Ensuring Feed Safety – A Case Study of the Implementation of HACCP into a Commercial Feed Milling Company

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Abstract

Stockfeed has emerged as a critical link in ensuring food safety. As the leading Australian stockfeed manufacturer, Ridley AgriProducts has implemented a national HACCP feed safety program across 21 feed mills, and integrated this into other programs such as customer relations, quality control and process improvement. The present paper describes the origin, design, implementation and outcomes of this program. The seven basic steps of the HACCP system are described in relation to this program and how they were addressed in the Ridley implementation. All potential feed-milling hazards were identified and the severity and risk level of each potential hazard were categorised as High or Low, Major or Minor. Those hazards, which were considered as High and Major became the HACCP plan hazards. Hazard analyses were based on known feed contaminants and/or error-prone areas that could compromise feed safety. The majority of these were directly related to possible effects on food safety, such as Salmonella contamination, whereas others were based on the necessity to avoid performance-related problems in livestock, such as rancidity in fats and incorrect pellet size. Finally, arguments are presented for the requirement to move beyond stand-alone HACCP programs, in particular back down the supply chain, to ensure complete integrity of feed manufacture.

Introduction

The European feed manufacturing and livestock industries have faced severe food safety issues throughout the last two decades. Some of these issues, such as the outbreak of Bovine Spongiform Encephalopathy (BSE), were impossible to predict, whereas others were more straightforward in their etiology. The Belgium Dioxin Crisis, which occurred in 1999 due to contaminated fat supplied to stockfeed manufacturers, is an example of the latter. There are a number of other incidents from around the world that show the importance of feed safety in ensuring the safety of human food. Currently, the stockfeed and livestock industries have the highest possible profile in the food supply chain, a situation that is likely to continue into the future.

One of the major areas of consumer concerns is bacterial contamination of food, and there have been a number of significant incidents recently such as the 1993 Jack-in-the-box hamburger *E. Coli* O157:H7 outbreak. In the USA alone food borne pathogens may account for up to seven million cases of food borne illness and up to 7,000 deaths per year. While historically most focus on these bacterial contamination issues was placed on the “post-harvest” sector (processing plants, cooking facilities) it is now acknowledged

that every segment of the "pre-harvest" sector (stockfeed, raw materials, farms) is also important (Smith, Sofos and Belk, 2000). The poultry industry has long recognized the importance of providing *Salmonella*-free feed to laying hens for example. Accordingly, there has been increased focus on feed as a source of bacterial contamination of livestock production units. What has become very clear, particularly since the mid-90's, is the crucial importance of stockfeed in the overall food supply chain.

The HACCP process of ensuring food safety was developed in the 1960's in the USA by a food company as part of its efforts to produce foods for the space program. This system identifies potential problems with food safety in advance and sets up methods to control each of the possible hazards identified. It is a proactive preventative program, and while finished products checks remain necessary the major focus is on stringent identification of potential hazards and preventing them during manufacture. The same principles have been successfully applied to feed safety by our organization.

Decision to Implement Hazards Analysis and Critical Control Points (HACCP) Feed Safety System

Over the past decade, Australian agriculture has embraced the principles of food safety, and has recognized at every level, from farm to fork, the importance of implementing food safety programs. Ridley AgriProducts is the leading stockfeed manufacturer in Australia. With stockfeed businesses in the United State of America and Canada, Ridley one of the world's leading stockfeed manufacturers. In Australia, the business has 21 manufacturing plants, producing 25-30% of the total compound feed production of approximately 4-5 million tonnes.

Although the Ridley business grew significantly throughout the late 1980's to early 1990's by acquisitions, there was early recognition of the importance of feed safety by senior management. There were formative meetings held in 1998 on the best course of action to ensure feed safety, and in September 1998 the decision was made to implement HACCP nationally. In December 1998 a 'National QA Steering Group' was formed charged with responsibility of driving the process. In January 1999 the Ridley Board of Directors gave the approval for national mill HACCP implementation.

The Seven Basic Steps of the HACCP System

The seven basic steps of the HACCP system are as follows:

- Identification of potential hazards
- Observation of the feed production process to identify critical control points
- Establishment of appropriate control procedures
- Establishment of monitoring procedures
- Development of a corrective action plan when there is a deviation from an established critical limit
- Establishment of verification procedures that the system is working

These steps were rigorously worked through as described in the following sections.

Hazard Analysis

Hazard analysis was conducted at Ridley AgriProducts feed mill situated at Corowa, New South Wales, with the aim being to develop a generic mill HACCP plan which could be customized at all other sites. Potential hazards were identified by working through the Corowa mill manufacturing process. The severity and risk level of each potential hazard were identified as High or Low, Major or Minor. Those hazards, which were considered as High and Major became the HACCP plan hazards.

