Designing HACCP for Cattle Feed

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Designing HACCP for cattle feed

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Abstract
Design of Hazard Analysis Critical Control Point (HACCP) system is needed to control the production process consider of cattle's sensitivity. The methods that is used in this research are HACCP and Failure Mode and Effect Analysis (FMEA). This method can identify hazards which possible occur in production process and biggest hazard which have to be prioritized. The result of the design is hazards are identified as not Critical Control Point (CCP). All hazards are identified as PRP. Biggest hazard which have to be prioritized by company is contamination with other feed that contain meat bone meal and error while giving hand add formula.

Keywords: HACCP, PRP, FMEA, Cattle Feed

Introduction

Not only the food industry, but also feed industry is now being demanded to provide feed safe- ty assurance for the consumers. Food and feed secu- rity assurance is evidenced by certification owner- ship stating that the company in producing food and feed has met the applicable food safety standards. One of the standards governing about food safety management is ISO 22000: 2009 which is used indi- rectly for feed safety. The ISO contains standards to be met by the industry to get certificates. This certifi- cate also helps the company to be superior in compe- ting with competitors because people are more confi- dent with the products which produced by the safe and reliable industry. Other standards that regulate the safety of feed is the Decree of the Minister of Ag- riculture No. 240/Kpts/ OT.210 /4/2003.

ISO 22000: 2009 discusses about food safety methods which one of them is HACCP (Hazard Ana- lysis Critical Control Point). HACCP is a quality assurance system based on the hazards that may occur in the production process. HACCP will analyze the hazards to the entire production process and provide actions to prevent the occurrence of such hazards. The HACCP system is expected to reduce and even prevent the occurrence of hazards in food and feed which produced by the food and feed industry.

Cattle is one of the food sources of meat and milk that are consumed by humans. The Ministry of Agriculture says that the consumption of beef is esti-
mated to reach 666 thousand tons by 2019 and will continue to increase. The main danger of beef is afla- toxin contamination. This type of bacteria and fungi are usually derived from the cattle that consumed feed such as grass and other feed products and easy
to grow in moist, wet and dirty conditions. During this decade, in some countries especially in Europe

has been shocked by the incidence mad cow disea- se, oral and nail disease in cattle (Center for Data and Information Systems of Agriculture Secretariat General of the Ministry of Agriculture,) [1]. The animal feed produced will pass through several machining processes in order to produce good animal feed and can meet the nutrients needed by livestock. The company hopes that by applying this HACCP system, the company can improve the quality of the products and participate in ensuring the safety of the food produced.

There are many applications of HACCP on the previous research. Jovaart, *et al*. [2] discussed how to apply the HACCP's system on chemical, physical and microbiological contaminants of milk. They used two parts of the production process, milk harvest and treatment of cows, as an example the HACCP application. Jordan and Mcewen [3] emphasized the incorporation HACCP plans for the preslaughter period of beef production. Their research concluded that while a temporary change in ration and duration of fasting does affect E. coli concentration in feces. These changes do not seem large enough to deliver a drastic improvement in beef carcass hygiene. The need to design HACCP plans being considered by Hathaway [4]. He described that gaining comprehensive information on carcass contamination levels is an essential first step in establishing food safety objectives for a particular beef production system, and in designing risk based HACCP plans. Vilar, *et al*. [5] developed the implementation of HACCP to control the influence of milking equipment and cooling tank on the milk quality. The implementation of HACCP with a few modifications proved to be a feasible strategy, although it was highly dependent on the active participation of the farm workers.

Methods

Hazard analysis critical control point (HACCP)

HACCP (Hazard Analysis Critical Control Po¬i¬nt) is one method to control food process¬ing from ra¬w ma¬te¬ri¬als, pro¬duc¬tion pro¬cess to dis¬tri¬bu¬tion. Co¬¬n¬¬t¬¬rol of food processing is done to ensure the safe¬ty of food produced so it is feasible to be consumed. The ro¬le of HACCP in food processing is to iden¬ti¬fy po¬¬s¬s¬¬i¬¬b¬¬¬le hazards in raw materials, products, to contamination and bacterial growth. (Chesworth,) [2].

