STUDY OF PERCEPTIONS, ATTITUDES AND PRACTICES ON HAZARD ANALYSIS CRITICAL CONTROL POINT IN ACHIEVING FEED SAFETY COMPLIANCE OF INDONESIAN STOCK FEED PRODUCTION

Studi Tentang Persepsi, Praktek dan Sikap terhadap Sistem HACCP pada Industri Pakan Dalam Mencapai Kesesuaian Keamanan Pakan

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Abstract

Indonesian stock feed industry has developed rapidly in the last ten years. However, almost all the stock feed industry have not yet been implementing the feed safety system including the feed hygiene practices. Therefore, A study of perceptions, practices and attitudes on hazard analysis critical control point (HACCP) in achieving feed safety compliance of Indonesian stock-feed production has been conducted. This study was carried out using frame works of study as follows, i.e. Module I, Assessment on existing conditions using methods of survey, observe, interview, plant visit and distribute a questionnaire to medium and large feed industries at 6 provinces, i.e Lampung, Banten, West Java, Center of Java, East Java and South Sulawesi with the number of samples for respondents about 20 feed industries; They were also asked about the feed hygiene practices in their business, their systems used such as HACCP, and the perceptions and attitudes toward a range of feed hygiene issues; Module II, Identification of potential critical control points; Module III, Evaluation of HACCP programs. The analysis was conducted using descriptive analysis method that developed by Hair *et al*. and to test the difference using one-way statistical analysis of variance. The results showed that the HACCP systems were implemented at 95% in the large feed industries and 65% in the medium feed industry, respectively (P< 0.005); 30% medium and 15% of large feed industry managers stated that their business represented a low-risk to feed safety. Higher levels of feed hygiene qualifications among the industry managers and higher perceptions among managers of the risk of feed safety of the business were also significantly related to use HACCP in sectors (P<0.05). Six potential hazards were identified along the process to be controlled as critical control points (CCPs). Total cost for implementing the system was around 1 billion and 400 millions rupiahs; while the time needed since designing up to fully operating the system with audit results fulfill the prerequisite programs and HACCP requirement was about 7 months.

Keywords: HACCP, feed hygiene, feed safety, perceptions, practices, attitudes

Abstrak

Industri pakan ternak Indonesia telah berkembang dengan cepat dalam 10 tahun terakhir. Namun, hampir semua industri pakan ternak tersebut belum mengimplementasikan sistem keamanan pakan yang diproduksinya termasuk praktek hygiene pakan. Oleh karena itu, studi tentang persepsi, praktek dan sikap terhadap sistem HACCP pada industri pakan dalam mencapai kesesuaian keamanan pakan telah dilakukan. Penelitian ini dilakukan dengan kerangka kerja sebagai berikut: Modul I, Kajian terhadap kondisi pada industri pakan skala menengah dan besar dengan metode survei, observasi, wawancara, kunjungan ke pabrik serta penyebaran kuesioner di 6 propinsi, yaitu propinsi Lampung, Banten, Jawa Barat, Jawa Tengah, Jawa Timur dan Sulawesi Selatan dengan jumlah sampel sebanyak 20 responden industri pakan. Mereka juga diberi pertanyaan tentang praktek hygiene yang dilakukan di perusahaan, sistem keamanan pakan yang digunakan seperti HACCP serta persepsi dan sikap mereka terhadap isu prkatek hygiene pada industri pakan tersebut. Modul II, Identifikasi terhadap potensi titik kendali kritis atau CCP; dan Modul III, Evaluasi terhadap program penerapan HACCP. Analisis dilakukan menggunakan metode analisis deskriptif yang dikembangkan oleh Hair et al. dan untuk menguji perbedaannya menggunakan analisis sidik ragam satu arah. Hasil studi menunjukkan bahwa sistem HACCP telah terimplementasi 95% pada industri pakan skala besar dan terimplementasi 65% pada industri pakan skala menengah (P<0,005); 30% para manajer di industri pakan skala besar dan 15% para manajer di industri pakan skala menengah menyatakan bahwa bisnis mereka termasuk yang mempunyai risiko yang rendah terhadap keamanan pakan. Makin tinggi kualifikasi hygiene industri pakan pada manajernya, makin tinggi pula persepsi manajer terhadap risiko bisnis keamanan pakan yang dikelolanya, juga berkorelasi nyata terhadap implementasi HACCP-nya. Ada 6 potensi bahaya yang teridentifikasi dalam proses produksi pakan yang perlu dikendalikan sebagai titik kendali kritis. Total biaya yang diperlukan untuk menerapkan sistem HACCP sekitar 1

milyar dan 400 ribu rupiah; sedang waktu yang diperlukan sejak desain hingga beroperasi penuh serta hasil audit berdasarkan persyaratan dasar dan persyaratan sistem HACCP diperlukan waktu 7 bulan.