Hazard analyses were based on known feed contaminants and/or error-prone areas that could compromise feed safety. The majority of these, such as *Salmonella* contamination, were directly related to possible effects on food safety, whereas others were based on the necessity to avoid performance-related problems in livestock, such as rancidity in fats and incorrect pellet size (Table 1).

Table 1. Hazards Analysis of a model feed manufacturing operation

High Risk / Major Severity	**Low Risk / Minor Severity**
Salmonella contamination	Excess Pesticides (OP's / OC's)
Weed seed contamination	Rancidity
Moulds & mycotoxins – ex cooler	Moulds & Mycotoxins – incoming RM's
Metal contamination	Excess Biogenic amines
Meatmeal in ruminant feeds	Excess heavy metals
Wrong RM or medication / amount in feed / cross-contamination	Pellet size
Wrong batch sequencing / flushing order	Incoming RM to incorrect silo / bin / tank
Insufficient mixing	Feed to incorrect out loading bin
Incorrect feed labelling / dispatch / unloading	

Identification of Critical Control Points

The standard HACCP definition of Critical Control Points (CCP) was used for identification as follows: *'CCP is defined as a point, step or procedure at which control can be applied and a food/feed safety hazard can be prevented, eliminated, or reduced to acceptable levels* (Loken, 1995). The following decision tree process was used to identify CCP's in the milling process:

- Do preventative / control measures exist for the identified hazard?
- Is the step specifically designed to eliminate or reduce the likely occurrence of a hazard to an acceptable level?
- Could contamination occur or increase to unacceptable level(s)?
- Will a subsequent step or action eliminate or reduce the hazard to an acceptable level?

Design and Implementation of the System

The evaluation stage conducted in the model feed mill involved the investigation of computer-based HACCP packages with the aim of facilitating the establishment and on-going maintenance of the HACCP system. A software package called RAMAS (QAS Software, UK) was purchased through QC Systems Pty Ltd (Melbourne) and the 'Model Mill' concept used to develop a standard mill HACCP plan. These plans were designed to complement as far as possible with quality assurance procedures already in place at feed mills. In May 1999 the first desk-top audit of the standard mill HACCP plan was carried out, and during August and September site training occurred. Site Production Managers were trained in the software package with the aim of having each site customize the standard plan to fit their own local situation. However, the Site Managers did not have the authority to change HACCP plan hazards or monitoring procedures, schedules etc.

All HACCP plans within the business are supported by well developed management systems, including Good Manufacturing Practice (GMP), basic mill hygiene, and Quality Control. To assist in all elements of quality management, a national network of Near Infrared Reflectance Analysers (NIR's) (20 filter machines) were installed. These machines, once properly calibrated, allow the rapid analysis of nutrient levels in raw materials and finished products. Following extensive testing and calibration, calibrations now exist for seven feed types (pigs, broiler, layer, dairy/beef, calf, universal, salmonid) and 19 of the main raw materials used in the manufacture of stockfeed. The NIR system is controlled by a central co-ordinator, who is responsible for ensuring the on-going accurate calibration of the NIR's and collation and reporting of all results. The NIR measurements of raw material nutrient levels are routinely used in the feed formulation process to ensure accuracy of diet nutrient levels versus specifications.

HACCP certification of individual feed mills is independently carried out by an accredited quality audit organization. This organization operates nationally, and undertakes the on-going audit programs necessary to retain certification for each of the 21 feed mills.

Operation & Results

The business has a national focus on quality management, with a National Quality Manager and four primary managers responsible for ensuring compliance with the HACCP system. A Customer Complaint and Mill Non-Conformance Reporting System was implemented in January 2001, again with a national reporting basis and process improvement plans.

A recent national review of mill HACCP plans indicate specific procedures and monitoring tests are being well managed on the majority of sites. While there are on-going regional reviews continually, a national review will be undertaken on a yearly basis. Results of CCP monitoring indicate identified hazards are being well managed through the system and that products meet strict safety criteria. Results of CCP monitoring have highlighted those areas where HACCP plan needs to be reviewed.

Since achieving HACCP certification Ridley AgriProducts southern Australia feed mills have had 559 samples (comprising raw materials, mill swabs and finished products) tested for salmonella contamination. Of the 559 samples tested 15% were found to contain Salmonella, with 95% of all positive tests being raw material related. No finished product samples were found to contain salmonella.

HACCP monitoring has also yielded interesting results in the area of purchasing control. All grain and pulse purchases must meet strict standards, including weedseed contamination. On average 1% of all loads of grain/pulses are rejected by Ridley sites, of which 1 in 7 are rejected for weedseed contamination. Other reasons for rejecting loads of grain/pulses include insect infestation & physical contamination such as metal objects, rocks and paddock trash.

