SUPPLY CHAIN RISK OF ANIMAL WELFARE, HALAL, AND FOOD SAFETY AT RPH JATIMULYA AND KRANJI MARKET IN BEKASI CITY

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Abstract: Risk management was needed to minimize economic loss due to risks related to animal welfare, halal, and food safety and was necessary for sustainable business development. This study identified risk factors and agents, analyzed risk impacts, and determined the effectiveness of mitigation strategies in their application to risk agents related to animal welfare, halalness, and safety at the Jatimulya abattoir and Kranji market meat retailers in the same supply chain of the beef industry in Bekasi City using the 2-Phase House of Risk (HOR) method. The results showed that there were 14 risk events caused by 16 risk agents at Jatimulya abattoir and 7 risk events caused by 11 risk agents at Kranji market beef retailers. The risk agents that had the potential to cause the largest risk events at RPH Jatimulya were bruises on cattle (A1), knives and tools not being sterilized before use (A8), and the absence of a cooler for storing meat after slaughter (A14). As for retail traders in Kranji market, the hands of sellers and buyers were not sterile (A18), knives and tools were not sterilized (A20), and meat storage in the freezer was mixed with other goods (A25). Priority risk mitigation strategies for Jatimulya abattoir were adjustment of overcrowded pen capacity (PA2), creating SOPs for the use of tools and making a place to sterilize tools (PA4), and renting cold storage (PA7). Meanwhile, the Kranji market beef retailers provided rubber gloves for buyers (PA9), created SOPs for the use of tools and the creation of tool sterilizers (PA12), and provided special refrigerators to store meat products (PA14).

Keywords: risk management, beef, animal welfare, halal, food safety

Abstrak: *Manajemen risiko diperlukan untuk meminimalkan kerugian ekonomi akibat risiko terkait kesejahteraan hewan, kehalalan dan keamanan pangan, serta diperlukan untuk pengembangan bisnis yang berkelanjutan. Penelitian ini mengidentifikasi faktor dan sumber risiko, menganalisis dampak risiko, dan menentukan efektivitas strategi mitigasi dalam penerapannya terhadap sumber risiko terkait kesejahteraan hewan, kehalalan, dan keamanan pangan di RPH Jatimulya dan pedagang daging di Pasar Kranji yang berada dalam satu rantai pasok industri daging sapi di Kota Bekasi. Penelitian ini dilakukan dengan menggunakan metode House of Risk (HOR) 2 Fase. Hasil penelitian menunjukkan bahwa terdapat 14 kejadian risiko yang disebabkan oleh 16 sumber risiko di RPH Jatimulya dan 7 kejadian risiko yang disebabkan oleh 11 sumber risiko di pedagang daging sapi eceran pasar Kranji. Sumber risiko yang berpotensi menyebabkan kejadian risiko terbesar di RPH Jatimulya adalah memar pada sapi (A1), pisau dan peralatan tidak disterilkan sebelum digunakan (A8), dan tidak ada pendingin untuk menyimpan daging setelah disembelih (A14). Sedangkan untuk pedagang eceran di Pasar Kranji, tangan penjual dan pembeli tidak steril (A18), pisau dan peralatan tidak disterilkan (A20), dan penyimpanan daging di dalam freezer tercampur dengan barang lain (A25). Prioritas strategi mitigasi risiko untuk RPH Jatimulya adalah penyesuaian kapasitas kendang penampungan yang terlalu padat (PA1), membuat SOP penggunaan alat dan membuat tempat untuk mensterilkan alat (PA4), dan menyewa cold storage (PA7). Sementara itu, pedagang daging sapi di Pasar Kranji menyediakan sarung tangan karet untuk pembeli (PA9), membuat SOP penggunaan alat dan membuat tempat sterilisasi alat (PA12), dan menyediakan lemari pendingin khusus untuk menyimpan produk daging (PA14).*

Kata kunci: *daging sapi, keamanan pangan, kehalalan, kesejahteraan hewan, manajemen risiko*

