microbial contamination risks and enhances consumer confidence in locally produced meat, milk, and eggs (Direktorat Pengolahan dan Pemasaran Hasil Peternakan, 2023). However, challenges such as low awareness, high compliance costs, and inconsistent enforcement continue to hinder its widespread implementation. Future efforts should improve regulatory consistency, expand educational outreach, and provide financial support for SMEs to ensure broader compliance with NKV standards. Strengthening these measures will enhance food safety, improve Indonesia's ability to meet international food safety requirements, and expand its market reach.

### 1.2 The Halal Assurance System

The Halal Assurance System (HAS) is a structured framework designed to ensure that food products, particularly animal-derived ones, comply with Islamic law (shariah) (Direktorat Pengolahan dan Pemasaran Hasil Peternakan, 2023). In Indonesia, Halal standards are implemented by Law No. 33 of 2014 on Halal Product Assurance, which mandates that all consumable products, including meat, must obtain Halal certification (Atiah & Fatoni, 2019) This system encompasses various stages of the production process, including the selection of raw materials, slaughtering procedures, processing, packaging, storage, and distribution, ensuring that the entire supply chain adheres to Halal principles (Raifah, 2018). Given that Indonesia has the largest Muslim population in the world, the Halal Assurance System is critical for ensuring consumer confidence and compliance with religious dietary laws, the growth of global Moslem population will experience a 35 percent increment from 1.6 billion in 2010 to 2.2 billion people in 2030 (The Pew Research Center (2011) in Nurrachmi, 2016). Hence the Halal food market will continue to dominate the global food market due to Moslems have to consume Halal food regardless whether they live within Moslem majority or minority societies. (Nurrachmi, 2016). Hasan and Awang (2009) in Nurrachmi (2016) report that most of Halal food exporters come from non-Moslem countries such as Australia, Canada, France, and New Zealand who has less Moslem popula-

tion. This condition indicates that developed countries who export Halal food are well aware of the importance of Halal business because eventually the Halal niche market contributes significantly to their country's revenue.

Halal certification in Indonesia, particularly for beef and other meat products, follows strict guidelines outlined in the Indonesian National Standard (SNI) for Halal Slaughtering and is regulated by the Halal Product Assurance Agency (BPJPH) under the Ministry of Religious Affairs (Atiah & Fatoni, 2019). The slaughtering process must be performed by a trained Muslim slaughterer, who invokes the name of Allah before cutting the animal's throat in a swift motion to ensure the complete draining of blood, a crucial aspect of Halal compliance (Nurrachmi, 2016). Minister of Agriculture Regulation No. 11/2020 also reinforces hygiene and sanitation standards within slaughterhouses, aligning them with Halal and food safety protocols (Permentan No. 11/2020). Meat imports must also meet Halal requirements, and exporting countries must have recognized Halal certification bodies that comply with Indonesian Halal standards (Nurrachmi, 2016).

The implementation of HAS provides several benefits. Firstly, it enhances consumer trust and facilitates market expansion, particularly in Halal-conscious markets such as the Middle East, Malaysia, and other Southeast Asian nations. Halal certification strengthens the competitiveness of Indonesian food products, making them more attractive in domestic and international markets. Secondly, compliance with regulatory requirements is crucial for Indonesian beef producers (Direktorat Pengolahan dan Pemasaran Hasil Peternakan, 2023). Halal certification ensures that their products meet local and global standards, facilitating exports to countries with stringent Halal regulations (Raifah, 2018). Additionally, HAS is often integrated with other food safety management systems, such as HACCP and GMP, ensuring comprehensive compliance with religious and food safety standards.

Despite its importance, the implementation of HAS in Indonesia faces several challenges. One of the most significant issues is the complexity of the certification process, which involves detailed inspections of the entire supply chain, making it time-consuming and costly, particularly for small and medium-sized enterprises (SMEs) (Putri *et al.*, 2020). Moreover, awareness and understanding of Halal certification requirements remain inconsistent, with many small-scale producers underestimating its importance, leading to limited adoption and compliance (Raifah, 2018). Another major challenge is the lack of alignment between global Halal standards, as different countries have varying interpretations and criteria for Halal certification. This inconsistency complicates export opportunities for Indonesian beef producers, who must navigate differing Halal regulations across markets.