In Australia, as for many other countries around the world, feeding animal protein meals to ruminants is banned. When first developing HACCP plans Ridley ensured that animal protein meals did not inadvertently make their way into ruminant diets by manually double and triple checking diet formulations. This process was both time consuming and open to human error. Format International, supplier of the diet formulation package used by Ridley AgriProducts, developed a BioSecurity™ module aimed at monitoring critical diet formulation requirements / hazards. Through purchasing and implementing BioSecurity™ checking procedures Ridley has maintained ruminant diets free of animal protein meals.

Ensuring the correct inclusion of specialist additives in standard pig, poultry and cattle diets is another critical element of Ridley's HACCP plan. Once again inclusion of such additives is controlled through the use of BioSecurity™.

Beyond HACCP

The normal food safety risk factors such as chemical residues, antibiotic residues and resistance, and microbial contamination could threaten domestic food safety and exports, and these are the very clear focus of most HACCP programs including the Ridley feed manufacturing program. However, abnormal incidents, such as the recent dioxin contamination of stockfeed in Belgium in 1999, have a large potential to threaten food exports. In the Belgium incident, motor oil containing very high levels of dioxin and PCB's had been mixed with frying fat at Fogra, a fats and oils recycling firm which supplies fats to animal feed makers. By the time that high dioxin levels were reported in livestock products, more than 1,000 farms were affected. The United States blocked European Union imports of pork and poultry, and Singapore banned all EU meat products. Countries from Switzerland to South Korea took similar measures against Belgian products. The incident effectively caused the complete cessation of Belgium livestock exports and seriously eroded consumer confidence in Belgium food products.

The question that we have been asking in relation to this incident is: "Do we currently have the programs in place to prevent such as occurrence within our operations?" Certainly the Belgium dioxin incident demonstrated the necessity for all parts of the food

supply chain to have independently-audited HACCP programs. There have been other well-documented cases where the supply of raw materials has compromised feed safety. The whole chain is only as strong as its weakest link. Therefore, we need to think beyond just "paddock to plate", and review all the contributors to the overall supply chain. This will necessitate down-stream hazards identification and auditing programs for all suppliers into the manufacture of stockfeed (Figure 1).

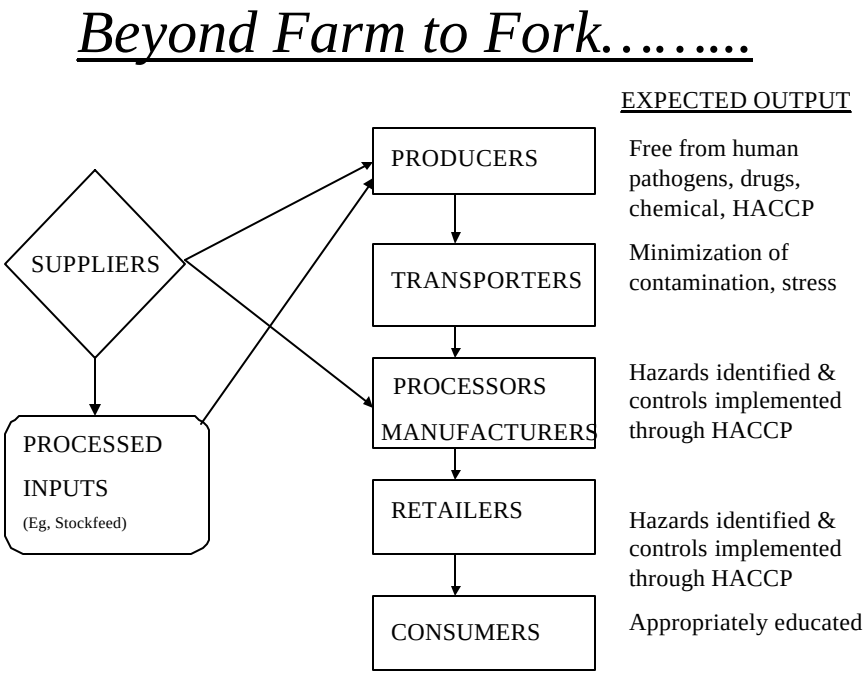

Figure 1. The interrelationships between units in the food supply chain – the multiple component nature of the food supply chain must be recognised in any HACCP program.

The next phase of the on-going development of the Ridley HACCP program will focus on supplier programs. While cereal grains & pulses are purchased according to National Agricultural Commodities Marketing Association (NACMA) standards, in some cases these standards require revision in the light of new information, and in other cases the standards no longer meet current industry standards. Additionally, in general the standards of raw material supply into the manufacturing operation need to be increased, and we will be working on this process over the coming months. In this way, the HACCP program used within Ridley AgriProducts will continue to evolve and be challenged internally to ensure the integrity of the feed supply chain. As a major member of the food chain we must move past simply focusing food/feed safety programs (HACCP) to an integrated management system where working safety, environmental safety and feed safety are second nature to our employees.

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