Meat Plant HACCP

Guidelines for the Application of a Hazard Analysis Critical Control Point (HACCP) System in a Meat Plant

Prepared by:

Food Protection
BC Centre for Disease Control

In Collaboration with:

BC Ministry of Health and the Five Regional Health Authorities: Vancouver Coastal, Fraser, Interior, Northern and Vancouver Island

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Introduction

There are a variety of potential hazards for most foods, including meat and meat products. Many of these hazards can occur during the processing stage. Because most meat plants are capable of processing high volumes of meat products, food-borne disease outbreaks can potentially affect large sectors of the population.

A hazard may be an unacceptable level of disease-causing microorganisms. Hazards can also be caused by chemicals that reach the food inadvertently through various environmental sources or during food processing, preparation or storage. Hazards can result from food additives being used in excess of functional or culinary needs. While the types of hazards can vary, the results are all the same - a food-borne disease outbreak.

For the meat plant manager, the objective is to prevent food-borne disease. This is also the basic approach of the Hazard Analysis Critical Control Point (HACCP) system. The HACCP system controls or eliminates those hazards, which cause foodborne disease outbreaks by identifying critical operations and providing effective and efficient methods for monitoring and controlling them. The final outcome is the highest assurance of food safety.

In summary, the benefits of a properly functioning HACCP system include:

1) A reduced public health risk.
2) Lower labour costs and more efficient use of resources through elimination of duplication.
3) Fewer customer complaints as overall quality improves.

The purposes of this publication are:

1) To introduce and explain the HACCP system in relation to a meat plant.
2) To illustrate and describe critical control points (CCPs) commonly found in meat plants.
3) To provide a schedule for monitoring CCPs.

It must be stressed that this manual only outlines the steps in building a HACCP system. Many of the hazards and the means to control them presented in it will be found in your meat plant. However, differences in processes and procedures between meat plants will result in hazards varying between meat plants. Because there is no set formula for developing a HACCP system, each plant must examine their operation and develop a HACCP system which best suits it.

Part I

The HACCP System - Application to a Meat Plant

A. Introduction

The HACCP system identifies and controls the steps in a meat plant, which are critical to producing safe and wholesome meat products. It examines and monitors the entire process so that the final product is not contaminated - it is not a test for contamination, after it may have taken place. The ultimate goal of a HACCP system is to eliminate all public health risk.

While the HACCP concept is relatively simple, it must be stressed that in order to succeed, management must provide commitment and leadership to the system. Only management leadership and resources can assure that the HACCP system will succeed. While one person may coordinate the system in a plant, everyone in the company must be involved.

The following sections in Part I of this manual will:

- Explain the preparatory steps necessary prior to implementation of the seven (7) HACCP principles.
- Describe the seven (7) principles of the HACCP system and how they can be applied to a meat plant. Figure 1 (page 10) illustrates these principles in schematic fashion.

To facilitate your understanding of this manual, the following information should be read in conjunction with those sections in Part II that apply to your plant. Remove those pertinent sections and refer to them as you read through the remainder of Part I.

B. The Pre-HACCP Steps

Prior to application of the seven (7) HACCP principles, there are five (5) preparatory steps a meat plant must first perform. They are:

1) Assemble the HACCP team.
2) Describe the product ingredients.
3) Identify the intended use of the product.
4) Develop the process flow diagram.
5) Develop the plant schematic.

1. Assemble the HACCP Team

Ideally, the development of the HACCP system is done by a team; not one individual. The team should be made up of a variety of individuals knowledgeable in the following areas: maintenance, production, distribution, and quality control. As well, one of these individuals should be familiar with HACCP.

As mentioned, in order for the HACCP system to succeed, management must provide the necessary leadership and resources. Successful HACCP systems are not a one-person effort. Everyone in the company, in one form or another, will be involved. The HACCP system will only succeed if management provides the HACCP team with the time, resources, and the authority necessary to implement an effective system.

2. Describe the Product Ingredients

For each product produced, all raw materials or ingredients used must be listed. Also included are the packaging materials. These are collectively known as inputs. Then with each input used, information regarding potential hazards is then gathered.

Questions to ask can include:

a) Are dressing procedures adequate to remove condemned or high-risk materials from carcasses?
b) Are there potential bacterial hazards with this ingredient? Does it need to be kept refrigerated? Does it have a shelf life? Where does it come from? Does the supplier perform bacterial testing? Can they provide bacterial test results?
c) Is this ingredient a potential allergen? Does this ingredient's production lend itself to possible chemical contamination? Antibiotics? Pesticides?
d) Is there any concern with this ingredient regarding glass or metal being present?