In conclusion, the Halal Assurance System ensures that beef and other meat products in Indonesia comply with Islamic dietary laws while maintaining high food safety standards. While regulatory frameworks, consumer trust, and market opportunities support its widespread adoption, challenges such as complex certification processes, lack of awareness, and global standardization issues hinder its full implementation. Addressing these challenges requires streamlining certification procedures, increasing awareness among producers, and promoting international harmonization of Halal standards. Strengthening these measures will not only enhance Halal compliance in Indonesia but also solidify the country's position as a leading global supplier of Halal-certified beef.

### 1.3 Hazard Analysis Critical Control Point (Haccp)

The Hazard Analysis Critical Control Point (HACCP) system is an internationally recognized framework for ensuring food safety by identifying, evaluating, and controlling hazards throughout the beef production chain (Chen *et al.*, 2022). In Indonesia, HACCP is legally mandated under the Indonesian National Standard (SNI) and must be implemented in all beef slaughtering and processing facilities. Specifically, SNI 7388:2009 sets microbial contamination limits for beef products, while SNI 3932:2008 outlines hygiene and sanitation requirements in meat processing (BSN, 2009). The Codex Alimentarius serves as a global reference for food safety, emphasizing that HACCP relies on prerequisite programs, including Good Manufacturing Practices (GMP) and Sanitation Standard Operating Procedures (SSOP), to establish a strong foundation for food hygiene and hazard control (Codex Alimentarius Commission, 1997; Indriani *et al.*, 2021). In meat handling, GMP ensures proper facility design, equipment maintenance, and operational hygiene, while SSOP focuses on sanitation measures such as water quality, cleaning procedures, and pest control. The Indonesian Ministry of Industry Regulation No. 75 of 2010 outlines 18 key components of GMP, including raw material control, personnel hygiene, and waste management, as well as 8 components of SSOP, covering aspects such as sanitation procedures and equipment cleaning. These prerequisite programs are essential for HACCP implementation in meat processing, as they minimize contamination risks and provide a structured approach to food safety management, ensuring compliance with both national and international standards. Applying HACCP is essential for ensuring compliance with national and international food safety regulations, particularly for beef producers exporting to countries with stringent food safety requirements (Chen *et al.*, 2022).

HACCP implementation in Indonesia's beef industry offers several key benefits. Firstly, it reduces contamination risks from biological hazards such as *Salmonella, Escherichia coli*, and *Listeria monocytogenes*, which are

significant concerns in the handling and storing of raw beef (Mandari *et al.*, 2022; Zulfikar, 2022). Critical control points (CCPs) in slaughterhouses and meat processing plants, such as carcass chilling, temperature control, and proper sanitation, have been shown to lower these pathogens' prevalence significantly (Putri *et al.*, 2020). Secondly, HACCP improves economic efficiency by reducing product recalls, spoilage, and financial losses, thereby enhancing the competitiveness of Indonesian beef in both domestic and international markets (Raifah, 2018). Thirdly, compliance with HACCP enables access to premium global markets, as many countries require HACCP certification for imported beef, making it a key prerequisite for Indonesian beef exports.

However, despite its advantages, HACCP implementation in Indonesia's beef industry faces significant challenges. One of the main obstacles is the high cost of implementation, particularly for small and medium-sized enterprises (SMEs). Setting up HACCP systems requires substantial investments in infrastructure, specialized equipment, and training, making it financially burdensome for smaller slaughterhouses and processors (Putri *et al.*, 2020). Another significant issue is limited technical knowledge and awareness among meat producers, especially in traditional slaughterhouses and wet markets, where food safety regulations are often poorly enforced (Raifah, 2018). Additionally, regulatory inconsistencies across Indonesia's provinces hinder uniform enforcement of food safety standards. A survey by Japan International Cooperation Agency [JICA], 2012; World Health Organization [WHO], 2023; Berdikari Consulting, 2024, revealed that only 45% of provincial-level regulatory bodies conduct routine HACCP compliance checks, leading to significant disparities in food safety enforcement across regions.