Kata kunci: *HACCP, hygiene pakan, keamanan pakan, persepsi, praktek, sikap*

1. INTRODUCTION

Indonesian stock feed industry has developed rapidly in the last 10 years and has spread in North Sumatera, Lampung, Banten, West, East and center of Jawa and South Sulawesi, because the consumption of feed for livestock to produce of meat products and its derivates increase sharply also. According to the Directorate of Livestock Affairs, Ministry of Agriculture (2009) has reported that there were about 30 feed industries in Indonesia that consist of 15 medium scale feed industries and 15 large scale feed industries. However, all of the stock feed industries have not been implementation of feed safety system including feed hygiene practices. Meanwhile, recently, feed industry or feed business operators has driven force for a real competition, especially in regarding to consider feed international trading condition and feed regulation in a change world in designing the overall policy. One of the factors feed industry to follow competition in global market is to produce stock feed product that meet in legitimate feed quality and safety objectives. There are 4 reasons that why the feed industry or feed business operators should be pay attention, i.e. Firstly, Public concern about the safety of food of animal origin has heightened due to problems that have arisen with *Bovine spongiform encephalopathy* (BSE), dioxin contamination, outbreaks of food-borne bacterial infections, and mycotoxins, as well as growing concern about veterinary drug residues and microbial resistance to antibiotics.

These problems have drawn attention to feeding practices within the livestock industries and prompted health professionals and feed industry closely scrutinize quality and safety to avoid contamination of foods of animal origin as a result of feeding systems (Speedy and Battaglia, 2002); Secondly, The new regulation places an obligation on people responsible for feed industry or feed business operators to ensure feed safety. This responsibility ranges from primary production of feed crops (e.g. on-farm) up to and including placing feed on the market. It also applies to the feeding of food producing animals and imports of feed from third countries (Ziggers, 2003).

Thirdly, The World Trade Organization (WTO) Sanitary and Phyto-Sanitary (SPS) Agreement call upon member to harmonized food and feed safety internationally. In this case, food safety crises linked to feed contamination have hightened international awareness of existing disparity among national legal limits for maximum levels of contaminants that could be associated with animal feedstuffs. This raises questions about the appropriate level of consumer protection and also constitute a barrier to trade (Speedy and Battaglia, 2002). Therefore, some countries including Indonesia wish to update policies in line with today's food and feed safety issues; and Fourthly, The potential for introduction of contaminants (microbiological, chemical, or physical) to eggs, beef, poultry and pig meat from feed is real. Because traditionally feed mills successfully implemented good manufacturing practice to produce feed clean of contaminants thus protecting raw food of animal protein. However, to increase the safety margin in the production of raw animal protein and to regain consumer trust, hazard analysis and critical control point (HACCP) implementation in feed mills on feed industry or feed factory is becoming a necessary (Ziggers, 2003).

In recent years, some Indonesian stock feed companies have exported to other countries and the feed processed product itself have entered in international market, i.e. to South Korea, Malaysia, Middle east, India, Philippine, Japan and Australia. However, the processed feed stock products for export to Australia need to be more attention than another countries for feed industry or feed business operators, because Australian government through Australian Quarantine and Inspection Service (AQIS) has a strict regulations and requirements. AQIS (1996) stated that in order to export products of animal origin to Australia must be made agreement that presented in Quality Assurance (QA) arrangement. A QA arrangement is arrangement between AQIS and a company which has implemented an effective quality assurance system under agreed conditions. AQIS staff then monitor the effectiveness of the company's quality and safety systems, through a continual audit program.

The Indonesian stock feed products that especially produce from feed stock industry for export purpose to Australia must be to fulfill the AQIS requirements. Concisely, there are seven rules required audit outcomes of AQIS requirements, i.e. (1) Only raw materials from AQIS approved suppliers are used in the stock feed and all ingredients used correlate with the list of ingredients supplied with the permit application; (2) No product of animal origin and

particularly meat and bone meal (MBM) is used as feed ingredients; (3) There is no adventitious cross contamination of raw ingredients by material of animal or bird origin; (4) There is no post-production contamination of the feed by any animal product and waste; (5) The time and temperature regime, as per the heat processed stock feed of plant origin protocol, is carried out; (6) All plant materials is non-viable i.e. has no ability to germinate, and (7) Transport of processed feed prevents contamination with animal material and weed seeds (AQIS, 2002).

The FAO Expert Consultation on Animal Feeding and Food Safety held in 1997 (FAO, 1998) noted that quality assurance (QA) begins with the concept of what the feed product is to be, in terms of the spices being fed and the results being sought. Key elements in effective QA at the feed production facility should include proper sampling, laboratory testing and microscopy, in-plant quality control, control of drug carry-over, plant sanitation and integrated pest management, plant cleanliness, the receiving area, and storage. QA procedures must be clearly documented and records maintained.

Applying hazard analysis and critical control point (HACCP) principles ensures that all potential safety hazards are thoroughly analyzed and assessed, that critical limits are established for all points along the chain that must be controlled to avoid occurrence of safety hazards, that effective systems for monitoring the critical control points are in place, and the plants for corrective action are established in the event of problems within the production chain. Processors and handlers of animal feed must further ensure that adequate documentation is maintained to demonstrate their adherence to HACCP principles (Speedy and Battaglia, 2002).