These questions are examples of questions that can be asked for each input. Questions to ask or information to be gathered will vary with ingredients and with how they will be later used or applied.

3. Identify the Intended Use of the Finished Product

With each finished product, identify its normal use by the consumer. There are a number of questions in this area that can be asked which might help identify any potential hazards in the processing steps:

a) Are the targeted consumers more susceptible to foodborne illness? i.e. seniors, hospital patients, infants

b) Is the food always well cooked by the consumer?

c) Do some consumers only lightly cook the food?...i.e. rare hamburger

d) Do some consumers not cook the food at all?…i.e. steak tartar

e) Would some consumers further process the food?…i.e. aging, fermentation, salting, drying, etc.

Answers to these questions and others may help the HACCP team in assessing potential hazards and their risk to the finished product.

4. Develop the Process Flow Diagram

In this step, the HACCP team identifies the important process steps in the production of the product being assessed. With a HACCP team made up of individuals with different specialties, potential hazards can begin to be identified with each of the various process steps. It may be useful for the HACCP team to consult with line personnel and ask for input - often people familiar with day to day problems are also most familiar with the potential hazards. Also useful, is simply observing the operations during production. Sometimes standing back and just watching an operation for some time can help identify hazards that are not immediately obvious.

5. Develop the Plant Schematic

The purpose of the plant schematic is to show:

a) Location of equipment

b) Plant Layout

c) Product (raw and finished)

d) Employee movement

e) Flow of ingredients and packaging materials

The plant schematic can also aid in the identification of potential hazards, in particular, with any areas of cross-contamination.

C. The HACCP System - A Step-by-Step Approach

Now that the pre-HACCP steps have been performed, it is time to begin building the HACCP system. Properly implemented, it will identify and control the critical steps in producing safe and wholesome meat products. The HACCP system has the following seven (7) principles. When applied properly to a meat plant, they minimize the potential of a foodborne disease outbreak.

- Identify the hazards
- Determine critical control points (CCPs)
- Establish critical limits for each CCP
- Implement procedures to monitor CCPs and record data
- Institute corrective action
- Establish record keeping systems to document the HACCP plan
- Verify the HACCP system is working

It may appear that the seven principles of the HACCP system, when applied to an entire meat plant, will be complicated and difficult to organize. However, when the meat plant is broken down into sections or processes, the number of CCPs becomes quite manageable.

1. Identify the Hazards

a) If not yet done, construct a flow diagram of each process in your meat plant. The block diagrams, as in Part II, or schematic diagrams can be used to illustrate each process.

b) The flow diagram should describe each process clearly and concisely. All processing steps must be included. As well, the actual equipment used, procedures, and operating practices should be described for each step.

c) Observe the process in operation identifying all potential hazards associated with each step in the process. Hazard analysis is a general assessment of the hazards involved in processing, handling, storage distribution, and the consumer abuse of a particular meat product. The product is potentially hazardous when all or some of the following risks occur:

   i) there are disease causing micro-organisms likely to be present if this step is not controlled.

   ii) there is a possibility of microbial toxins.

   iii) there is a possibility of chemical or physical contamination.

   iv) there is a potential for consumer abuse.

   To determine the risk of a hazard, consider first what can go wrong with a process step, and then what effect it will have on the consumer if this step is not controlled.

d) The following table contains examples of the three types of hazards.

Meat-Related Consumer Hazards

Microbiological	Chemical	Physical
• pathogenic microorganisms • cross-contamination	• toxins • cleaners/sanitizers • food additives	• glass/metal • bones (if labelled boneless)

Note: The identification of microbiological hazards requires an understanding of the dangerous organism's profile, particularly those factors that influence its survival/growth in meat. Much of this information can be found in Appendix B.

e) For each identified potential hazard, list any measures that may control it. Control Measures (CMs) are steps or controls in the process designed to eliminate or control a hazard (i.e. knife sanitizing, proper refrigeration). In general, CMs focus on one of the following:

i) raw materials and ingredients

ii) preservative factors (pH, water activity, etc.)

iii) time/temperature (either cooling or cooking)

iv) sanitation

v) preventing cross-contamination

vi) employee practices and hygiene

f) The potential hazards and control measures, considered together, identify possible critical control points (CCPs).

