

A CASE STUDY

## Food safety: A holistic approach for preventing food-borne hazards

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**M**onitoring of cleaning and disinfection effectiveness is partly a matter of trained visual assessment and partly of microbiology. A plant that is not visually clean represents a risk of microbial contamination. The control of these risks is best achieved by a HACCP (Hazard Analysis Critical Control Point) approach.

The critical control points (CCPs) in the cleaning and disinfection programme should be identified and measurement and protocol set up. Some of the CCPs can be readily measured, for example the solution concentration of a detergent or disinfectant, while others involve checking the procedure itself. After each CCP stage in the cleaning procedure, the operator should check the effectiveness and thoroughness. This check should be backed up by the hygiene supervisor, who, if not satisfied, should ask for a repeat of the stage.

Quality assurance and/or production personnel should also check the plant regularly, looking in particular for old soil deposits not removed at the last clean and build up of fungi, corrosion or scale deposits. The supervisor and his or her team should allow be periodically audited ensure that the cleaning and disinfection procedures are being followed chemical solution strengths should be regularly checked by titration, fast kit or conductivity meter.

Food safety is related to all steps in the food chain. It starts from livestock producer who should bear the responsibility to provide clean and healthy animals which are free from undesirable residues followed by thorough manufacturing processes to retail outlets, hotels and restaurants and the consumer's kitchens. Food poisonings organisms can

be introduced into the food chain at any stage, but the most important is judged to be at primary production where intensive system of husbandry and with the breeding of stock solely for productivity purposes without regard for disease resistance constitutes the main offenders.

### *Hygiene assessment system (HAS):*

Risk assessment principles are also used as a tool for assessing and monitoring hygienic standard. Most of the systems developed depend upon observations being made at each step in a process, with points being awarded according to the degree of compliance with the required standard. Scores are weighted with regard to the risk partial compliance accords the safety of the final product. A total score at the end of the inspection gives a measure of the hygienic compliance.

### *Hazard Analysis Critical Control Points (HACCP):*

The concept of HACCP was the first time introduced by H. E. Bauman and other scientists in 1971 in the USA (Jay, 1996). HACCP and microbiological specifications are two excellent means of ensuring safety and good keeping quality of the food products. Food-borne risks can be easily assessed by adopting HACCP (Edwards *et al.*, 1997). ICMSF (1988) defined hazard as "Unacceptable contamination, growth of microorganisms, undesirable chemicals and physical agents or factors in foods".

### *Sequential steps in a HACCP system:*

All HACCP system comprises the following sequential steps.

#### *- Hazard analysis:*

This recognizes the risks present in

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the ingredients, equipment, or introduced during processing. Hazard analysis identifies infectious agent or any other factors affecting food safety and stability. The first step in applying the HACCP system to food manufacturing operation is to identify the microbial hazards and risks within the operations. The analysis requires many specialists such as microbiologist, engineers, veterinarians, cleaning experts, and so on. ICMSF (1988) recommends that all of the data emerging from this analysis should be collated into a flow chart as follows-