The potential difficulties of applied HACCP in small and medium feed industry or small and medium feed business operators have been widely discussed. The possible barriers to its development in these sectors according to Hertog (2001) are as follow through: (a) a lack of financial resources and purchasing power, (b) more complicated feed-handling practices, and (c) a lack of technical expertise and available personnel. In contrast, for many large feed industry or feedstock manufactures, HACCP has become mandatory and voluntary trading standard in international feed trade (Tielen, 2005).

Nevertheless, only limited data exist about either about feed hygiene management and good manufacturing practice in general on the Indonesian feed industry or more specify the application of HACCP. The studies that do exist have tended to use local rather than national samples and focused on one industry sector.

The objectives of this study were: (a) to identify the general of feed hygiene and use of HACCP to risk-perceptions and practices in medium and large feed industry; (b) to explore the relationship between feed hygiene practice and the two medium and large enterprise sectors, and (c) to improve good manufacturing practice (GMP) and standard operating procedure (SOP) as prerequisite program and implement a HACCP system in stock feed formula preparation and production at one large enterprise Indonesian stock feed company as case study.

2. METHODOLOGY

2.1 Materials

The materials used of this study consist of a questionnaire that was designed to feed hygiene practices and feed safety management systems, and letters. The content of this questionnaires are asked about feed hygiene and feed safety management systems (i.e. feed hygiene practice, aspect of staff training, feed handling and storage program, stock rotation, HACCP training, full HACCP implementation system, temperature monitoring of feed processing, microbiological, physical and chemical testing and documentation of feed production practice and risk-perceptions

2.2 Methods

The study of perceptions, attitudes and practices on Hazard Analysis and Critical Control point (HACCP) of Indonesian stock feed production has been conducted from April to October in 2009. The study was conducted using frame works of study as follows, i.e. Module I, Assessment on existing conditions; Module II, Identification of potential critical control points; and Module III, Evaluation of HACCP programs.

2.2.1 Module I: Assessment on Existing Conditions

Assessment on Perceptions of The Risk to Feed Safety

The methods used for assessment on perceptions of the risk to feed safety study was conducted by a survey, observation, an interview and application a questionnaire to medium and large feed industry in Banten Province, Lampung Province, West, Centre and East Jawa Province, and South Sulawesi Province. The number samples of medium and large feed industry or feed business operators that be surveyed, observed, interviewed and applied a

questionnaire in the seven provinces above totally there were 20 feed industries that consist of 10 medium feed industries and 10 large feed industries

The observation was carried out by checking and evaluating the company's GMP or feed mill's GMP and standard operating procedure (SOP) for verification and to learn about the feed milling process. The observed and evaluated area were: (1) Premises, which covers the building exterior and grounds, feed mill interior, lighting, dust collection, waste disposal, employee facilities, water and boiler; (2) Receiving, Storage and Transportation, which covers incoming and outgoing carrier inspection, receiving area design, ingredient inspection, purchasing, warehousing, medication handling, bin storage, return and rework, chemical management; (3) Equipment, which covers equipment design, scale calibration, mixer validation, sterilizer validation, and preventive maintenance; (4) Housekeeping and Pests, which covers housekeeping and sanitation, and pest control programs; (5) Personnel, which covers employee training and hygiene health requirements and visitor policy; (6) Manufacturing Controls and Documentation, which covers sampling procedures, sequencing and flushing, identifications of lots, label review, master formula, and customer complaints; (7) Recall and Withdraw procedures, which covers recall and withdraw procedures.

Assessment on Practices of Feed Hygiene and HACCP

Assessment on management of feed safety systems were evaluated by observing, checking and monitoring the feed mill system and feed hygiene and hygiene practices using checklist that developed by American Feed Industry Association (Butcher and Miles, 2003). The management evaluation was emphasized on aspect of staff training, monitoring staff for personnel hygiene and illness/infections, cleaning and sanitation schedules, feed handling and storage program, stock rotation, HACCP training for all feed mills employees (operators, supervisors, and managers, time and temperature monitoring of feed mill sterilization, inspection of feed stock on delivery, microbiological testing and documentation of feed hygiene practices. The purpose of the evaluation was to measure whether management high commitment and support the feed safety program or not.

The results of survey, observe, an interview and response of the questionnaires were conducted analyze through descriptive analysis that develop by Hair *et al.* (1987). To test if there were differences between two sectors of feed industries' characteristics with regard to their perceptions, practices and attitudes on feed hygiene and HACCP management system; a one-way statistical analysis of variance with Statistical Package for the Social Science (SPSS) test was used. Test of significance were based on Chi-square statistics and student t-test (Moore and Mc.Cabe, 1987) to determine whether medium or large feed industries more likely to implement feed hygiene practice and feed safety management system. Spearman's test was also used in analysis of Likert scale results

2.2.2 Module II: Identification of Potential Critical Control Points

A control that is essential to prevent or to eliminate a hazard or to reduce it to acceptable level is referred as a critical control points (CCP). Once the CCP's are identified, the maximum/minimum value to prevent, eliminate or reduced hazards to an acceptable levels is decided

To evaluate the microbiological (such as *Salmonella sp, Bovine spongiform encephalopathy* or BSE, new variant of *Creutzfeldt-Jakob Disease* or vCJD) cross contamination problems along the process, feed mill processing flow diagram were drawn-up and used to conduct hazard analysis. Potential physical (stone, metals, soil, silica), chemical (such as pesticides, hormones or mycotoxins) and microbiological hazards were identified for each preparation steps. Microbiological criteria were used to developed a preliminary HACCP system and to provide reference value to evaluate the impact of the HACCP program after implementation.