Case studies in HACCP application within Indonesia's beef industry highlight successes and areas needing improvement. A study on Asal Seiya Sekata (ASESE), Ltd., a West Sumatran beef jerky (dendeng) producer, demonstrated that implementing HACCP by identifying CCPs such as boiling, frying, and packaging significantly reduced contamination risks, ensuring a safer final product (Putri *et al.*, 2020). Similarly, in HACCP-certified cold storage facilities, maintaining critical temperatures at -18˚C has effectively prevented bacterial growth and spoilage in frozen beef products (Zulfikar, 2022). However, many traditional slaughterhouses and meat vendors continue to operate without standardized HACCP protocols, leading to inconsistent beef quality and potential food safety hazards (Raifah, 2018).

In conclusion, HACCP plays a pivotal role in safeguarding food safety in Indonesia's beef industry, ensuring compliance with SNI standards and Codex Alimentarius guidelines. While HACCP implementation enhances food safety, reduces economic losses, and strengthens consumer confidence,

challenges such as high costs, lack of expertise, and uneven enforcement continue to hinder its widespread adoption. To address these barriers, government incentives, training programs, and stricter regulatory enforcement are needed to promote HACCP adoption across all levels of the beef supply chain. Strengthening HACCP compliance will be essential for maintaining Indonesia's beef industry competitiveness in the global market while ensuring consumer food safety.

## 2. Comparative Analysis: Local Vs. Imported Beef

Imported beef benefits from well-established quality assurance systems, including HACCP certification and strict Halal compliance, making it a preferred choice for premium markets such as hotels, restaurants, and supermarkets. In contrast, Indonesia's local beef production is strongly rooted in Halal requirements, which gives it a unique advantage in catering to the domestic Muslim consumer base. However, HACCP enforcement remains inconsistent, particularly in smaller processing facilities, leading to variations in quality control and food safety risks (Raifah, 2018). These inconsistencies contribute to differences in the physicochemical and microbiological quality of local and imported beef. Imported beef, particularly from Australia, generally meets higher standards in terms of marbling, tenderness, and shelf-life due to controlled breeding, feeding, and cold chain management. From a chemical perspective, imported beef is often monitored for antibiotic residues, heavy metals, and pesticide contamination, ensuring compliance with international food safety standards. Biologically, imported beef undergoes strict pathogen control measures, including HACCP-certified slaughtering and processing, reducing the prevalence of *Salmonella*, *Escherichia coli*, and *Listeria monocytogenes*. In contrast, local beef quality varies due to differences in slaughtering practices, inadequate cold chain infrastructure, and inconsistent HACCP implementation. Addressing these inconsistencies presents an opportunity for Indonesia to enhance its competitiveness through improved regulatory integration, stricter enforcement of quality assurance systems, and increased adoption of HACCP.

Unlike Australia, where HACCP is legally mandated for all meat exports, Indonesia has yet to implement nationwide enforcement across all slaughterhouses due to financial constraints and regulatory inconsistencies (Sahari *et al.*, 2024). While this has given Australian beef a competitive edge, Indonesia can leverage its well-established Halal Assurance System to strengthen market positioning. By integrating HACCP more comprehensively with the existing Halal framework, Indonesia can address key compliance gaps. Strengthening regulatory enforcement, particularly through mandatory audits and financial incentives for SMEs, would ensure a more uniform adoption of HACCP across the industry. This strategy would not only improve domestic food safety but also

provide Indonesia with a competitive advantage in international Halal markets, especially in Southeast Asia and the Middle East.

The preference for imported beef in premium markets is largely driven by its well established quality assurance systems. To bridge this gap, Indonesia has the opportunity to strengthen its domestic standards by integrating HACCP more comprehensively with its existing Halal Assurance System. Instead of perceiving imported beef as superior, the country can enhance its quality assurance infrastructure to align with both domestic and global standards. With strategic investments in cold chain logistics, regulatory consistency, and HACCP training for small and medium-sized slaughterhouses, Indonesia's beef industry can reduce its reliance on imports while boosting consumer confidence in locally sourced beef (Agus & Widi, 2018).