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INTRODUCTION

Based on data from the Central Statistics Agency (BPS) (2022) in Figure 1, the average expenditure per capita per week to consume beef per district/city in rupiah is IDR 5,877. This makes Bekasi City the third city with the highest beef consumption in Indonesia after East Jakarta and South Jakarta. If converted into units of weight with the assumption that the price of meat is Rp140,000 per kilogram according to information from infopangan. jakarta.go.id (2023), the annual per capita beef consumption of Bekasi City residents is 2.2 Kilograms. According to data from the Dewan Perwakilan Rakyat Daerah Kota Bekasi (DPRD) (2022), Bekasi City's annual beef demand is 6,000 tonnes. Factors affecting beef demand in Bekasi City are beef price, per capita income, education, number of children in the family, consumer tastes, and the price of substitute goods such as the price of native chicken meat, broiler meat price (Munarka et al. 2015). In addition, Nurhuda et al. (2013) explained that economic growth also affects consumption, especially household consumption in Bekasi City.

According to the Kementerian Pertanian (2022), only 19% of beef is cooked at home, while the remaining 81% of beef is consumed as processed or ready-to-eat meat in hotels, restaurants, and cafes. This is in line with Apriantini et al. (2021) who explained that the type of business that buys the most frozen beef is the restaurant business, which is 44.44%. Ironically, the beef supply for hotels, restaurants and cafes is still largely met by frozen meat imports. Furthermore, business consumers buy more beef in frozen form, amounting to 63.93%. According to Burhani et al. (2013), this is due to the condition of the domestic beef supply, which is in a deficit condition, that is, the supply is lower than the demand. In addition, the product standards required by hotels, restaurants and cafes are quite high, especially with regard to halal, food safety, and even animal welfare, so not many local abattoirs and meat sellers are able to fulfill this demand. Members of the beef industry supply chain in Bekasi City generally only consist of collectors, abattoirs, retail meat sellers, hotels, restaurants, cafes (horeka), and households. Farmers who provide live cattle to the beef industry in Bekasi City come from outside the city, namely Bandung Regency, Cianjur, Serang, and Lampung. Supply chain risk management is an important issue to consider in the beef industry. The uncertainty of an event in supply chain activities is a risk that will impact business losses (Noerdyah et al. 2020).

Implementation of risk management, especially in relation to animal welfare, halalness and food safety that is not up to standard, risks causing economic loss for abattoirs and meat retailers. This is due to downgraded slaughter products that cannot be sold at their best price or even discarded due to quality that does not meet market demand. The worst risk of non-standard animal welfare risk management is the cessation of livestock supply to the abattoir. On the other hand, good risk management is needed especially for abattoirs to improve the classification of the abattoir itself in the beef supply chain and business development such as opening up opportunities to open new market shares not only to traditional markets, but also to supermarkets and even exports to international markets.

This research was conducted at a type C abattoir where the slaughter products (meat and others) can only be consumed and circulated within the inter-district area (Alpina et al. 2021), so there are still risks related to animal welfare, halal, and food safety. The same research conducted by Elvandra et al. (2018) in managing supply chain risks in cattle fattening at PT Catur Mitra Taruma. The identification results show that in mapping supply chain activities based on Supply Chain Operations References (SCOR) which is an integrated process of plan, source, make, and deliver, the source process has the most risks from a total of 29 risk events identified in the company. Based on the results of the risk handling analysis, there are recommendations for 10 priority risk mitigation actions that can be implemented at PT Catur Mitra Taruma in the prevention of supply chain risks that have the potential to arise in the company. The hypothesis of this study is that the implementation of risk management, especially with regard to animal welfare, halalness, and food safety at the Jatimulya abattoir and beef retail traders in the Kranji market, is still not up to standard.

The House of Risk method was used by Noerdyah et al. (2020) to mitigate the risk of animal welfare, halal, and security of the medium-scale broiler meat industry supply chain. The results showed that there were 38 risk events and 27 risk sources for animal welfare, halalness, and safety in the supply chain of the medium-scale broiler meat industry. The risk sources with the highest ARP values were mismanagement of broiler meat storage techniques by retailers (A26) with an ARP value of 144 and mismanagement of broiler meat storage by slaughterhouses (A15) with an ARP

value of 126. These risk sources are also prioritized based on the Pareto Diagram with a cumulative value of 30.65% of the overall value of priority risk sources in the medium-scale broiler meat industry supply chain can be prevented from occurring by implementing risk mitigation strategies based on priorities including counseling on meat handling hygiene (PA5), counseling on halal product storage (PA3), and the use of ice cubes when the electricity goes out (PA6). These mitigation strategies are expected to improve aspects of animal welfare, halalness, and safety in the supply chain of the medium-scale broiler meat industry. Risk management is needed to minimize economic loss due to risks related to animal welfare, halal and food safety and is necessary for sustainable business development (Choirun et al. 2020). This research uses a qualitative exploratory approach with direct observation and conducting interviews on both supply chains mentioned earlier. The purpose of this research is to identify risk factors and agents, analyze risk impacts, and determine the most feasible risk mitigation strategies to be applied to risk sources related to animal welfare, halalness, and food safety in the beef industry supply chain at RPH Jatimulya and Kranji Market, Bekasi City.