The identification of hazards was carried out according to Codex Standards, guidelines and recommendations include provisions (CAC, 1997) relating to quality and safety of feed ingredients of origin (Butcher and Miles, 2003) by examining the characteristic of the feed ingredients and finished products, and evaluating the variables that could influence the safety of feed stock product. The CCP determination were identified through application of five question steps Decision Approach (CAC, 1997; Jones, 2002) to reach steps to the feed stock formula preparation and production

2.2.3 Module III: Evaluation of HACCP Programs were focused on Costs of HACCP Implementation, Time Schedule and

Auditing Costs of HACCP Implementation and time needed to fully implement the system were analyzed through deep interviewing the operators, middle and top ranks of the management. The interview was done to discover the seriousness of every single person in the feed industry or feed factory in implementing the HACCP system. HACCP programs would not be operated automatically.

Quality and safety audit were aimed to asses the quality and safety system to ensure that procedures written in the manual were being followed and effective practice. The quality and safety audit was assisted by Australian Quarantine and Inspection Service (AQIS). The method used for collecting objective evidence was by means of interview, observation of workplace activities and/or environmental conditions and verification of the HACCP Plan especially the temperature and retention time of sterilization including probe thermometer (PT 100) calibration programs. The scope of the audit included : sourcing of raw materials, transport of raw material to manufacturing facility, pre-production and production, post-production, maintenance and sanitation, pest control, employee, documentation, HACCP Plan facility uses a HACCP system and the ability to demonstrate the planned system was used routinely.

3. RESULT AND DISCUSSION

3.1 Perceptions of The Risk to Feed Safety

Feed safety expectations are often based on how well a feed industry especially managers are capable of performing, i.e. the concepts of As Low As Reasonably Achievable (ALARA) rather than stated degree of stringency. Managers' perceptions of the risk to feed safety posed by their business practices based on the results of the survey, observation, interview and response when they were asked to asses what risk to feed safety, low, medium or high, were presented at Table 1.

Table 1 Managers' Perception of The Risk to Feed Safety posed by Their Business Practices (n=20).

Risk levels (*)	**Operation of feed industry**	
	Medium	**Large**
High	2 (10%)	7 (35%)
Medium	6 (30%)	3 (15%)
Low	2 (10%)	-
Don't know	-	-

Note : (*) = A χ 2 test revealed no significant differences between responses from two feed industry sectors (P.0.05).

Based on Table 1, was shown that the most of feed industry sectors identified themselves as high-risk (9 feed industries), 6 medium feed industries and 3 large feed industries identified themselves as medium-risk, and 2 feed industries identified as low-risk feed business. Yet the large feed processing industries were regarded as high-risk, because of feed products they handled and statistical were often exported to the other countries that content of sensitive ingredient used like raw food of animal protein. Suggesting to proposes as possibility that outbreaks of feed contamination were most commonly associated with sensitive ingredients.

Accurate interpretation of this risk data should be become interested in the handling practice of the feed processing involved. Feed processing handling a combination of raw ingredients that content raw food of animal protein and feed products have tends to increased risk of cross contamination were likely to identify themselves as high to medium-risk feed business. Meanwhile, the use and implementation of HACCP among the whole sample was also found related significantly to a number of other factors, notable (to note) higher risk perceptions among feed managers, higher levels of feed hygiene qualifications among managers, and being part of local, regional/national, or multinational chain in particular (Table 2).

Table 2 Relation Between The Use and Implementation of HACCP to Managers' Risk Perception and Training, Product Handling and Feed Industry Status (n = 20).

Characteristics	Using and Implementing of HACCP	
	Yes (%)	No (%)
Managers' perceptions on feed safety risk		
- High risk	35	15
- Medium risk	20	35
- Low risk	45	50
Probability	$X^2 = 13$	P< 0.005
Status of the feed mill industry		
- Local/regional chain	-	30
- National chain	40	70
- Multinational chain	60	-
Probability	$X^2 = 42$	P< 0.001
Managers' level of feed hygiene qualification		
- Basic	15	55
- Intermediate	35	35
- Advanced	50	10
Probability	$X^2 = 15$	P<0.001

Based on Table 2, it can be seen that most feed industry managers thought their feed business represented as a low-risk to feed safety with responses Yes (45%) and No (50%). Managers' risk perception on feed safety have positive implications for the enthusiasm with both good manufacturing practices and HACCP implementation in general will be adopted. In this case, feed industries or feed business operators whose managers perceived them to be high-risk feed product were more likely to use and implement of HACCP. Although the issue of the risk in term of feed safety was a highly contentious subject, however risk might be evaluated in terms of attributable feed processing cases that type of feed business, it might be refer to the type and range of handle.