Recognizing these gaps not only highlights areas of improvement but also showcases opportunities for Indonesia to differentiate its beef industry through an integrated approach to Halal and food safety compliance. In Indonesia, the Nomor Kontrol Veteriner (NKV) is a mandatory certification ensuring hygiene and sanitation in meat handling and processing facilities, as regulated under Government Regulation No. 95/2012 and Minister of Agriculture Regulation No. 11/2020. However, many small and medium-sized slaughterhouses struggle to obtain NKV certification due to infrastructure limitations, lack of training, and inconsistent enforcement (Direktorat Jenderal Peternakan dan Kesehatan Hewan, 2023).

Table 1. Comparison of Quality Assurance Systems in Local and Imported Beef

| Aspect | Local Beef (Indonesia) | Imported Beef (Australia) |
|---|---|---|
| Halal Certification | Mandatory, regulated by BPJPH and MUI | Voluntary but widely adopted for export purposes |
| NKV Certification/ Implementation | Required for licensed slaughterhouses, but limited enforcement in small-scale facilities | Not applicable (Austra-lia follows national food safety regulations) |
| HACCP Compliance | Limited adoption, primarily in large-scale facilities | Mandatory for all export-oriented meat processing plants |
| Consumer Perception | Lower due to inconsistent quality control | Higher due to internationally recognized safety standards |

Simultaneously, the Halal Assurance System (HAS) is governed by Law No. 33/2014 on Halal Product Assurance, requiring all meat products to comply with Islamic dietary laws. This system mandates that slaughtering must be performed by a trained Muslim butcher, with proper invocation and complete blood drainage to ensure Halal integrity (Atiah & Fatoni, 2019). Despite its significance, the implementation of Halal certification in Indonesia faces challenges, including variations in slaughtering practices, limited awareness among small-scale producers, and the need for stricter monitoring along the supply chain (Nurrachmi, 2016).

Since both NKV and Halal certification emphasize hygiene, sanitation, and traceability, their integration within the beef industry is essential for ensuring food safety while maintaining religious compliance. Strengthening regulatory enforcement, increasing industry awareness, and providing financial incentives for small slaughterhouses are crucial steps to improving compliance and enhancing Indonesia's competitiveness in the global Halal meat market.

### 3. Comparative Perspective: Lessons From Malaysia and Australia

Indonesia can enhance its beef industry's food safety and halal assurance by adopting best practices from Malaysia and Australia. These countries were chosen for comparison because they have well-established regulatory frameworks that ensure compliance with stringent food safety and halal standards. Malaysia is recognized for its comprehensive halal certification system, which aligns with global halal requirements, while Australia is a major beef exporter to Indonesia with a robust food safety and traceability system. Learning from their approaches can provide valuable insights for improving Indonesia's regulatory framework and industry practices.

While Indonesia's halal certification primarily ensures religious compliance, its integration with food safety regulations is still evolving (Sariyah, 2023). A more holistic approach can be seen in Malaysia, where JAKIM has successfully developed a system that not only guarantees halal integrity but also incorporates stringent hygiene, traceability, and food safety measures across the entire supply chain (Halal Foundation, 2022). Indonesia can adopt Malaysia's approach by enhancing synergy between the Indonesian Ulema Council (MUI), the Halal Product Assurance Agency (BPJPH), and the Ministry of Agriculture. The MUI is responsible for determining the halal status of products, the BPJPH for issuing halal certificates, and the Ministry of Agriculture for overseeing food safety standards. This collaboration can ensure that halal certification incorporates robust food safety protocols. Additionally, Indonesia's Veterinary Control Number (NKV) is mandatory for slaughterhouses, yet challenges in enforcement and compliance persist, especially among SMEs (Anggraini *et al.*, 2021). Malaysia's Veterinary Health Mark (VHM) has been successfully

integrated into national food safety regulations, allowing for more effective oversight. Indonesia can improve its enforcement by providing technical and financial assistance to SMEs, streamlining certification processes, and strengthening inspection mechanisms at regional levels.