METHODS

Research was conducted at the Jatimulya abattoir and beef retailers in Kranji Market, Bekasi City within the same supply chain. Jatimulya Abattoir was chosen as the research location because of the abattoir's desire to expand its business and market share not only to traditional markets, but also to modern markets, hotels, and restaurants. Data collection and processing was carried out from June to August 2023. The approach taken was a qualitative approach, where data collection was carried out using observation and questionnaire survey methods of pre-determined sources. Data validity and reliability are tested based on several criteria, namely credibility, transferability, dependability, and confirmability (Afiyanti, 2008). This research uses primary and secondary data. Primary data was obtained from questionnaires and observation. The questionnaire was given to the head of the production unit, while for the operators, they were interviewed on what incidents might occur related to animal welfare, halal and food safety. Then they were asked about their projections of how often such incidents occur and what the impact of such incidents is. This is in line with Widhiani et al. (2022) who explained that

the head of production had attended risk management training, making it easier for him to answer questions about the risk assessment process. The identification of risk events and risk sources in each supply chain activity was then carried out based on literature studies and interviews with expert respondents, namely the owner and employees of Jatimulya abattoir. The employees interviewed included three people in charge of handling livestock in cages, one employee in charge of the stunning process, and one halal slaughterer. Then the owner and two employees of beef retailers in Kranji Market, Bekasi City. However, it is quite difficult to understand the concept of risk and risk management for his subordinates. Secondary data comes from the company's historical data and also various literature. To determine the respondents for this study, expert judgment was used.

HOR Phase 1 (HOR-1)

HOR-1 begins by mapping supply chain activities based on Supply Chain Operations References (SCOR) which is an integrated process of plan, agents, make, and deliver (Astuti et al. 2017). Next step is assessing risk events, risk agents and the correlation between risk events (Ei) and risk agents (Ai). The assessment of the severity (Si) of risk events is carried out using a Likert scale of 1-5 as found in Godfrey (1996) which indicates that the risk event has no impact on the supply chain of the medium-scale beef industry in Bekasi City. The risk agent occurrence (Oj) was assessed using a scale of 1-5 as found in Godfrey (1996), indicating that the risk agents almost never appears until it almost certainly appears in the beef industry supply chain in Bekasi City. The correlation assessment between the risk occurrence and the risk agents (Rij) is then carried out with values of 0, 1, 3, and 9 which indicate no linkage, low linkage, moderate linkage, and strong linkage. The next stage in HOR-1 is the calculation of the Aggregate Risk Potential (ARP) value. ARP is used as a consideration in determining the priority ranking (Pi) of risk agents that need to be given more attention. The ARP calculation of the risk agents (ARPj) as explained by Pujawan and Geraldin (2009) can use the following formula:

$$ARPj = Oj\sum_{i=1}^{n} Si \times Rij$$

The results of the HOR-1 assessment and calculation are presented in Table 1.

Table 1. HOR 1

Risk Events	Risk Agent					Si
	A1	A2	A3	A4	A5	
E1	R11	R12	R13	…	…	S1
E2	R21	R22	…	…	…	S2
E3	R31	…	…	…	…	S3
…	…	…	…	…	…	S4
Ei	…	…	…	…	…	S5
Oj	O1	O2	O3	…	On	
ARPj	ARP1	ARP2	ARP3	…	ARPn	
Pi	P1	P2	P3	…	Pn	

Risk status can be known by combining likelihood and effect. The risk status is obtained by multiplying the assessment of the level of impact or severity (Si) on the risk event with the assessment of the level of occurrence of the risk agents or occurrence (Oj) of the risk agents. The risk map will assist in positioning the risk status, so that the handling will be more comprehensive. The risk status can be seen in the risk map presented in Figure 1.