There was evidence which suggest that the most managers in the feed industry or feed business operators have limited understanding in the principles and applications of the HACCP strategy. In addition to its application of HACCP within the Indonesian medium feed sector was limited. Therefore, in medium feed industries, HACCP must be able to adopt flexibility to the different working pattern in operational and great, often unexpected variations in potential demand and workloads. Furthermore, the lack of financial resources, technical expertise, knowledge and expertise in HACCP, management commitment to obtain this knowledge and small staff base only; both of them resulting in sufficient understanding of the function of HACCP principles and add to the difficulties in implementing HACCP.

Larger feed industries can invest resource in training for successful implementation of HACCP, meanwhile smaller and medium feed industries may have other priorities. The later point was confirmed by a survey, observed and interview of 10 medium feed industries at seven provinces region in Indonesia which found that medium feed companies were less likely to invest in hygiene and feed safety than larger ones.

Meanwhile, time constraint and resource requirements of HACCP implementation have mentioned as crucial factors influencing acceptance and implementation of the system by feed business operators not only in large feed industries but also in medium feed industries. Based on response by respondents about perceptions and opinions of feed operators regarding HACCP not implemented in their companies due to three concerns, i.e. (1) high cost of training employee, (2) high cost of laboratory facilities and prerequisite programs; and (3) high cost of operating the system

3.2 Practices of Feed Hygiene and HACCP

Feed safety is results of several factors i.e. legislation should be established at a minimum hygiene requirements; official controls should be in place to check feed business operators' compliance and feed business operators should establish and operate feed safety programs and procedures based on the practices of feed hygiene and HACCP principles. Meanwhile, the implementation of good manufacturing practices (GMP) plays an important role in controlling potential contamination health hazards. An important consideration in implementing HACCP is the recognition that a critical interdependency between HACCP and prerequisite exist. These

reffered to as all practices and conditions need prior to and during the implementation of HACCP and which are essential for need safety. Therefore, prior to implementing, feed business operator or feed manufacturing must be engaged in GMP (WHO, 1998).

The results of survey, observe, an interview and response from respondents that be asked to identify or to know how the feed industry was arrange feed hygiene practices and feed safety management systems were implemented was shown at Table 3 and Table 4.

Table 3 The Relationship Between Each Feed Industry and Implementation of Feed Hygiene Practice or Condition of Prerequisite Programs

No.	Minimum hygiene standard practices as prerequisite programs	Operation of feed industry (%)	
		Medium	Large
1.	Premises (building exterior and ground, feed mill interior, lighting, dust collection, waste disposal, employee facility, water and boiler)	65	95
		$X^2 = 82$	P<0.001
2.	Receiving, transportation, and storage (Incoming and outgoing carrier inspection, Receiving area design, Ingredient inspection, Purchasing, Warehousing, Medication handling, Bin storage, Return and rework, Chemical management)	60	90
		$X^2 = 78$	P<0.001
3.	Equipments (Equipment design, Scale calibration, Mixer validation, Sterilization validation, Preventive maintenance)	65	95
		$X^2 = 82$	P<0.001
4.	Housekeeping and Pest (Housekeeping and sanitation, Pest control programs)	60	85
		$X^2 = 73$	P<0.001
5.	Personnel (Employee training, Hygiene health requirement, Visitor policy)	65	90
		$X^2 = 86$	P<0.001
6.	Manufacturing control and Documentation (Sampling procedure, Sequencing and flushing, Identification of lots, Label review, Master formula, Customer complaints)	60	95
		$X^2 = 91$	P<0.001
7.	Recall and Withdrawl (Recall procedure, With-drawl procedure)	65	95
		$X^2 = 82$	P<0.001

Table 4. The Relationship Between Each Feed Industry and Implementation of HACCP

No	Feed safety management (HACCP)	Operation of Feed Industry (%)	
		Medium	Large
1.	Aspect of staff training	65	95
		$X^2 = 82$	P<0.001
2.	Monitoring staff for personnel hygiene & illness/ infection	65	90
		$X^2 = 86$	P<0.001
3.	Cleaning & sanitation schedules	60	85
		$X^2 = 73$	P<0.001
4.	Feed handling and Storage programs	65	90
		$X^2 = 86$	P<0.001
5.	Stock rotation	90	95
		$X^2 = 6$	P<0.001 NS
6.	HACCP training of Managers	65	90
		$X^2 = 86$	P<0.001
7.	Full HACCP Implementation System	65	95
		$X^2 = 82$	P<0.001
8.	Temperature monitoring of feeds	60	95

No	Feed safety management (HACCP)	Operation of Feed Industry (%)	
		Medium	Large
		$X^2 = 91$	P<0.001
9.	Inspection of feedstuff on delivery	60	85
		$X^2 = 73$	P<0.001
10.	Microbiological, physical & chemical testing	65	95
		$X^2 = 82$	P<0.001
11.	Documentation of feed production practice	65	95
		$X^2 = 82$	P<0.001

Note : NS = Not Statistically Significant at the 0.001 level.