Hazard Analysis and Critical Control Points (HACCP) compliance in Indonesia is required for large-scale slaughterhouses but struggles with enforcement in smaller facilities due to financial and technical limitations (Wicaksani & Adriyani, 2018). HACCP is a systematic preventive approach to food safety that addresses physical, chemical, and biological hazards as a means of prevention rather than finished product inspection. In contrast, Australia mandates HACCP across all meat processing plants, ensuring consistent food safety standards through government backed audits (Sahari *et al.*, 2024). Indonesia can enhance HACCP adoption by implementing structured government programs that provide subsidies, training, and incentives for SMEs to achieve certification. Furthermore, Indonesia remains heavily reliant on beef imports due to gaps in local production and food safety compliance (Sariyah, 2023). Malaysia has positioned itself as a regional halal food hub through rigorous halal and safety standards, while Australia dominates the global beef export market with its strict regulatory framework. By strengthening the integration of halal assurance, NKV, and HACCP, Indonesia can enhance consumer confidence, improve local beef quality, and reduce dependency on imported beef.

By learning from Malaysia and Australia, Indonesia can develop a more resilient beef industry that ensures halal integrity, food safety, and global market competitiveness. Strengthening regulatory enforcement, improving HACCP adoption, and integrating food safety with halal certification are crucial steps toward achieving a robust and competitive beef industry in Indonesia. The adoption of these best practices can lead to improved consumer confidence, higher quality local beef, reduced dependency on imported beef, and a stronger position in the global market.

Table 2. Comparative Analysis of HAS, NKV, and HACCP Implementation

| Aspect | Indonesia | Malaysia | Australia |
|---|---|---|---|
| Halal Assurance System | Managed by BPJPH & MUI, but focuses more on religious compliance than integrated food safety (Sariyah, 2023). | Overseen by JAKIM, which has a globally recognized and structured halal certification system (Halal Foundation, 2022). | Halal certification is voluntary but widely adopted for exports, with multiple Islamic certification bodies ensuring compliance (Sahari *et al.*, 2024). |
| Veterinary Control Number (NKV) / Equivalent | NKV certification is mandatory for slaughterhouses but faces challenges in enforcement, particularly in SMEs (Anggraini *et al.*, 2021). | Malaysia implements the Veterinary Health Mark (VHM), which ensures hygiene and food safety compliance in processed meat products. | Australia enforces strict food safety standards through Safe Meat Australia and AUS-MEAT, with strong government-backed traceability systems like the National Livestock Identification System (NLIS) (Sahari *et al.*, 2024). |
| HACCP Implementation | Mandatory for large slaughterhouses but poorly enforced in smaller facilities due to financial constraints (Wicaksani & Adriyani, 2018) | HACCP is compulsory for export oriented beef processors, and government programs support SME compliance (Halal Foundation, 2022). | HACCP is legally required for all meat processors, with strict government and industry collaboration ensuring high compliance (Sahari *et al.*, 2024). |
| Regulatory Enforcement | Regional inconsistencies in enforcement, with limited monitoring in smaller slaughterhouses (Anggraini *et al.*, 2021). | Strong centralized oversight by JAKIM and the Ministry of Health, ensuring uniform compliance across regions. | Highly structured and strictly enforced regulations, with independent auditing and frequent inspections (Sahari *et al.*, 2024). |
| Market Competitiveness | High demand for halal-certified beef, but relies on imports to meet domestic consumption needs (Sariyah, 2023). | Malaysia is a major halal beef exporter, supplying markets across Southeast Asia and the Middle East (Halal Foundation, 2022). | Australia is one of the world's largest halal beef exporters, supplying Indonesia, Saudi Arabia, and UAE (Sahari *et al.*, 2024). |

## 4. Challenges in Implementing Quality Assurance Systems

Implementing comprehensive food safety systems such as NKV and HACCP in Indonesia's beef production faces several key challenges. One of the primary barriers is the high cost of implementation, particularly for small-scale slaughterhouses and meat processors. A study by Asmara *et al.* (2021), Hasna & Ardiansah (2023) found that the average cost of upgrading infrastructure to meet HACCP standards in Indonesia ranges from IDR 500 million to IDR 1 billion per facility, which is a significant financial burden for SMEs. Establishing HACCP compliant facilities requires specialized infrastructure, continuous monitoring, and trained personnel, which can be prohibitively expensive (Zulfikar, 2022). For instance, strict temperature control for frozen meat storage demands high capacity cold storage units, costing upwards of IDR 500 million per facility. This is unaffordable for many SMEs, as only 23% of small and medium sized slaughterhouses in Indonesia have adequate cold storage systems. Additionally, studies indicate that while large companies such as PT Elders Indonesia have successfully implemented GMP and SSOP, around 65% of smaller producers still lack the resources to adopt HACCP due to financial constraints and limited technical knowledge (Inagi (2023); MK Academy (2024); Raifah (2018)).