The HACCP application system in the food indus-try has seven (7) important basic principl¬es as re¬¬¬com¬mend-

ed by the National Advisory Co¬m¬mi¬t¬tee on Microbiological Criteria for Foods (NACMCF) and the Codex Alintarius Commi¬ssion (CAC). The se¬ven basic principles of HACCP are as follows (Pierson and Corlett,) [5] including:

1. Principle 1: Hazard analysis
2. Principle 2: Determine the Critical Control Point (CCP)
3. Principle 3: Determine the critical limit for each CCP
4. Principle 4: Establish the monitoring system of CCP
5. Principle 5: Establish corrective action
6. Principle 6: Establish verification system
7. Principle 7: Establish monitoring system

Hazard analysis is obtained by identify¬ing all possible hazards in the production process. Th¬e¬¬se dangers are then given preventive acti¬on an¬d ana¬lyz¬¬ed their significance. The significan¬ce of the hazard is determined by how often the ha¬zard occurs and what effect it caused. Haz¬ard sig¬¬ni¬fi¬can¬ce can be used as a reference in the de¬ter-mination of critical control points (CCP).

Pre Requisite Program (PRP)

PRP is a basic requirements program that must be fulfilled by food and feed companies in run¬ning the production process. PRP is designed by a com¬¬pa¬¬ny to support the infrastructure and ensure the safety of food and feed produced so that it is not harm¬¬ful to consumers and job safety. PRP as a ba¬sic requirement is used to control hazards such as bio¬lo¬gi¬¬cal, chemical, physical, and even conta¬mination between product (Sikora Tadeuz et.al. 2007). PRP must be verified and modified according to company needs. The PRP should also be well do¬cu¬men¬ted by the company. PRP is preventive that plays a role in preventing the occurrence of haz¬¬ards or minimizing the significance level of hazards so that no significant hazards are iden¬tified as PRP (Kumar et.al,) [4].

Operational Pre Requisite Program (OPRP)

OPRP is an operational action given to the PRP. The operational actions provided are moni¬toring and verification actions. Operational action are provided if the PRP is unsuccessful in mini¬mizing the significance of possible hazards. OPRP has a role similar to CCP that analyzes hazards and controls significant hazards in order to stay in control.

Table 1: Occurrence rating in HACCP

Frequency	Occurrence
0-1 times/month	Low
2-4 times/month	Medium
>5 times/month	High

Table 2: Risk rating in HACCP

Effect	Risk
Disorders that do not cause death in animals that consume the feed	Low
Disorders that cause death in animals that consume the feed	Medium
Disease until death in humans	High

Table 3: Hazard significant matrix in HACCP

		Severity		
Occurrence		L	M	H
	l	Ll	Ml	Hl
	m	Lm	Mm	Hm*
	h	Lh	Mh*	Hh*

*generally is categorized as significant hazard and considered into CCP

*L=l=low, M=m=medium, H=h=high

OPRP in its implementation has monitoring and verification actions as in CCP. The difference between OPRP and CCP is at the critical limit. OPRP is used to control hazards that do not have clear and measurable critical limits. OPRP usually set significant hazards but not classified as CCP. OPRP within a company must be clearly documented (Sikora Tadeuz et.al,) [Error! Reference source not found.].

Failure mode and effect analysis (FMEA)

Failure mode and effect analysis (FMEA) is a tool that systematically identifies the consequences of system or process failures, and reduces or eliminates the chances of failure. FMEA process is used to identify failure through RPN (Risk Priority Number) which is influenced by 3 main variables such as severity, occurrence, and detection. Severity is a rating or level that refers to the serious impact of a potential failure mode. The impact of these ratings ranges from 1 to 10, where scale 1 is the lightest impact while 10 is the worst as shown in Table 5. Detection is a rating or level that refers to how well the company is in detecting the hazards (Table 6). Occurrence is a value that refers to how often hazards occurs (Table 4). RPN value obtained through the multiplication of the three variables namely severity value, occurrence and detection (S x O x D). The higher the RPN value, the greater the risk caused by the hazard.

Results and Discussion

Hazard Analysis

Hazard analysis is the first step in HACCP design. Hazard analysis contains any hazards that may occur in any production process, the cause of the hazard, and the impact of the occurrence of hazards. Potential hazards in the production of cattle feeds are the danger of strange object contamination, con- tamination with other products containing meat bone meal (MBM), misrepresentation of hand-add formulas, incorrect amounts of weights, uneven mix- ed feed, less or overcooked feed, the water content and the heat of the feed is too high and label and packaging errors.