HOR phase 2 (HOR-2)

HOR phase 2 (HOR-2) was used in this study to prioritize the most effective risk mitigation by considering reagents. The selection of risk agents is done in HOR-2 based on the order of ARP values from the highest using the Pareto Principle (Pujawan and Geraldin, 2009). The Pareto Principle can be used for business and industry in improving quality. The Pareto Principle, namely 80/20, explains that 80% of risk events come from 20% of risk agents that are the cause (Sari et al. 2018). Determination of risk mitigation is then carried out by direct observation and interviews as well as brainstorming with expert respondents so that it is expected to get the right risk agents prevention action. Risk mitigation evaluation (Ejk) is conducted by assessing the correlation between mitigation strategies (Pai) and selected risk agents with values of 0, 1, 3, and 9 indicating no linkage, low linkage, moderate linkage, and strong linkage. The next stage is the calculation of the Total Effectiveness (Tek) value or the level of effectiveness of mitigation strategies in their application to risk agents as formulated by Pujawan and Geraldin (2009) as follows:

$$Tek = \sum_{j=1}^{n} ARPj \, Ejk$$

Degree of Difficulty (Dk) assessment was conducted to determine the level of difficulty of each selected risk mitigation strategy using a scale of 3-5 which indicates the level of difficulty of implementing low to high risk mitigation strategies. The next stage is the calculation of Effectiveness to Difficulty (ETDk) to determine the priority ranking of mitigation strategies (Rk) as formulated by Pujawan and Geraldin (2009) as follows:

$$ETDk = Tek/Dk$$

Priority ranking of risk mitigation strategies (Ri) is done based on the ETDk value with the highest value being the prioritized mitigation strategy.

Severity Level

Risk Matrix Analysis	Not Significant (1)	Minor (2)	Moderate (3)	Significant (4)	Very Significant (5)
Almost Certain (5)	5	10	15	20	25
Sometimes (4)	4	8	12	16	20
Often (3)	3	6	9	12	15
Rarely (2)	2	4	6	8	10
Almost Never (1)	1	2	3	4	5

(Occurrence Level)

Dangerous Level	Score	Description
Low	1-4	Can still be tolerated
Medium	5-12	Controlled to a tolerance limit
High	15-25	Intensive monitoring and controlling

Figure 1. Risk map

Risk Management Process

This research has a framework starting from determining the risk context, namely supply chain risk. Next, the researcher will identify supply chain risks related to animal welfare, halalness and food safety at the Jatimulya abattoir and beef retailers in Kranji Market, Bekasi City in the same supply chain into a risk register. The risks that have been identified in the risk register are then analyzed and evaluated for each risk. The risks that have been evaluated will then be treated for each risk.

RESULTS

Supply Chain of Beef Industry in Bekasi City

Indrajit and Djokopranoto (2002) explain that the supply chain is a concept where there is a regulatory system related to product flow, information flow and financial flow. Slow development and even business bottlenecks in the distribution of goods and services from producers to consumers are often caused by mistakes in choosing distribution channels. If not managed properly, the length of the supply chain in livestock products, especially beef, can lead to high costs, including transaction costs, transport costs, storage costs, packaging costs, damage costs and profits of each actor and others (Mulyadi, 2005).

Meat as a superior livestock commodity is agents from slaughterhouses (RPH). Related to the beef supply chain, there are several costs that must be incurred in each trading institution. The slaughterhouse has a role as a place for large traders to slaughter their cattle for sale to contractors and retailers. The abattoir, which is the highest supply chain in the beef industry in Bekasi City, West Java Province, is a public service unit that has technical, economic and imperial functions in slaughtering animals in Bekasi City and its surroundings. Before reaching consumers, it will pass through several links in the trade chain such as large traders and retailers. Meat consumers in Bekasi City are divided into 2 levels, including level 1 consumers consisting of hotels, hospitals, and processing traders. While level 2 consumers are consumers of processed beef products. The beef supply chain diagram in Bekasi City can be seen in Figure 2.
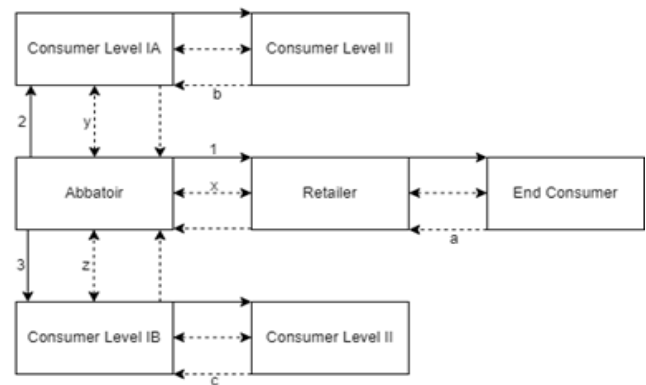