According to Table 3 and Table 4, it can be seen that between of two feed industry sectors have a statistically significant different factors in the feed hygiene practices by individual feed industries as well as in HACCP implemented. Almost of the large feed industries were two times more likely than medium feed industries in the implementing basic feed hygiene practice or condition prerequisite programs. This pattern were reflected by: (1) Aspect of premises that received 95% of large feed industries compared to 65% of medium feed industries; (2) Receiving, transportation and storage that received 90% of large feed industries compared to 60% of medium feed industries; (3) Equipments that received 95% of large feed industries compared to 60% of medium feed industries; (4) House keeping and Pest that received 85% of large feed industries compared to 60% of medium feed industries; (5) Personnel that received 90% of large feed industries compared to 65% of medium feed industries; (6) Manufacturing control and Documentation that received 95% of large feed industries compared to 60% of medium feed industries; and (7) Recall and withdrawl that received 95% of large feed industries compared to 60% of medium feed industries.

In accordance with Table 4 was also shown that between of two feed industry sectors have a statistically significant different factors in the HACCP implementation by individual feed industries. Large feed industries generally were one and half or two times more likely than medium feed industries to be using HACCP. This patterns were reflected and supported by: (1) The HACCP training managers received 90% of large feed industries compared to 60% of medium feed industries; (2) Monitoring of temperature during a process of feeds that received 95% of large feed industries compared to 60% of medium feed industries; (3) Inspection of feedstuffs on delivery, that received by 85% of large feed industries compared to 60% of medium feed industries; and (4) Microbiological, physical and chemical testing that received by 95% of large feed industries compared to 65% of feed industries. However, only routine procedure such as stock rotation was being practiced by most of feed industries in each sector. In addition, among feed industries that implementing HACCP, where managers had received HACCP training, then 70% were able to identify that they had adopted all seven of the HACCP principles. This compared with only 30% in feed industries where managers had not been formally trained in HACCP.

Most of feed industries conducting general feed hygiene practices such as aspect staff training on basic feed hygiene, monitoring of staff for personnel hygiene and illness/infections, cleaning and sanitation schedules, feed handling and storage, temperature monitoring of feed processing and stock rotation. These were a prerequisite practices that are foundation of any successful transition to HACCP approach (NACMCF, 1998; Sperber *et al*., 1998). The role of microbiological testing is of particular interest, although this rarely used in the Indonesian medium feed industries. Nevertheless, an understanding of the use of microbiological criteria within HACCP plans is arguably fundamental to their success (Buchanan, 1995).

3.3 Attitudes Towards HACCP Systems

The attitudes of management for medium and large feed industries towards HACCP management system are very important in the development of feed safety implementation. The success or failure of feed safety management at feed industry or feed business operator depends on whether management support the feed safety programs. The results of survey, observe, and assess of feed industry's attitudes in the implementation of HACCP and based on attitude scaling use to determine respondents' attitude towards system HACCP was presented at Table 5.

Table 5 Managerial Attitudes of The Feed Industry Sectors Towards Three Statements about HACCP System

Attitude statements from respondents (*)	Managerial Group	Attitudes		
		Agree (%)	Disagree (%)	Neither Agree/Disagree (%)
1. Formal hygiene systems, e.g. HACCP are difficult to apply in your feed business size	Large Medium	30 45	45 30	25 25
2. Formal hygiene systems, e.g. HACCP are difficult to apply in your sector of feed industry	Large Medium	20 45	60 25	20 30
3. It is easy to get information on HACCP	Large Medium	65 35	15 25	20 40

(*) Respondents were invited to respond on five-point Likert scale from strongly agree to strongly disagree. All agree and disagree responses were recorded and merged for this analysis.

According to Table 5, it can be seen that feed industry sector was found to be significantly related to the responses for all three statements ($P<0.005$). Partition of $\chi 2$ tables to reveal the specific relationships among different feed industry sectors showed that medium feed industries were significantly more likely than large feed industries to agree with statements 1 and 2. Meanwhile large feed industries were most likely to agree with statement 3. Based on to put across the whole of the sample, feed industries that implementing HACCP were significantly more likely to disagree with statements 1 and 2 and also to agree with statement 3 about the easy of getting information on HACCP ($P<0.001$).

A further analysis using Spearman's ρ showed that feed industries with greater numbers of feed handlers were significantly less likely to agree with statement 1 ($\rho = + 0.18$; $n = 20$; $P<0.01$). Most of feed industry sectors agree with statement 1 so that this having a relatively negative attitude toward the development and implementation of HACCP were also more likely to agree with statement 2 ($\rho = + 0.60$; $n = 20$; $P<0.001$).

Several studies have assessed the effectiveness of feed hygiene and HACCP training in exchange the knowledge, attitudes and practices of feed handlers or workers. Some positive impact of training upon feed handlers' or workers' knowledge (Manning, 1994; Sudibyo *et al.*, 2001) while others have criticized traditional knowledge based training methods as having little impact on attitudes or behaviors (Ehiri *et al.*, 1997).

The data presented in this paper merely evaluated the levels of training held by different staff within the feed industry sampled. However, feed industry managers in the sample had obviously implemented HACCP without any formal training. This have a negative impact upon the likehood that they were able to identify and they had a full seven-principles system in place. These findings suggest that the HACCP training manager is important in ensuring that the system is properly implemented and maintained, preventing and potential abuse of the system due to lack of understanding of HACCP. They also expected to draw attention to the problem of feed industry/feed business in using expertise or external consultants to implement HACCP and over-looking the need managerial HACCP training. Ownership was important part of any HACCP system with managerial understanding and commitment fundamental to its ongoing effectiveness (NACMCF, 1998).

