APPLICATION OF HACCP PRINCIPLES IN BEEF SLAUGHTER AND FABRICATION

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SUMMARY

The National Academy of Sciences of the United States has recommended the use of the Hazard Analysis Critical Control Points (HACCP) system of food safety assurance in meat processing and regulatory inspection. In the summer of 1993, our group was approached by representatives of a major fast-food chain and its suppliers of ground beef patties to develop a HACCP training course for beef slaughter and fabrication. Based on a model released by the National Advisory Committee on Microbiological Criteria for Foods (NACMCF) and in consultation with the above group, we developed such a course, which we taught eight times to their suppliers of beef trimmings. The purpose of this paper is to present the principles of HACCP, but more importantly, to report on our involvement in HACCP and to present an application of HACCP principles to beef slaughter and fabrication.

Introduction

The objective of HACCP programs is to provide as close to 100% assurance as possible that products will be free of hazards (Pierson and Corlett, 1992). Traditional quality control programs are unable to provide such assurance. During the 1980s, the HACCP system was recommended for use in regulatory inspection programs by scientific expert groups, such as committees of the United States National Academy of Sciences (Anonymous, 1985). In the fall of 1989, the Food Safety and Inspection Service (FSIS) announced its intention to implement HACCP as a science-based system for its meat and poultry inspection programs (Adams, 1990). The NACMCF has issued a HACCP paper (NACMCF, 1992) in which it explains and defines HACCP. This paper summarizes the principles of HACCP and presents development of a model HACCP plan for beef slaughter and fabrication.

The Principles

HACCP is an effective and rational approach for assuring food safety throughout all stages of production, from the field to consumption (NACMCF, 1992; Pierson and Corlett, 1992; Sofos, 1993). It consists of seven principles: Principle No. 1 deals with "conducting a hazard analysis by preparing a list of steps in the process of preparing a food where significant hazards could occur and by describing the preventive measures for these hazards." Hazards have been defined by the NACMCF as any biological, chemical or physical property that may cause an unacceptable consumer health risk. After completion of hazard analysis, the HACCP team prepares a flow diagram identifying all steps of the process and highlighting those associated with important hazards.

HACCP Principle No. 2 is to "identify the critical control points (CCP) in the process to assure food safety." The CCP are defined as any point in the chain of food production and processing, from raw materials to finished product (from the field to the mouth), at which loss of control can result in an unacceptable food safety risk, or at which control can be applied to prevent, avoid, eliminate or reduce the severity of hazards. All hazards identified by the hazard analysis step must be controlled at the appropriate CCP. The International Commission on Microbiological Specifications for Foods defined two types of CCP (ICMSF, 1988; Tompkin, 1990). These are CCP1, which should assure control of a hazard, and CCP2, which minimize, but cannot assure, complete control of a hazard. Others divide CCP as process CCP, and CCP at which action can be taken to avoid a deviation. However, the terminology used is not important. Application of the HACCP principles to accomplish the objective of safe food is important. Different industries should feel free to adopt any terminology that fits their products. HACCP is a concept. It is not a "canned recipe" for widespread application without modifications. Principle No. 3 of HACCP is to "establish critical limits (CL) for preventive measures associated with each identified CCP." These CL are one or more criteria or tolerances that

need to be met at each CCP, and serve as boundaries of safety. Each CCP may have more than one CL, and if control is lost in even one of them, then a potential hazard may develop in the product. Parameters or criteria for which CL may be set include temperature, time, pH, water activity, acidity, salt and preservative concentration, moisture content, product and equipment dimensions, sanitizer concentration, viscosity, as well as sensory properties such as appearance, texture and aroma (NACMCF, 1992). For example, CL for cooking of ready-to-eat, ground meat patties to destroy vegetative pathogenic bacteria would be: minimum internal patty temperature, oven temperature, and time of heating, which would be affected by factors such as belt speed, patty thickness, patty composition and oven humidity (Pierson and Corlett, 1992).

HACCP Principle No. 4 is designed to "establish CCP monitoring requirements, and procedures for using the results of monitoring to adjust the process and maintain control." This is a planned sequence of observations and measurements to determine whether CCP are under control, and to produce an accurate record for future verification. Monitoring can be scheduled or continuous testing or observation of CCP and their CL, and must be documented, because failure to monitor and to control a CCP is defined as a critical defect (i.e., leads to a hazard). Thus, monitoring detects or prevents critical defects. Monitoring should ideally be continuous. This may be possible with physical and chemical parameters such as temperature, time and pH. Continuous monitoring is accurate and effective only when the equipment and instruments are in good working order and well-calibrated for accuracy. When application of continuous monitoring is not possible, the experts should establish monitoring intervals (e.g., statistical process control) or visual monitoring that can be relied upon to identify development of hazardous situations.