Figure 2. Channel patterns in the beef supply chain in Bekasi City (1, 2, 3 (Product Stream); a, b, c (Cash Flow); x, y, z (Information Flow); End Consumer (Fresh Beef Consumer); Consumer Level IA (Hotel and Hospital); Consumer Level IB (Meat Processed Trader); Consumer Level II (Consumers of processed beef product))

Jatimulya abattoir is in the first beef supply chain in Bekasi City and has a supply chain only to beef retailers in the wet market and end consumers. Jatimulya abattoir does not yet have a supply chain to hotels, hospitals or the meat processing industry.

Identification of Risk Factors and Agents in the Beef Supply Chain Related to Animal Welfare, Halal, and Food Safety

Based on the results (Table 3) of the identification of risk events in each activity that can affect aspects of animal welfare (AW), halalness (H), and food safety (KP) for business actors of RPH Jatimulya and retail traders in Pasar Kranji Bekasi City in one supply chain, there are 14 and 7 risk events respectively. The risks are classified into 3 animal welfare risks, 6 halal risks, and 10 food safety risks for RPH Jatimulya and 1 halal risk, and 6 food safety risks (Table 4). While the results of risk agents identification at the Jatimulya abattoir based on the results of respondents assessments showed 16 agents of risk (Table 5). While the results of risk agents identification at beef retail traders in Kranji Market, Bekasi City showed 11 agents of risk (Table 6).

Table 3. Risk event identification results at RPH Jatimulya

Code	Risk Events	Risk Classification
E1	Risk of meat in trim	AW
E2	Risk of livestock dying when stunned prior to slaughter	AW and H
E3	Risk of knives breaking and remaining in the meat during slaughter and processing	KP
E4	Risk of slaughter not reciting bismillah	H
E5	Risk of improper slaughter point	AW and H
E6	Risk of meat contamination from knives and utensils	KP
E7	Risk of incomplete blood discharge from the body	H and KP
E8	Risk of green innards and gallbladder rupture	KP
E9	Risk of contamination from wash water	KP
E10	Risk of perforation and leakage of packaging materials	KP
E11	Risk of meat not receiving all packaging materials	KP
E12	Risk of faster meat withering and spoilage	KP
E13	Risk of meat contamination during storage	KP and H
E14	Risk of beef contamination during shipping	KP and H

Table 4. Risk event identification results at Kranji Market Bekasi City

Code	Risk Events	Risk Classification
E21	Risk of remaining unsold products	KP
E22	Risk of meat being contaminated with bacteria when sold	KP
E23	Risk of knives breaking and remaining in the meat during slaughter and processing	KP
E24	Risk of contamination with contaminants from packaging materials	KP
E25	Risk that beef delivery time is not as planned	KP
E26	Risk of beef contamination during storage with products of unclear halal status	H
E27	Risk of unstable freezer beef storage temperature	KP

Table 5. Risk agents identification results at RPH Jatimulya

Code	Risk Agents	Code	Risk Agents
A1	Bruise on cattle	A9	Officer error in identifying livestock deaths
A2	Use of stunning equipment more than once by staff	A10	Staff error in separating offal
A3	Stunning positioning errors made by officers	A11	Leaching water that was not tested in the laboratory
A4	Poor tool maintenance management	A12	Packaging material quality is not good
A5	Officer error while performing work	A13	Packaging type and size not as planned
A6	Errors by halal slaughterers	A14	No cold storage for meat after slaughtering
A7	Rusty knives and tools	A15	Storage of meat products with offal in one container
A8	Knives and tools are not sterilized before use	A16	Storage of poorly packaged products

Table 6 Results of risk agents identification in retail traders in Kranji Market, Bekasi City

