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A New Approach to Food Safety - HACCP

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SUMMARY: Hazard Analysis and Critical Control Points (HACCP) represents a new food inspection strategy for the future (USDA, 1989). It is a simple system of process control and an effective means of identifying potential hazards in food systems. The first step is an evaluation of facilities, practices, procedures and the use of raw materials and food products. Then, hazard characteristics of food systems can be assessed and risk categories established. The potential for microbial abuse should be determined by identifying microorganisms of concern and sensitive ingredients and establishing sampling plans and analytical methods. Determination of Critical Control Points (CCP's) and establishment of procedures to rapidly and continuously monitor those CCP's insure control of health hazards. Corrective actions to eliminate hazards created by loss-of-control at CCP's should be documented. Verification procedures to assure that CCP's are under control and effective must be established.

INTRODUCTION: Hazard Analysis and Critical Control Points represents a rational approach to food safety because it uses accumulated plant data in establishing the system for a plant. It is comprehensive because it evaluates raw materials, ingredients, equipment, and facilities. Continuous monitoring of all operational procedures and systematic evaluation of each step of meat slaughtering and processing operations insure the highest possible level of food safety.

Hazard Analysis and Critical Control Points has been described as an effective means of identifying potential hazards in food. It requires an in-depth knowledge of a food and its ingredients. Development of criteria for HACCP is closely linked to means of control and monitoring of the food system. The HACCP system promotes the use of controls and criteria in the early stages of food preparation. Safety is achieved by careful attention to ingredients and processing steps (Corlett, 1987).

The objective of HACCP is to insure that safe, wholesome and unadulterated food reaches the consumer and its use should eliminate much of the finished product microbiological testing now being done. It depends upon process control throughout product life, identification of potential hazards and establishment of Critical Control Points (CCP's) in the food system to minimize the presence of unacceptable health risks, e.g. cooking roast beef to 145°F to destroy Samonella (Bauman, 1989).

DISCUSSION: There are seven basic principles to a HACCP system (Bauman, 1989):

1) The identification and assessment of hazards associated with growing, transporting, slaughtering, processing/preparation, distribution, and consumption of a given food product = Hazard Analysis

2) A determination of CCP's to control any identifiable hazards

3) The establishment of critical limits to be met at each identified CCP, e.g., temperature, time, chlorine level, etc.

4) The establishment of procedures to monitor CCP's

5) The establishment of corrective actions to be taken when there is a deviation from a process schedule identified by monitoring at a CCP

6) The establishment of an effective record keeping system for the HACCP plan

7) The establishment of procedures to verify that the HACCP system is working correctly

To be successful a HACCP system must, as mentioned above, give attention to the condition of the animals on the farm and enroute to market as well as at the abattoir. Spread of disease -producing agents from mother-to-offspring and by means of contaminated feed represent serious hazards to the food supply that must be identified. In addition the practice of hauling animals long distances to slaughter in manure-laden trucks contributes to contamination of the meat during slaughter (Childers, 1989). Slaughtering procedures which present hazards must also be carefully monitored. Some of these procedures include removal of the head, hide, hair and feet, evisceration and organ separation, carcass washing, and chilling. Cross contamination by workers and equipment should be minimized (Childers, 1989). The application of a HACCP system to processing and preparation of meat products must first include a hazard analysis with an assessment of the hazard characteristics of the food system. The characteristics that must be evaluated are as follows (Bauman, 1989):

1) Does the product contain "sensitive" ingredients in terms of known microbiological hazards

2) Does the process contain a controlled processing step that effectively excludes or destroys harmful microorganisms

3) Is there substantial potential for abusive handling in distribution or consumer channels that could render the product harmful when consumed

After risk assessment has been accomplished - i.e., sensitive ingredients, microbial destruction, and abuse potential have been determined - then each food product can be assigned to one of the following risk categories (Haberstroh, 1988):

Category I-----applies to non-sterile products designated and intended for consumption by at-risk populations, such as infants, the aged, the infirm, and the immunocompromised

Category II----subject to all three (3) of the general hazard characteristics above

Category III---subject to two (2) of the general hazard characteristics above

Category IV----subject to one (1) of the general hazard characteristic above

Category V-----no general hazard characteristics

When considering the potential for microbiological abuse, a number different sources must be evaluated, including contaminated raw materials and ingredients, proper sanitation of equipment and production areas, lack of proper temperature control, cross-contamination and poor food handling practices.