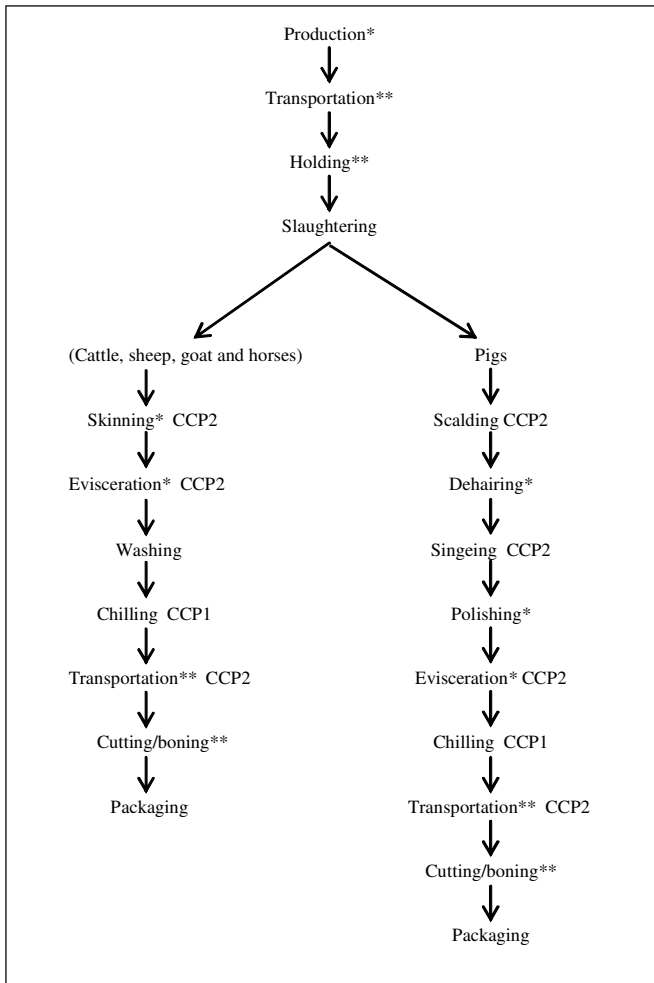


Fig. 1 : Flow diagram for fresh meat production and processing

- Determination of critical control points (CCPs):

Codex Alimentarius Commission, Codex (1991) defines CCP is a location, practice, procedure or process at which control can be exercised one or more factors which if controlled, could minimize or prevent a hazard. This definition has subsequently been revised and subdivided as follows-

CCP1: It is a CCP where the hazard can be prevented or eliminated.

CCP2: It is a CCP where the hazard can be

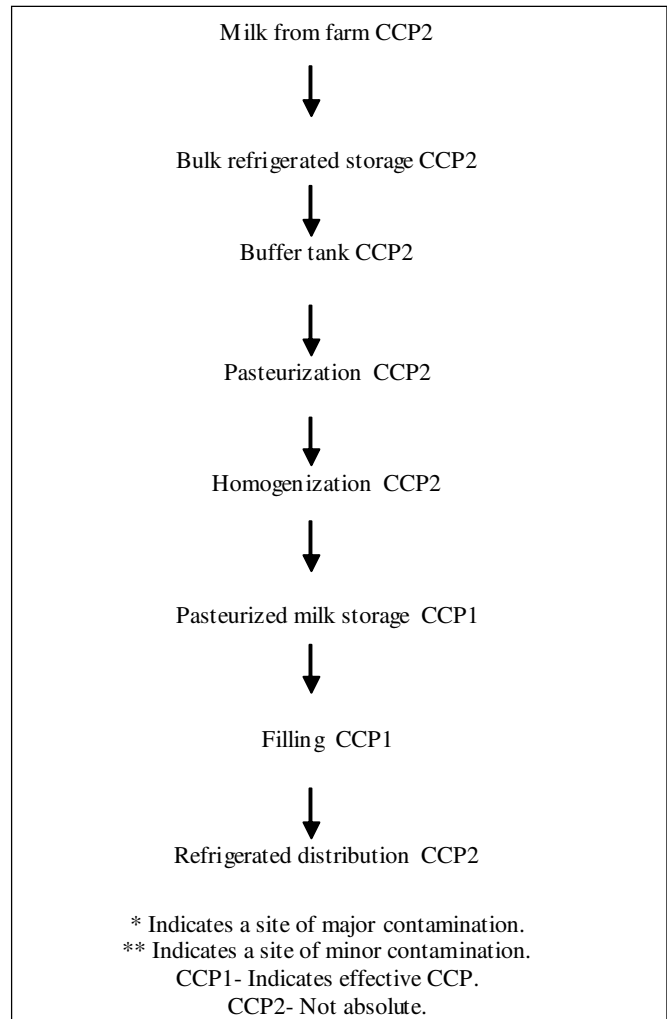


Fig. 2 : Flow diagram for milk Pasteurization

minimized, reduced or delayed.

- Specification of the criteria:

Criteria are specific limit of characteristics such as physical, (time or temperature), chemical; (salt or acetic acid) and biological (sensorial or microbiological). Quantitative criteria such as time, temperature, pH and the concentration of various chemicals, can be measured and indicate definitely that a system is or is not controlled.

- Implementation of the monitoring system:

Monitoring is the systematic checking of the process or procedure at a particular CCP in an order to detect any deviation from the criteria which have been set.

- Corrective action:

Procedures must be established so that immediate action can be taken for detection of deviation from the established criteria.

- *Verification:*

Verification checks are carried out systematically by the quality assurance staff and veterinary inspection team. Verification may involve some microbiological checks of end product, structures and equipment.

- *Documentation:*

Establishment of the documentation is essential for working of HACCP system in a proper way.