The danger of strange object contamination in the animal will cause a disturbance or physiologi- cal disruption to the organ or animal system. One of

the diseases caused by strange object in cattle is pericarditis traumatika and bloat Other Contami- nation like with other products containing MBM can cause cattle to be exposed to mad cow/BSE disease. Bovine Spongioform Encephalopathy (BSE) is a progressive disease affecting the central nervous sys- tem (CNS) in adult cattle aged 2-8 years. Epidemiological studies carried out by reported that

BSE disease is caused by scrapie-like agents carried through MBM (Wilesmith *et al.*) [10].

An essential element of both macro and micro minerals is needed for the physiological pro- cesses of livestock, especially ruminants. Mineral deficiency disease in cattle is mainly due to the lack of certain mineral content in animal feed, but it is not possible due to the interaction of mineral elements in the feed. This disease can lead to decreased body weight, lethargy as well as decreased production and reproduction. Cases of deficiency of mineral elements have been reported both in Java and outside Java. (Darmono) [11].

Inaccurate scales can affect the nutrients contained in animal feed, especially in the addition of nutrients (premix material). Inaccurate scales can cause the nutrients needed by the cattle are not met so that eventually the cattle will experience mineral deficiency due to lack of nutrients. (Decree of the Minister of Agriculture) [12].

Feed with too high moisture content and overheating in the pellet process can trigger the growth of mold / mold. Fungi / mold activity may trigger the activity of mycotoxins that are harmful to the cattle if the cattle are ingested with feed that contaminated with mycotoxins. Mycotoxins contained in the diet can cause cancer in animals. The pelleted feed should be fed into the cooling chamber until its temperature is equal to the ambient temperature. The detail of hazard analysis is shown in Table 7.

The hazards that have identified the cause and impact are then analyzed for significance. Hazard significance as in Table 3 is determined through the combination between frequency rating (Table 1) and impact of occurrence (Table 2). The results of hazard significance analysis for cattle feed production can be seen in Table 8.

Table 4: Occurrence rating in FMEA

Frequency	*Occurrence*
0-1 times/month	1
2-3 times/month	2
4-5 times/month	3
6-7 times/month	4
>7 times/month	5

Table 5: Severity rating in FMEA

Effect	*Severity*
Does not cause disruption to cattle	1
Causes disruption but does not interfere with cattle growth	2
Causes disorders that interfere with cattle growth	3
Causes illness to death in cattle	4
Danger to human (disturbance, disease until death)	5

Table 6. Detection rating in FMEA

Criteria	*Detection*
Control of the company is able to prevent failure occurs	1
Control of the company is able to make the chance of failure becomes very small	2
Control of the company is able to make the chance of failure to be small	3
Control of companies less able to prevent the occurrence of failure / opportunity failure is still high enough	4
The control of the company has no impact / the company has no control	5

All hazards are categorized as insignificant hazards. All hazards are declared to have a low rating because the frequency of occurrence is 0 times per month during the observation period ie Febru- ary-April 2017. The combination of occurrence and impacts as shown in the Table 8 shows that there are no significant hazards and all hazards are not continued in CCP determination. All hazards are categorized as PRP as shown in Appendix 1.

Table 7: Hazard Analysis

Process	Hazard	Causes	Effect
Intake	Strange objects contamination	Previous process/environment	Pericarditis Traumatica and Timpani diseases
	Contamination with other product which contain MBM	The path is not perfectly clean	Mad cow disease
Grinding	Strange objects contamination	Previous process/environment	Pericarditis Traumatica and Timpani diseases
Mixing	Error while giving hand add formula	Human Error	Cause metabolism disruption
	Incorrect amounts of weight	Scale is not accurate	Mineral deficiency disease
	Strange objects contamination	Previous process/environment	Pericarditis Traumatica and Timpani diseases
	uneven mixed feed	Inappropriate mixing time test	Cause metabolism disruption
	Contamination with other product which contain MBM	The path is not perfectly clean	Mad cow disease
Pelletizing	under or overcooked feed	Inappropriate valve steam temperature	Affect the nutrition of feed
	Water content and the heat of feed is too high	sensor cooler not working properly	Growth of fungi in feed
Packing	Label and packaging error	Human Error	Poisoning in cattle
	Contamination with other product which contain MBM	The path is not perfectly clean	Mad cow disease

The combination of occurrence and impacts as shown in the table shows that there are no significant hazards and all hazards are not continued in CCP determination.