Another significant challenge is the limited awareness and adoption of food safety regulations among small holder farmers and slaughterhouse operators. A recent study found that only 35% of slaughterhouses in Java comply with HACCP principles, primarily due to a lack of knowledge about the benefits and requirements of HACCP and NKV certification (Anggraini *et al.*, 2021). Many traditional slaughterhouses and meat processors operate without formal HACCP plans, not only due to financial constraints but also because of the perception that HACCP is unnecessary for local markets. A Japan International Cooperation Agency [JICA], 2012; World Health Organization [WHO], 2023; Berdikari Consulting, 2024 found that 45% of slaughterhouse operators were unaware of HACCP benefits, highlighting the urgent need for targeted awareness programs and government led training initiatives. In contrast, Malaysia and Australia have structured government programs that provide financial assistance and technical training to promote HACCP adoption among SMEs (Halal Foundation, 2022). Furthermore, regulatory inconsistencies across Indonesia's provinces hinder uniform enforcement of food safety standards (Hasna & Ardiansah, 2023). A survey revealed that only 45% of provincial level regulatory bodies conduct routine HACCP compliance checks, resulting in significant disparities in enforcement, particularly in rural slaughterhouses where oversight is minimal. A survey reported that 40% of slaughterhouses in rural areas lack regulatory supervision,

exacerbating the challenge of uniform food safety implementation.

It is crucial to emphasize the need for industry participation in addressing these challenges, as their involvement is key to improving food safety in Indonesia. By adopting structured government interventions, providing financial incentives, and improving education on food safety management, Indonesia can bridge existing gaps and enhance the overall quality assurance system within its beef industry.

In Indonesia, the Veterinary Control Number (NKV), Halal Assurance System (HAS), and Hazard Analysis Critical Control Point (HACCP) are three essential frameworks that ensure the safety, hygiene, and compliance of meat products with both national and international standards. NKV, regulated under Ministry of Agriculture Regulation No. 11/2020, serves as a mandatory certification verifying hygiene and sanitation in slaughterhouses and meat processing facilities. This certification ensures that animal-based food products meet public health and food safety requirements. Meanwhile, the Halal Assurance System (HAS), mandated by Law No. 33/2014 on Halal Product Assurance, guarantees that meat products adhere to Islamic dietary laws. This system requires proper slaughtering practices conducted by trained Muslim butchers, complete blood drainage, and strict segregation from non-halal substances throughout the supply chain. Additionally, HACCP, based on Codex Alimentarius guidelines, functions as a systematic preventive approach to food safety by identifying and controlling biological, chemical, and physical hazards in meat processing.

These three systems are interconnected, forming a comprehensive food safety and quality assurance framework. NKV acts as a prerequisite for both Halal and HACCP certification, as it ensures that slaughterhouses and processing facilities comply with hygiene and sanitation regulations before applying for additional certifications. Halal certification complements NKV by incorporating religious compliance requirements, ensuring that meat products meet both hygiene standards and Islamic principles. HACCP further reinforces these systems by implementing a risk-based food safety management approach, identifying critical control points (CCPs) to prevent contamination and ensure consistent product quality. Despite their complementary roles, these systems are currently implemented separately, often resulting in inefficiencies and regulatory redundancies.