HACCP Principle No. 5 is to "establish corrective actions to be taken when monitoring indicates that there is a deviation from the established CL." The actions to be taken should eliminate or control the potential hazard that was generated by the deviation. The corrective actions also assure safe disposition of faulty or suspect products, and that the CCP have been brought under control. Specifically, corrective action plans should deal with: 1) disposing of faulty or potentially unsafe product; 2) correction of the cause of the deviation; and 3) maintenance of records of the corrective actions that were applied when deviations occurred.

Principle No. 6 of HACCP is to "establish effective record-keeping procedures that document the HACCP system." The approved written HACCP plan and all related records must be filed and available at the plant. Record-keeping is useful because: 1) it can be used as evidence of product safety; 2) it provides documentation of compliance with regulations; 3) it enhances review of plant procedures; and 4) it is useful in tracing product lots or batches when necessary.

The last, or Principle No. 7, is to "establish procedures for verification that the HACCP system is working properly." Verification includes: 1) scientific or technical procedures and audits to verify that the CL at each CCP are satisfactory; 2) procedures ensuring that the HACCP plan is working effectively, based on frequent reviews and verification; 3) documented periodic validations to ensure accuracy of the plan; and 4) regulatory responsibilities and actions to ensure that the HACCP system is working properly. Verification may be done by the company, its customers, or the regulatory authority.

A HACCP plan for beef slaughter and fabrication

Early in 1993, there was a large outbreak of hemorrhagic colitis, involving more than 500 cases and three deaths, which was attributed to undercooked ground beef contaminated with *Escherichia coli* O157:H7, that was served at restaurants of a fast-food chain in the western United States (Sofos and Smith, 1993). This, led to more extensive testing and detection of more outbreaks or sporadic cases of the illness. These developments led a major fast food chain to initiate efforts to establish a formal HACCP system in their operation as well as to require HACCP of their suppliers. As part of this effort, we of the Center for Red Meat Safety at Colorado State University developed and taught a HACCP course for beef slaughter and fabrication to the companies that slaughter cattle and produce trimmings which are used by the ground beef patty makers to provide this company with the meat for its hamburgers.

The basis for our course and HACCP plan was the model developed by the NACMCF (1993). However, we modified it by using five instead of seven CCPs (Fig. 1) and by establishing standard operating procedures (SOP) as part of the HACCP plan. These CCP were considered very important because: 1) at skinning or hide removal the muscle tissues are first exposed to contamination which should be minimized; 2) at evisceration and viscera handling there is potential for fecal and ingesta contamination to be introduced onto the meat; 3) at final carcass washing, which may also include spraying/rinsing with a chemical agent such as acetic or lactic acid, there is an opportunity for reduction of contamination, but also for redistribution of contamination over the entire the carcass; 4) Carcass chilling is important because it limits proliferation of bacterial contaminants; and 5) storage temperature of primal cuts or trimmings should be monitored to avoid (freezing) and reduce (refrigeration) microbial proliferation. These were the five CCP recommended; however,

each individual company may apply more CCP if they feel it is necessary or applicable in their operation. For each of the CCP and other steps in the flow chart (Fig. 1) we provided criteria or CL to be met; monitoring procedures and frequency needs; corrective or preventive actions to be taken; records and measurements needed; and verification needs. The attendees were also taught how to develop, together with their workers, SOP for each processing step or each individual worker. Examples of CL, records to be maintained and frequency of monitoring suggested at each CCP are presented in Figure 2. The attendees were asked to start development of charts for monitoring, verification and record-keeping systems for their operations. Also, an auditing or verification system to be used by the companies, as well as the buyers of their products, was presented.

Conclusions

HACCP is a preventive system of food safety assurance which, if applied properly, can control points or steps in the food chain that could lead to a hazardous situation. As such, it serves as a tool for prevention rather than for after-the-fact detection of problems. For its success, however, there is a need for continuous commitment by management and employees and it is important to train people and make them feel a part of an important team; and someone must assume responsibilites for the overall implementation of the program.

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