Code	Risk Agents	Code	Risk Agents
A17	Beef procurement from abattoirs exceeds demand	A23	Packaging type is not appropriate (Goods are packed using black plastic bags)
A18	Due to unsterilised hands of sellers and buyers	A24	Delivery order/request from customer is delayed
A19	Rusty knives and tools	A25	Storage of meat in the freezer mixed with other items
A20	As a result of unsterilised knives and equipment	A26	Unstable electricity voltage
A21	Poor tool maintenance management	A27	Freezer yang sudah tidak bekerja dengan baik
A22	Officer error while performing work		

Impact Analysis of Beef Supply Chain Risks Related to Animal Welfare, Halal and Food Safety

The result of the risk severity calculation at RPH Jatimulya is 43% moderate impact, 28% significant, and 29% very significant. Similar to RPH Jatimulya, all risks at beef retailers in Pasar Kranji have impacts ranging from minor to very significant. Based on the results of the calculation, the largest percentage is 43% of risks with significant impact, while 14% of risks with minor and moderate impact respectively. The results of the percentage assessment of the likelihood of occurrence of 29 work activities at the RPH Jatimulya show that the largest chance of an accident occurring is 37% rarely and the smallest chance is 6% almost never. Meanwhile, the results of the percentage assessment of the likelihood of occurrence of 19 work activities at Kranji Market beef retailers as found in Figure 6 show that the largest chance of accidents occurring is 28% often, and 18% each sometimes, rarely, almost certain, and almost never occur.

Risk Analysis Results Using the HOR Method phase 1

Based on the results of the calculation, the top 3 rankings of the largest ARP values at RPH Jatimulya were the bruise on cattle (A1), knives and tools were not sterilized before use (A8), and there was no cold storage for meat after slaughter (A14). The results showed that Jatimulya abattoir in 29 activities was medium risk as many as 10 (62%), high risk as many as 6 (38%).

The risk of meat in trim (E1) caused by bruising on the meat (A1) has a score of 25 or is in the red zone at a risk status where the risk is almost certain to occur and the severity of the risk is very high. This is done to reduce the potential incidence of bruising that can lead to meat in trim. Overcrowded cage capacity is a clear cause of bruising on carcasses due to interactions between animals and humans, animals and facilities, and animals and animals. In accordance with the statement of Strappini et al. (2012) that the causes of bruising can be divided into three types of interactions of livestock with humans, livestock with livestock, and livestock with facilities. Furthermore, adjusting the holding capacity is in accordance with the livestock welfare SOP. Livestock holding in abattoirs when animals are standing, must have sufficient space to assume a balanced position. When animals are lying down, animals should be able to assume a normal lying position, not on top of each other (MLA 2012). Similarly, the risk of meat contamination from knives and tools (E6) caused by knives and tools not being sterilized before use (A8) and the risk of faster meat withering and spoilage (E12) caused by no refrigeration for meat storage after slaughter (A14) are both in the red zone at risk status with a score of 20. Biological contamination hazards can be caused by several things including mold and bacteria. This is in accordance with the explanation of Frost et al. (1998) who said that in abattoirs biological hazards must be considered because it is a group of zoonotic agents consisting of pathogenic bacteria such as Salmonella entrica, E. coli O157:H7 and Listeria sp.

The top 3 largest ARP values in retail traders in Kranji Market, Bekasi City are the non-sterile hands of sellers and buyers (A18), unsterilised knives and equipment (A20), and storage of meat in the freezer mixed with other items (A25). The results showed that meat retailers in Kranji Market, Bekasi City in 19 activities were assessed from the risk table (Figure 10). The calculation results obtained low risk as much as 2 (18%), medium risk as much as 4 (36%), high risk as much as 5 (46%).

The risk of meat being contaminated with bacteria when sold (E22) from unsterilised hands of sellers and buyers (A18) has a score of 25 and from unsterilised knives and equipment (A20) has a score of 20 or is in the red zone of risk status where the risk is almost certain to occur and the severity of the risk is very high. Similarly, the risk of beef contamination during storage with products with unclear halal and hygiene status (A25).

Observations of retailers in the Kranji market showed that meat products that were not sold out were stored in freezers and mixed with other storage items such as food products, drinks, and others. Even though they are packaged using plastic, the risk of being contaminated by biological contaminants still exists. This is in accordance with the general guidelines of the halal assurance system of the Institute for Food, Drug and Cosmetic Studies of Majelis Ulama Indonesia (LPPOM-MUI) (2008) which explains that the storage procedure of materials/products must ensure the avoidance of materials/products from contamination by haram and unclean goods.