To optimize their effectiveness, an integrated approach should be established through a unified regulatory framework. This could involve the harmonization of NKV, Halal, and HACCP certification processes, reducing administrative burdens on meat processors and ensuring a streamlined inspection system. Joint auditing and inspection mechanisms could be introduced, enabling regulatory bodies to assess compliance with all three

Table 3. SWOT Analysis of Halal and Food Safety Systems in Indonesia's Beef Industry

| Factor | Description |
|---|---|
| Strengths (S) | • Indonesia's robust demand for Halal-certified beef is underscored by its prioritization of the Halal Assurance System (SJPH), a key factor in the country's commitment to food safety and potential for market growth.<br>• NKV provides a structured certification process to ensure compliance with food safety.<br>• HACCP is internationally recognized, allowing for better market access and export potential. |
| Weaknesses (W) | • There's a pressing need for improved awareness and understanding of food safety systems among small and medium enterprises (SMEs), a crucial area that requires immediate attention.<br>• High implementation costs, particularly for HACCP, require significant infrastructure and training investment.<br>• Inconsistent enforcement and monitoring across different regions in Indonesia. |
| Opportunities (O) | • The increasing consumer preference for food safety and Halal-certified products domestically and internationally presents a significant opportunity for growth and market expansion.<br>• Government initiatives and policies supporting the adoption of HACCP, NKV, and Halal certification in slaughterhouses.<br>• Potential partnerships with international organizations to align local standards with global food safety requirements. |
| Threats (T) | • Strong competition from imported beef, mainly from Australia, already complies with international food safety and Halal standards.<br>• Halal certification standards vary between Indonesia and international markets, creating potential trade barriers.<br>• Limited financial incentives and support for SMEs to implement food safety systems. |

frameworks simultaneously. Additionally, a digital traceability system linking NKV, Halal, and HACCP certification records could enhance transparency and accountability across the supply chain. Learning from international best practices, particularly from Malaysia's integrated Halal and food safety system under JAKIM and Australia's strict HACCP-based

meat export regulations, Indonesia can strengthen its regulatory landscape. By establishing a more structured integration of NKV, Halal, and HACCP, Indonesia's meat industry can enhance its competitiveness in both domestic and global markets, ensuring food safety while maintaining Halal integrity.

### 5. Benefits of Implementing Food Safety Systems

Adopting Good Manufacturing Practices (GMP), Sanitation Standard Operating Procedures (SSOP), NKV, and HACCP offers numerous advantages for Indonesia's beef industry. Compliance with international food safety standards enhances consumer trust and market confidence, particularly among export oriented businesses (Indriani *et al.*, 2021; Zulfikar, 2022). NKV, a key component in this context, plays a crucial role in ensuring the safety and quality of beef products. By aligning with global food safety frameworks, Indonesia can reduce import dependency and expand its market reach. Strengthening domestic quality assurance systems will boost Indonesia's ability to compete with major beef-exporting countries such as Australia and Brazil. Complying with international food safety requirements, such as HACCP and GMP, will open new opportunities for Indonesian beef exports, particularly in Halal-sensitive markets such as the Middle East and Southeast Asia (Raifah, 2018). These comprehensive food safety measures not only reduce contamination risks and minimize foodborne illnesses but also have the potential to significantly increase profitability for local meat processors (Putri *et al.*, 2020), providing a strong incentive for their adoption.

## CONCLUSION

Integrating the Halal Assurance System (HAS), Veterinary Control Number (NKV), and Hazard Analysis Critical Control Point (HACCP) is crucial for ensuring food safety and improving the competitiveness of Indonesia's beef industry. However, small and medium sized slaughterhouses (RPHs) face challenges such as financial limitations, lack of technical knowledge, and inconsistent enforcement of regulations. To overcome these obstacles, a multi-stakeholder collaboration is needed. The government, industry, and academic institutions must work together to support slaughterhouses. The government should create a centralized monitoring system, provide financial aid and training, and ensure consistent enforcement of regulations across provinces. Additionally, agencies such as BPJPH, the Ministry of Agriculture, and MUI must improve coordination to make Halal certification and food safety processes more efficient. The beef industry should take gradual steps to implement HACCP, invest in better cold chain logistics and digital tracking, and collaborate with international partners like Meat & Livestock Australia (MLA) to improve industry standards. By strengthening this integration, Indonesia can enhance the quality, safety, and marketability of its beef products while ensuring compliance

nce with both food safety and Halal standards.

By implementing these strategic measures, Indonesia can enhance consumer confidence, improve the quality and safety of locally produced beef, and reduce its reliance on imported meat. Strengthening the integration of HAS, NKV, and HACCP will elevate Indonesia's position in the global Halal market and contribute to sustainable food safety practices, economic growth, and long-term industry resilience.

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