3.4 Potential Critical Control Point (CCP)

Principally and generally, every medium or large the feed processing lines cover a simple steps as follows: Raw material receiving, raw material warehousing, intake, raw material bin, dosing, grinding, mixing & feed additive, conditioning, sterilizing at 85^{o}C for 3 minutes, pelletizing, cooling at 5^{o}C above the room temperature, packaging or bagging off, finished good warehouse and delivery. To ensure proper production in the feed processing factory/ manufacturing, potential critical control point (CCP) were identified base on hazard analysis and evaluation of hazards and CCP using AQIS criteria (AQIS, 1996). The analysis resulted 6 potential critical control point (CCP) as possible hazards that need to be controlled.

CCP 1 was identified as biological and physical hazards in the receiving raw material as full/whole seed, soil or sand silica, animal protein and flea. All raw and packaging materials are purchased against specifications agreed with the

list suppliers who are inspected, reviewed and assessed annually on the base of raw materials quality and availability. The acceptable limit/tolerance of feed whole seed is absent, soil (sand silica) maximum 2.5%, animal protein (meat bone meal) is absent and flea is also free/absent. Receiving raw materials is critical control point because feed ingredients are major source of contamination in finished feeds (Jones, 2002). It was illustrate the point that pathogens can be isolated from virtually any organic feed ingredient. It would appear, therefore, that if one expects to control pathogen in feeds, one must first address control of pathogens in feed ingredients.

According to Butcher and Miles (2003), high risk ingredients should be screened carefully. Generally, animal protein (*meat bone meals*) have high levels of *Salmonella* as microbiological hazard contamination than do plant proteins. Poultry aflatoxin meal and feather meal should be considered high risk ingredients. These product often contain the same serotype that are concurrently identified as causing contamination in local poultry populations. Adequate records should be kept on each feed ingredient supplier, including base line quality control data.

CCP 2 was identified as biological and physical hazards in grinding steps. Grinding is critical because contamination from full/growing seed (biological) and rope, woody vase, alumina (physical) could brought a microbial growth in feeds. In addition, that feeds are in equilibrium with moisture in their surrounding. This means that, given time, feed will either absorb or give up moisture do the surrounding air. Headley (1979) demonstrated the positive correlation between feed moisture and relative humidity. The acceptable limit/tolerance of full/growing seed is absent, used screen seed 8 mm, and rope, woody vase is absent also. It is therefore essential that daily test of result from grinding step for 3 sequential batch by QA or trained operator to ensure that this condition was maintained for every batch of product.

CCP 3 was identified as microbiological hazards in the step of sterilization. Sterilization constitutes as critical control point (CCP) because possible hazard for this step are of microbiological origin (virus, bacteria, fungi, *Salmonella*) and are related to the possible growth and presence of the microorganism in case of inadequate thermal process. Therefore, the conditions of sterilization process are monitored and checked by supervisor, so that the temperature and the time of sterilization requirement remain undergo within the prescribed critical limits, that is 85^{o}C for 3 minutes, which is controlled by Norvidan computer program.

In either case, if considerable deviations are observed, the quality control manager orders a rejection or reprocess of that particular batch. Corrective action that should be taken were included: (a) If automatic system does not function properly, the operation of the machine must be stopped; (b) If the temperature do not reach 85^{o}C, the reject slide must be automatically open and output slide linked to press 2 and 3 must be shut down; (c) If the retention time is less than 3 minutes, the slide linked to the press must be automatically closed down; and (d) material processed out of standard must be separated “not Australia”. Decision from QA manager. In addition, one of the purposes of sterilizing is to eliminate vegetative cells of pathogens (or reduce them to acceptable level) that may have been introduced to the process by the materials or by processing that occurs before the sterilizing step (ICMSF, 1996).

CCP 4 was identified as microbiological/biological hazards (fungi) in step of cooling. Cooling constitutes as critical control point (CCP) because of the maximum limit of 5^{o}C above the room temperature was required by AQIS standard and measuring the temperature of the product in the packing bag before it is stitched. In this case, finished pellets must not be allowed to come into contact with objects prior to falling into the cooler. Meanwhile, pellets falling on the floor must be considered a possible source of contamination and should not be added back to the finished feed. Feeds can also be easily contaminated in poorly designed or managed coolers. In fact, several studies have noted that Salmonella contamination of feed can increase within coolers (Davies and Wray, 1997; Israelsen *et al*., 1996).

CCP 5 was identified as biological/microbiological hazards in step of finished goods warehousing. Finished good warehousing constitute a critical control point (CCP), because contamination from flea, insect, bird dirt/drop and mouse that content *Salmonella* can survive in the feed product packaged in the bag; and able to multiply in the finished product bagging during finished good warehousing; so it can be medium risk for public health. The acceptable limit/tolerance in step of finished good warehousing were included : bird and its dirt was absent; flea and dirt was also absent, and mouse and its dirt population controlled. Preventive action that must be taken were included: (a) Setting the wire-net in every ventilation and sliding screen gate for all

warehouses to prevent against birds and mouse coming in; (b) Pest control performed by pest control company and QA Manager: setting up the bait station, which is checked every two weeks; (c) Daily inspection against disturbance due to insect, other pest and observation of warehouse condition by QC staff under-supervision of QA Manager; and (d) Separation product lot for Australia with pole and yellow chain, and notice board marked with for Australia.