Never should equipment and utensils used for raw product be allowed to come in contact with those used for finished product. All raw materials and ingredients should be kept out of the food danger temperature zone of 45-140°F as much as possible. Special concern must be given to the psychrotrophic organisms which can grow at temperatures as low as 32°F. Proper time/temperature relationships for thawing and tempering, cooking, in-process steps, cooling, freezing, and storage must be maintained. Cross-contamination from utensils, equipment, hands, clothing, air, or liquids should be avoided. All employees should follow proper food handling practices such as wearing clean clothing and gloves and hair and beard nets, keeping their hands clean, and insuring that they have no unprotected cuts, sores or nasal discharges (Haberstroh, 1988).

Determination of which organisms of concern might be associated with a particular product or ingredient may be used to establish levels of risk with special significance being given to Salmonella, Staphylococcus, Escherichia coli 0157:H7, Cl. botulinum, Cl. perfringens, Listeria, Campylobacter, and Yersinia.

"Sensitive" ingredients and compound materials be should be identified and include the following (NRC, 1985):

1) Raw, cooked or processed red meat, poultry, and seafood
2) Dried milk and milk products and cheese
3) Dried egg and egg products
4) Soy flour and dry yeast
5) Spices
6) Low acid products such as vegetables
7) Water and ice

The hazard category for each ingredient should be determined for the organisms of concern. Breading batter mix might be considered low risk for Salmonella unless it contained soy protein which could give it high potential risk for Salmonella. Cheese and sausage would be high risk for Staphylococcus enterotoxin because of their lower water activity - A_w (NRC, 1985).

Monitoring of hazards in products and ingredients requires adoption of analytical testing methods for the organisms of concern. Then, a sample evaluation plan must be designed which requires establishment of acceptable limits for these organisms and designation of the acceptability of the products sampled. For this, a 2-class attribute plan is generally used - acceptable/unacceptable (Haberstroh, 1988). Complete product analyses are needed in order to assess the risk presented by each different food product. All ingredients in that product should be evaluated, including the % used in the product, the hazard category of those ingredients, and their specific hazard contribution (NRC, 1985). For example, frankfurters manufactured with pork would be a greater risk than those containing only beef. Those containing soy flour would be of greater risk than those containing dried milk, if the meat components were the same (Childers, 1989).

Consideration must be given to the production practices critical to the safety of the

product. Both open and closed types ofequipment are used in meat processing and have advantages and disadvantages related to cross-contamination, sanitation, and inspection. Measurements which can be performed during processing are of great benefit as are product tests which are simple, rapid and yield results in a short period of time (Childers, 1989).

Product distribution practices, particularly for refrigerated products, are of critical importance because they may influence shelflife and affect the condition of the product when it reaches the consumer. Necessary steps must be taken to insure that frozen products are continuously stored at 0^{o} to maximize their shelflife (ICMSF, 1988). Unfortunately, some consumers now identify frozen products as "old" ones which have been frozen simply to extend their shelflife so care must be taken to attractively present these products for retail sale. Relative humidity is a critical factor in product storage since it influences both microbial growth and organoleptic properties such as juiciness (Childers, 1989).

The food industry will probably never be able to produce a "consumer-proof" product but must continue to strive for packaging methods and materials which will withstand maximum consumer abuse, e.g. foil pouches, sturdy overlay film and bags, and controlled atmospheric packaging. Proper and attractive labeling which attract the consumer's attention can create an awareness of proper food handling techniques. Microwave-oven-ready products should be sturdily-packaged and accurately labeled in order for the consumer to realize maximum benefit from this new method of packaging and preparation (Childers, 1989).