Observations of retailers at Kranji Market in Bekasi City showed that meat products that were not sold out were stored in freezers and mixed with other storage items such as food products, drinks, and others. Even though they are packaged using plastic, the risk of being contaminated by biological contaminants still exists.

Analysis of The Most Feasible Risk Mitigation Strategies To Be Applied To Risk Sources Related To Animal Welfare, Halalness, and Food Safety

The ARP value that has been obtained in HOR-1 is used as a basis for determining the priority of risk agents that need to be developed mitigation strategies. The next stage is to design mitigation strategies to be applied to prioritized risk agents. The design of mitigation strategies is obtained from the results of brainstorming with expert respondents in accordance

with the conditions of the business premises. The results of the design of several mitigation strategies obtained to minimize the possibility of risk agents at Jatimulya Abattoir and beef retail traders in Kranji Market, Bekasi City can be seen in Table 7.

The assessment of the correlation/relationship between risk agents and mitigation strategies carried out in HOR-1 is then used as the basis for determining the effectiveness of each mitigation strategy designed in dealing with emerging risk agents in the HOR-2 calculation. An assessment of the level of difficulty in implementing risk mitigation is also made based on the cost and human reagents capabilities of the Jatimulya Abattoir and retailers in Kranji Market, Bekasi City in the beef industry supply chain. The overall HOR-2 results for RPH Jatimulya can be seen in Table 8.

Table 7. Draft of some risk mitigation strategies

Code	Risk Agents	Code	Risk Mitigation
A4	There is a height difference between the vehicle body and the ramp	PA1	Renovate the ramp according to the height of the truck bed
		PA2	If the tailgate lid is opened sideways, a special lane is created that bridges the tailgate to the ramp
		PA3	If the tailgate lid can be opened downwards, bedding and metal matting are provided so that it is safe for livestock to pass through
A14	Knives and tools are not sterilized before use	PA4	Making SOPs regarding the use of tools and making tool sterilization stations
		PA5	Provide some knives and tools to be used interchangeably
A20	No refrigeration for meat storage after slaughtering	PA6	Purchase and install cold storage
		PA7	Renting cold storage
		PA8	Do not leave the meat too long and send it immediately after slaughtering
A24	Due to unsterilised hands of sellers and buyers	PA9	Provide rubber gloves to buyers
		PA10	Provide wastafel or hand sanitisers
		PA11	Make a display case or barrier so that buyers do not need to hold the product
A26	As a result of unsterilised knives and equipment	PA12	Making SOPs regarding the use of tools and making tool sterilization stations
		PA13	Provide some knives and tools to be used interchangeably
A31	Storage of meat in the freezer mixed with other items	PA14	Provide a freezer only for meat storage
		PA15	Performed data collection on products stored in the freezer

Table 8. Results of HOR-2 for RPH Jatimulya

	PA1	PA2	PA3	ARP
A4	9	9	9	225
TEk	2025	2025	2025	
Dk	3	5	4	
ETD	675	405	506	
Rank	1	3	2	
	PA4	PA5	ARP	
A14	9	9	180	
Tek	1620	1620		
Dk	3	4		
ETD	540	405		
Rank	1	2		
	PA6	PA7	PA8	ARP
A20	9	9	3	180
Tek	1620	1620	540	
Dk	5	4	3	
ETD	324	405	180	
Rank	2	1	3	

Table 9. HOR-2 results for meat retailers

	PA9	PA10	PA11	ARP
A24	9	9	3	225
TEk	2025	2025	675	
Dk	3	4	5	
ETD	675	506	135	
Rank	1	2	3	
	PA12	PA13	ARP	
A26	9	9	180	
TEk	1620	1620		
Dk	3	4		
ETD	540	405		
Rank	1	2		
	PA14	PA15	ARP	
A31	9	3	180	
Tek	1620	540		
Dk	4	3		
ETD	405	180		
Rank	1	2		

Priority mitigation strategies for the emergence of risk agents in the beef supply chain at RPH Jatimulya are adjustment of overcrowded pen capacity (PA2), creating SOPs for the use of tools and making a place to sterilize tools (PA4), and renting cold storage (PA7).