CCP 6 was identified as biological hazards in step of delivery. Delivery constitute a Critical Control Point (CCP), because contamination from flea, insect, bird drop/dirt that contain salmonella, Bacillus can survive in the finished product package in the container; and able to multiply in the finished product during delivery. Preventive action that must be taken were included: (a) Inspecting the cleanliness of transporting vehicle, full seed, liquid, insect, dirt, etc. (b) Ensure the load feasibility; the floor has no whole, the cover is not leaking; and loaded vehicle must be immediately covered

3.5 Costs of HACCP Implementation

Implementing and operating HACCP in the feed stock factory or feed business operator requires a relatively big cost for improving the prerequisite programs and the system. Based on this study's experience there were two major costs, i.e. "cost for implementing and operating the HACCP' and "cost for maintaining the system". Detail cost as listed in Table 6 shows the total of Rp 1.360,000,000,-. This figure will be varied between feed processing factory.

Table 6 Cost For Implementing and Operating The HACCP System

No.	Activity	Cost, Rp
I.	**Cost for Implementing and Operating the HACCP System**	**1.310.000.000**
	* External consultants	25.000.000
	* Investment in new equipment (sterilizer, micro tracer tester, etc.) and improving GMP facilities	1.250.000.000
	* Staff training and education	15.000.000
	* Managerial changes	10.000.000
	* Structure change to plant	10.000.000
	* Staff time in documenting system	10.000.000
II.	**Cost for Maintaining the System**	**50.000.000**
	* Monitoring	5.000.000
	* Sampling and testing	15.000.000
	* Cost associated with process modification	20.000.000
	* Others	10.000.000
	TOTAL	**1.360.000.000**

There are two reasons that motivate the case study feed company to spend the money for implementing the system; those were to meet the customer and legal requirements (AQIS' requirements) and to improve product quality and self life, as well as to reduce product failure and wastage.

3.6 Time Needed

The experience of this study gave a figure of the length time needed to prepare and implement the HACCP system in the large scale feed stock factory, i.e. 7 months. This length of time was used for: (1) HACCP Plan development through consultation with external consultants, QC Manager replacement and document preparation needed about 1-2 months; (2) HACCP Plan implementation including the improvement of good manufacturing practice (GMP), investment in new equipment, training and education, and other requirements needed 2 months; (3) HACCP maintenance needed 3 months, used for routine activities associated with the HACCP system, time to monitoring procedures to ensure that feed safety hazards under control as critical control point (CCP) at their operation, time devoted to records for monitoring required by the feed company's HACCP Plan followed by the corrective action reports.

3.7 Quality and Safety Auditing

Through consultation and assistant given during this research, the feed company completed documents and records as required by HACCP system; including: (1) HACCP Plan, current state and history of amendments, (2) Monitoring and

keeping records of CCP requirements, deviations and undertaken corrective actions, (3) hold/trace/recall records, in case of deviations, (4) training records to show that personnel is well trained, (5) calibration records related to instrumentation and (6) auditing & Inspecting records for non-conformance cases.

The quality and safety audit was conducted by Australian Quarantine and Inspection Service (AQIS) with Center of Agro Based Industry (CABI) as an observer. The purpose of the audit is to measure compliance to the company's quality and safety program manual and to determine the following: (a) The quality and HACCP system in place effective in achieving organizational goals and quality targets; (b) whether the quality and safety system meets codes, standards and regulations invoked by contract or legislation; (c) The management has developed the quality and safety systems needed to satisfy the contractual or legal obligation; (d) The extent to which the documented quality and safety system in place within the organization; (e) Within the organization is carrying out activities in accordance with the quality and safety system documented in the quality manual. It was concluded that the case study of feed stock factory was complied with their HACCP Plan and quality system, and their implementation met regulatory requirements

4. CONCLUSIONS

Most of medium feed industry sectors have perceptions of the risk to feed safety as low-risk, however large feed industries have been widely as high-risk feeds.

Practices of feed hygiene and HACCP on the two feed industry sectors were have statistically significant different factors in the feed hygiene practices by individual feed industries as well as in the HACCP implemented. Large feed industries have one and half up two times more likely than medium feed industries to implementing basic feed hygiene practices and HACCP systems.

The attitudes of feed industries managerial towards HACCP system showed that medium feed industries more likely to agree with statement 1 (HACCP are difficult to apply in their feed business size) and statement 2 (HACCP are difficult to apply in their sector of feed industry). In contrast, large feed industries more likely to agree with statement 3 (It is to get information on HACCP).

The six potential critical control points were identified as known CCP's that needed to be controlled in order to produce safe feed stock. These six potential CCP's were: raw material receiving, grinding, sterilizing, cooling, finished good warehousing, and delivery. Implementation of HACCP system in the large feed stock factory needed total cost of around 1 billion and 360 millions rupiah. The time needed since starting to plan the system until fully operational was about 7 months.

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