- *Implementation of HACCP system:*

For the implementation of a HACCP system it is essential to first assemble a HACCP team. This is followed by the description of the product with the intended use of the product, thereafter; a flow diagram is drawn with an on-site verification of the flow diagram. The hazards associated with each step are determined and the preventive measures to control them are taken.

***Some critical control points in dairy and meat industry:***

To control microbial hazards some CCPs have been described by various workers (Simonsen *et al.*, 1987; Herendra and Franco, 1991; Herendra and Franco, 1996) as follows-

- *Milk and milk products:*

Pasteurization.

- *Raw meat:*

Contaminated animal feeds, skinning, evisceration, spoilage of intestinal contents, chilling, scalding (for pigs and poultry), washing (poultry) and freezing (*Cysticercus cellulosae* and *Trichinella* are killed by freezing).

- *Sausages:* Chilling, freezing and smoking.

- *Semi-dry/dry sausages:*

Inoculation of culture, ripening; salt, water and acid content; and fermentation (time and temperature control).

***Microbiological specifications/standards:***

HACCP and microbiological specifications under 2-3 class sampling (attribute) schemes are two excellent means of ensuring food quality.

***Microbiological specification:***

This refers to “the microbiological criterion that forms the conditions of acceptance of a specific food or food ingredient by a food manufacturer or private or public purchasing agency”. Two types of microbiological specifications have been recommended for ensuring food safety and keeping quality. These are pathogenic and indicator organisms. Standards for specific pathogenic

organisms have been proposed from time to time either by fixing maximum permissible limits per unit (gram, ml., or cm.2) of food or by testing presence or absence of the organism in a given unit of food. e.g. *Staphylococcus aureus* or *Salmonella* spp, respectively. Indicator organisms are organisms or group of organisms that indicate likely presence of hazard that may occur in food or water but they themselves may or may not be responsible for the hazard e.g. coliforms indicate the likely presence of other enteric pathogens in food.

***Microbiological standards:***

This refers to “a criterion incorporated in a law or regulation, controlling foods produced, processed or stored in, or imported into the area of jurisdiction of the regulatory agency”. Microbiological standards have been proposed from time to time, depending upon the necessity. Generally the decisions on the acceptability of food lots based on the examination of few samples taken from the batch.

***Attribute sampling schemes:***

The schemes state the criteria for acceptance of a food lot on the basis of examination of certain required number of sample units by defined methods *i.e.* the scheme prescribe sampling procedure and decision criteria. There are two types of sampling schemes.

- ***Two class plan:***

These denote two attributes *i.e.* presence or absence of an organism in a given sample unit. This scheme is applied for more hazardous type of organism like *Clostridium botulinum*.

- ***Three class plan:***

This plan has three attributes and can be divide a lot into 3 categories acceptable (n, m); unacceptable (more than m) and marginally acceptable (c). The higher limit (M) is safety limit and values beyond this may be hazardous. “m” represents the lowest possible count that may occur under good manufacturing practices (FAO, 1977). “n” is the number of sample units to be examined.

***Criteria for devising sampling schemes:***

There are three most important factors that should be considered for devising attribute sampling schemes.

- ***Microbial incidence:***

It is essential to know the pattern of distribution of microorganisms in foods.

- *Hazard:*

If a product poses a potentially severe hazard, a two attribute scheme (presence or absence) has to be devised. In case of moderate or low hazard, a three class plan can serve the purpose.

- *Processing technique:*

Milk, meat, eggs, poultry and other foods are subjected to a variety of processing techniques. In an abattoir or meat processing plant, the carcass may be subjected to cutting, deboning, mincing, chilling freezing etc. Other may require pasteurization, ultra-heat treatment, scalding, radiation and incorporation of additives, chemical preservatives and vacuum or modified atmospheric packaging and canning. Hence, it is essential to investigate the survival or growth of microorganisms before finalizing the sampling scheme.

***Recommendations of national and international agencies/organizations on microbiological specifications and regulations regarding food safety: International agencies/organizations:***

- *Food and agriculture organization (FAO):*

This is mainly concerned with food production and suggests guidelines for healthy and safe foods.

- *World health organization (WHO):*

This is mainly concerned with the health of the consumers and formulation of various specifications for hygienic food production.