PRP

PRP in controlling or preventing strange objects contamination is by installing the filter in 3 initial process of

production that is process intake, grinding and mixing. Filter functions and conditions are controlled through routine checking and cleaning performed at the beginning of each shift by each operator of the production process. Routine checking and cleaning is done to keep the filter in optimal condition (not torn, not clogged and clean).

PRP to control and prevent the occurrence of contamination of MBM in cattle feed is by make a special line and machine to distinguish feed containing MBM and not. Cleaning and discharging lanes and engines first before changing any type of feed to prevent the contamination.

The company has a requirement or PRP to control and prevent the occurrence of a formula error on the hand add process before mixing. The prevailing PRP for this hazard is with the separation/ specialization of the container. The container for formula hand add for cattle feed is blue.

The company control and prevent the occurrence of the inappropriate number of scales by calibrate the scales on a regular basis every beginning of the shift. Weighing calibration is done by matching the weight of weigh stones weighed by the number of displays that appear on the scales.

PRP for uneven weight of feed is by setting the standard mixing time applicable for each feed mixing process. Standard mixing time is also always redefined every 6 months.

Table 8: Significancy of hazards

Process	Hazards	Frecuency	Severity	Significancy
Intake	Strange objects contamination	Low	Medium	Not Significant
	Contamination with other product which contain MBM	Low	High	Not Significant
Grinding	Strange objects contamination	Low	Medium	Not Significant
Mixing	Error while giving hand add formula	Low	Medium	Not Significant
	Incorrect amounts of weight	Low	Medium	Not Significant
	Strange objects contamination	Low	Medium	Not Significant
	uneven mixed feed	Low	Low	Not Significant
	Contamination with other product which contain MBM	Low	High	Not Significant
Pelletizing	Error while giving hand add formula	Low	Medium	Not Significant
	Incorrect amounts of weight	Low	High	Not Significant
Packing	Strange objects contamination	Low	Medium	Not Significant
	uneven mixed feed	Low	High	Not Significant

Time test to ensure that the time standard that used is appropriate.

PRP in preventing the occurrence of feed that under or overcooked is by setting the steam valve temperature regularly at the beginning of each shift. This routine arrangement is done by the pellet operator.

PRP to control and prevent the amount of water and the heat is by checking and cleaning routine sensor detection in the detection pellet machine. Checking and cleaning is done by the pellet operator at the beginning of each shift.

PRP owned by the company in preventing the occurrence of labeling and packaging errors is to re-check the labels and packaging. Sampling is also carried out to determine whether the product with the label and packaging is appropriate and has met the quality standards or not. Labels to be packed into the packaging are also distinguished by their type of animal. For example, for cattle the label that is inserted into the packaging is brown.

FMEA

Failure Mode and Effect Analysis is used to determine the biggest failures that should be prioriti- zed by the company. The greatest failure is obtained through the greatest RPN value. Failure that needs to be prioritized by company is contamination with other products containing MBM and errors when pouring formula hand add. The detail of RPN value for each hazard in each process can be seen in the Appendix 2.

Conclusion

Hazards and contamination that may occur are strange objects contamination, contami- nation with other product which contain MBM, hand add formula error, inaccurate scales, non- homogeneous feed, water content in the feed is too high and overheating, and label and packaging errors.

All hazards are identified as insignificant hazards. The insignificant hazards show that ha- zards is under control and no longer being a threat.

These hazard is identified into PRP control. The hazards that classified as PRP are a controllable hazards because the basic requirements applied by the company are already able to control these hazards.

HACCP design especially on cattle feed is done to be able to know whether cattle feed is guaranteed to cattle and human health indirectly.

The analysis result of HACCP design shows that there is no CCP in cattle feed production process. All identified hazards are classified as insignificant hazards in terms of the occurence and consequence of the hazards so they are not continued to the CCP determination.

FMEA (Failure mode and effect analysis) is used to determine the greatest potential hazard that occurs in the company. FMEA results show that the biggest hazards that need to be the focus by company are the hazards of the product contaminated with other products which containing MBM on the packing process with the RPN score 8, the hazard of formula hand add error with RPN score 8 and the hazard of the product contaminated with other products containing MBM in the process intake with RPN score 6. All three of these hazards have a high RPN score because the level of consequences is severe enough to cause death in cattle. However, the company has been able to control this hazard as evidenced by the odds of occurrence is 0 times in period of 3 months.

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