Raw materials and ingredients constitute an important part of a HACCP system and should not be ignored. The hazard categories used by the plant should also be used to establish specifications for suppliers and to review suppliers procedures to assure that the specifications can be met on a guaranteed basis. The specifications should be thorough and include all areas of the manufacturing process such as incoming materials and process controls, tests, good manufacturing practices, and plant maintenance. The purchaser should give the supplier a written report of inspection and analysis as often as necessary (Bauman, 1989).

To a large degree, the success of a HACCP program depends upon the management of the system. A single individual should be in charge of and understand the <u>entire</u> system and be responsible for a separate department which deals with the entire scope of plant operations which pertain to HACCP. This department should deal with all procurements, reliability reviews and proper safety controls. All HACCP-responsible employees should receive good supervision, be well-trained, have specific assignments for monitoring each CCP, and know what action should be taken if that process goes out-of-control. The head of the department should approve any changes in any part of the process. (Corlett, 1987).

The HACCP system must be continually evaluated to insure that it helps prevent obsolescence, keeps up-to-date with changes which may occur in the food system and consumer use, and continually identifies potential situations that may increase hazard risks. The evaluation process should validate the selection and designation of CCP's to prevent hazards

and assess situations that may occur causing loss-of-control at CCP's which result in unacceptable food safety risks (Corlett, 1987).

These assessments may be necessary because of new or potentially hazardous conditions affecting food such as a change in characteristic of conventional food pathogen - e.g., Escherichia coli 0157:H7, or the emergence of a new pathogen - e.g., Listeria monocytogenes, (Corlett, 1989). In some cases, potential failure of a critical control point may result from failure of heat pasteurization to control a heat resistant pathogen (L. monocytogenes) or loss of pH control in low acid canned foods (tomatoes) (Childers, 1989).

Re-evaluation of the HACCP system may become necessary if new product development makes changes in raw materials, ingredients or suppliers; preparation or processing procedures; product formulations; packaging; the distribution system, storage or display; or situations that may result in new uses by the consumer. Up-dating of the HACCP system may be required in some instances by changes of manufacturing practices, such as product flow within the plant, modification or replacement of equipment, new sanitation or cleaning practices or schedules, or modification of the storage or distribution system. Changes in consumer use of the product such as the increased use of fresh, rather than frozen or canned products, and the trend toward increased use of microwave rather than conventional cookery must be considered (NRC, 1985).

Although microbiological hazards are currently the most important, in a HACCP system consideration must also be given to physical and chemical hazards. Physical hazards may be controlled by metal detectors and magnets, sifters and screens, control recorders, and flow diversion valves (Childers, 1989). Chemical hazards are usually identified as violative residues in food products. Agricultural chemicals still represent a serious threat to our food supply, especially the chlorinated hydrocarbon pesticides with their long half-lives (Katsuyama, 1987). Although polychlorinated biphenyls are no longer being manufactured, their use over several decades has left large amounts in the environment with the potential for migration into our food supply. Presently, aflatoxins are the most commonly-occurring natural substances found in foods, although there is an alarming increase in the number of other mycotoxins being found (Childers, 1989).

The ban of diethylstilbestrol as a growth promoting hormone has eliminated the seriousness of this problem in the meat supply. By using the Swab Test on Premises (STOP), the Calf Antibiotic and Sulfa Test(CAST), and the Sulfa On Site test(SOS) the U.S. Department of Agriculture routinely monitors for antibiotic and other drugs that might be used in downer animals, dairy cows with mastitis, swine, and veal calves at slaughter (Childers, 1987).

The HACCP system for a food processing plant must contain procedures to detect these hazardous chemical agents in its raw materials and exclude them from its manufactured products.

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