Sholichah (2017) explained that meat storage needs to be done at low temperatures to extend the shelf life and maintain meat quality. The storage process with freezing temperatures (-1.5°C) is able to destroy most pathogenic bacteria and slaughterhouses are places that are prone to and have a high risk of pathogenic microbial contamination (Ilahi 2021). The overall HOR-2 results for beef retail traders in Kranji Market, Bekasi City can be seen in Table 9. Meanwhile, the priority mitigation strategies for the emergence of risk agents in the beef industry supply chain at beef retail traders in Kranji Market, Bekasi City are providing rubber gloves for buyers (PA9), making SOPs for the use of tools and making a place to sterilize tools (PA12), and providing a special refrigerator to store meat products (PA14).

The environment where chicken and beef are sold is also very influential on the number of E. coli bacterial contaminants so it is necessary to pay attention to where the meat comes from because it is possible that the slaughterhouse does not experience contamination but when it is in the sales or market place it can provide an opportunity for contamination of E. coli bacteria in meat (Utari, 2016). Majelis Ulama Indonesia (2023) explains that in making food and beverages, apart from the main raw materials, there are also additives and processing aids.

Managerial Implication

Managerial implications for the prioritization of risk sources that need to be given greater attention or those with the highest ARP values are based on the mitigation strategies that are most likely to be carried out by both the Jatimulya Abattoir and beef retailers in Kranji Market, Bekasi City. The risk source is the height difference between the vehicle body and the ramp at RPH Jatimulya, management must immediately renovate the ramp so that it meets the standard, especially in terms of ramp height. So that livestock can descend and ascend to the transport vehicle properly without any risk of accidents.

Furthermore, for the risk of knives and tools not being sterilized before use, management must make SOPs for the use of tools and create a special place for tool sterilization. So that product contamination by microorganisms originating from knives and production tools can be minimized. This is also done by the management of beef retailers in Kranji Market, Bekasi City. Finally, to minimize the risk of not having a cooler for storing meat after slaughter,

the management must provide cold storage either by purchasing or renting. Cold storage serves to minimize the risk of meat spoiling quickly after slaughter.

To minimize the risk of unsterile hands of sellers and buyers, the management of beef retailers in Kranji Market, Bekasi City, should provide rubber gloves for buyers. This is to minimize the risk of microorganism contamination during the buying and selling process. Furthermore, to minimize the risk of meat storage in freezers being mixed with other goods, management should provide special freezers for meat storage. This is to minimize storage mixed with other goods whose halal and food safety status is unclear.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Meat distributed in the supply chain of Jatimulya Abattoir and Kranji Market in Bekasi City has not fulfilled the principles of animal welfare, halal, and food safety. This is because there are still potential risks that occur at the Jatimulya abattoir and beef retailers in Kranji Market, Bekasi City in the same supply chain, namely 14 and 7 risk events respectively. The results showed that the slaughterhouse in Jatimulya obtained medium risk as 10 (62%), high as 6 (38%). Meanwhile, research shows that meat retailers in Kranji Market, Bekasi City, in 19 activities obtained low risk as 2 (18%), medium risk as 4 (36%), high risk as 5 (46%).

Priority risk mitigation strategies for Jatimulya abattoir are adjustment of overcrowded pen capacity (PA2), making SOPs for the use of equipment and creating a tool sterilization station (PA4), and renting cold storage (PA7). Meanwhile, beef traders in Kranji Market provide rubber gloves for buyers (PA9), make SOPs for the use of tools and create a tool sterilization station (PA12), and provide a special refrigerator to store meat products (PA14).

Recommendations

The first beef producer in the beef supply chain in Bekasi City, can mitigate risks as outlined in this study. Especially if the abattoir wants to reduce the losses that have occurred so far, improve the abattoir classification, and expand the market. The regular risk mitigation supervision is needed at both the Jatimulya

abattoir and meat retailers by assigning individual and team responsibilities. Not only risks with high hazard levels, risks with medium hazard levels, but also need to be mitigated to reduce the impact of risks that occur with frequent occurrence rates.

The risk management analysis conducted in this study is based on the company's management point of view. Suggestions for future research are expected to expand the scope of research by involving stakeholders outside the company's internal. Risk assessment can not only be done on the supply chain but other operational activities or even other business units in the same research object.

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