- *Office international des epizootics (OIE):*

This prescribes international animal health code, which consists of six parts. Part I deals with definitions, epidemiological information/notification, veterinary ethics and import and export procedures. Part II mentions 15 animal diseases. Part III contains 68 diseases important in international trade. Part IV includes diagnostic tests for the purpose of international trade and general requirements of health and hygiene. Part V prescribes ten model international certificates approved by OIE. Part VI details diseases notifiable to OIE, sanitary certificate of meat, identification of meat and attestation of wholesomeness by veterinarians.

- *International organization for standardization (ISO):*

This organization formulates international standards on food hygiene, food microbiology and food assurance of many foods including foods of animal origin.

- *International commission of microbiological specifications for foods (ICMSF):*

This organization suggests microbiological specifications under 2-3 attribute schemes and several HACCP systems for meat, meat products, poultry, seafoods, eggs, milk and milk products.

- *Commission of European communities:*

The commission has laid down certain regulations pertaining to animal foods as follows-

(i) Requirements for import of bone products, horns and horn products, hooves, and hoof products (94/446/EC, June 14, 1994).

(ii) Specimens of health certificates for import of milk and milk products (95/343/EC, July 27, 1995).

(iii) Import of fresh poultry meat (96/712/EC, Nov. 28, 1996).

(iv) Import of egg products (97/38/EC, 18 Dec., 1996).

(v) Import of poultry meat, game meat and rabbit meat (97/41/EC, 18 Dec., 1996).

(vi) Import of minced meat and meat preparation (29/29/EC, 17 Dec., 1996).

***National agencies:***

- ***Agricultural and processed food products export development authority (APEDA):***

Government of India, ministry of commerce, Gazette of India, part II, section III, and subsection II. This agency has prescribed the regulations for animals, slaughter procedures, abattoir requirements, inspection, personal hygiene, layout plans, sampling, testing and specifications for transport and information regarding application for veterinary health certificate by exporter.

***Schedule I:***

This schedule states laws for sampling of canned processed meat.

***Schedule II:***

States standards for canned beef.

***Schedule III:***

It gives standards luncheon meat.

***Schedule IV:***

States standards for chopped meat.

***Schedule V:***

It prescribes minimum requirements for an abattoir.

<b>(a) Selection of cans for testing:</b>	
Lot size	Number to be tested
500	6
500-1000	7
1000-5000	8
5000-10000	9
More than 10000	10

<b>(b) Opening of packaging cases:</b>	
Lot size	Number to be tested
100	2
100-500	3
500-1000	4
1000-5000	5
More than 5000	6

**- Bureau of Indian Standards (BIS):**

BIS involves in formulating standards for a number of items including all foods of animal origin.

**- AGMARK grading:**

The directorate of marketing and inspection (DMI), Ministry of Agriculture has important function in the field of standardization, grading and quality control of agricultural and allied commodities.

**- Prevention of food adulteration (PFA) Act:**

PFA-Act 1955 of Government of India prescribes standards for edible fat, saponification and iodine value of lard, beef, mutton and goat fats; use of preservative like sulphur dioxide, sodium or potassium nitrite in sausages, sausage meat, cooked pickled meats, ham and bacon; and toxic metals like lead, copper, arsenic, tin and zinc in canned meats, meat extracts and unspecified foods. It prescribes restriction on use of antioxidants and flavouring agents like BHA, BHT, citric acid and monosodium glutamate under clauses. Similarly, use of insecticides, e.g. dieldrin, DDT, lindane etc. in meat, eggs, poultry and fish has been restricted above certain limit.

**- Meat food product order (MFPO)-1973:**

This prescribes that no meat food product shall contain any poisonous chemicals in excess of permitted quantity. These are lead, copper, arsenic and zinc; which shall not exceed the levels of 2.5, 2.0, 2.0, 250 and 50 ppm, respectively.

**- Memorandum of understanding (MOUs):**

Many MOUs exist between Government of India and food importing countries, which specify regulations of export of foods from India to their countries. Regulations of meat export from India to Iran for e.g. have prescribed the conditions for chilling, deboning, freezing, storage, packaging, transportation and inspection by Iran veterinary organization.

**- State and local self-governments:**

Every state of Indian union has a system of food inspection and mechanism of enforcing the laws. These are generally under directorate of health services. Similarly at local level municipal corporation or town areas has authority inspect and enforce public health laws through sanitary inspectors and veterinarians. These include ante-mortem and postmortem inspection of animals. The authorized veterinary officer only certifies meat from healthy animals.

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