2. Determine Critical Control Points (CCPs)

a) Once a possible CCP has been identified, the HACCP Decision-Making Chart (see Figure 1 - page 10), is used to confirm whether or not a CCP exists: It requires you to answer the following questions:

i) Does a control measure exist?

ii) Does the control measure control the hazard to an acceptable level?

iii) Could the hazard contaminate the product?

iv) Is this control measure the last opportunity for controlling the hazard?

b) Mark each CCP on your flow diagram. Do not use the HACCP system for monitoring purely quality issues. Only use HACCP for direct hazards since non-essential monitoring may dilute out the detection of potential hazards.

c) The CCPs identified in the flow diagrams in Part II are explained in the accompanying tables. They will assist you in the identification of CCPs in your plant.

3. Establish Critical Limits for each CCP

a) Critical limits are tolerances or operating constraints set for each CCP to ensure control of the hazard or risk. They are monitored to determine whether the control measure for that CCP is within acceptable levels.

b) Critical limits may be derived from a variety of sources, such as regulatory standards, literature surveys, experimental studies, or expert advice.

c) Strict adherence to tolerances is important in maintaining a HACCP system. Product safety is not negotiable. There is no such thing as "almost risk-free".

d) Critical limits may vary depending on the processes in your plant.

e) For assistance in establishing critical limits, refer to the fourth column in the tables in Part II.

4. Implement Procedures to Monitor CCP and Record Data

a) Monitoring is the scheduled testing or observation of a CCP and its limits. In Part II, the second and third columns in each table specify the monitoring steps and frequencies for each CCP. Again, you may need to modify them to suit the needs of your plant.

b) Monitoring should be done at a frequency proportional to the degree of consumer risk involved. The monitoring procedure should provide the necessary information to allow for corrective action to be taken before the process is out of control or, at least, minimize the time that it is.

c) Generally, monitoring of CCPs can best be accomplished through the use of physical and chemical tests (i.e. temperature recording charts or measurement of salt levels in salt brine) and through visual observations. The use of microbiological testing is rarely an effective means of monitoring CCPs because of the time required to obtain results. However, microbiological criteria do play a role in verifying that the overall HACCP system is working.

d) The monitoring procedures must provide useful and practical information.

Records must be kept to ensure the CCPs are being monitored on a regular basis.

5. Institute Corrective Action

a) In any HACCP system, CCPs will fail. When this happens corrective action plans must be in place to ensure that the operator knows exactly how to react to a detected problem and bring the critical control point back under control without delay. Action plans must include:

   i) a procedure for holding product pending completion of analysis to confirm product safety

   ii) disposition of the product

   iii) confirmation that the CCP has been brought under control

b) If the product cannot be proven safe, dispose of it.

c) As well, the reasons for deviations must be found, documented and corrected.

d) The fifth column, "Action on Deviations" in each table in Part II lists the appropriate actions to take when CCP critical limits are not met.

6. Establish Record Keeping Systems to Document HACCP Plan

a) Records are an integral part of a working HACCP system. Proper records can ensure that a product was prepared and handled in a safe manner. As well, they may identify the reason for a system malfunction, allowing the operator to correct a potential problem.

b) A single individual should be made responsible for ensuring all data is recorded. This individual must have authority to ensure:
   i) all data is collected
   ii) all data is centrally located and easy to retrieve
   iii) a record of all CCP deviations is kept, and, most importantly
   iv) appropriate action is taken when results deviate beyond the critical limits

c) The record keeping system must be as simple as possible. A single binder for smaller operations or a single filing cabinet for larger operations should be more than adequate.

7. Verify that the HACCP System is Working

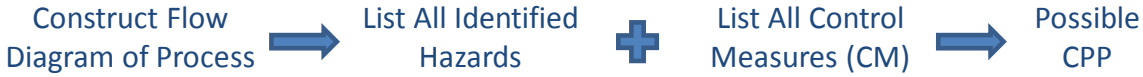
a) Some meat plants are now performing regular quality control testing of their finished products. Results from quality control tests may often indicate that a HACCP system is not performing as required. In such cases, the system must be reviewed to ensure:
   a) the present HACCP system is being followed
   b) all hazards were identified in the initial HACCP system.

b) Other methods to verify the HACCP system is working include:
   i) close monitoring of consumer complaints.
   ii) verification inspections: unannounced equipment inspections.
   iii) regular review of the current HACCP system. Have processes, procedures, or formulations changed since the initial HACCP system was implemented?
   iv) random sample collection and testing (separate from regular Q.C. testing protocol).

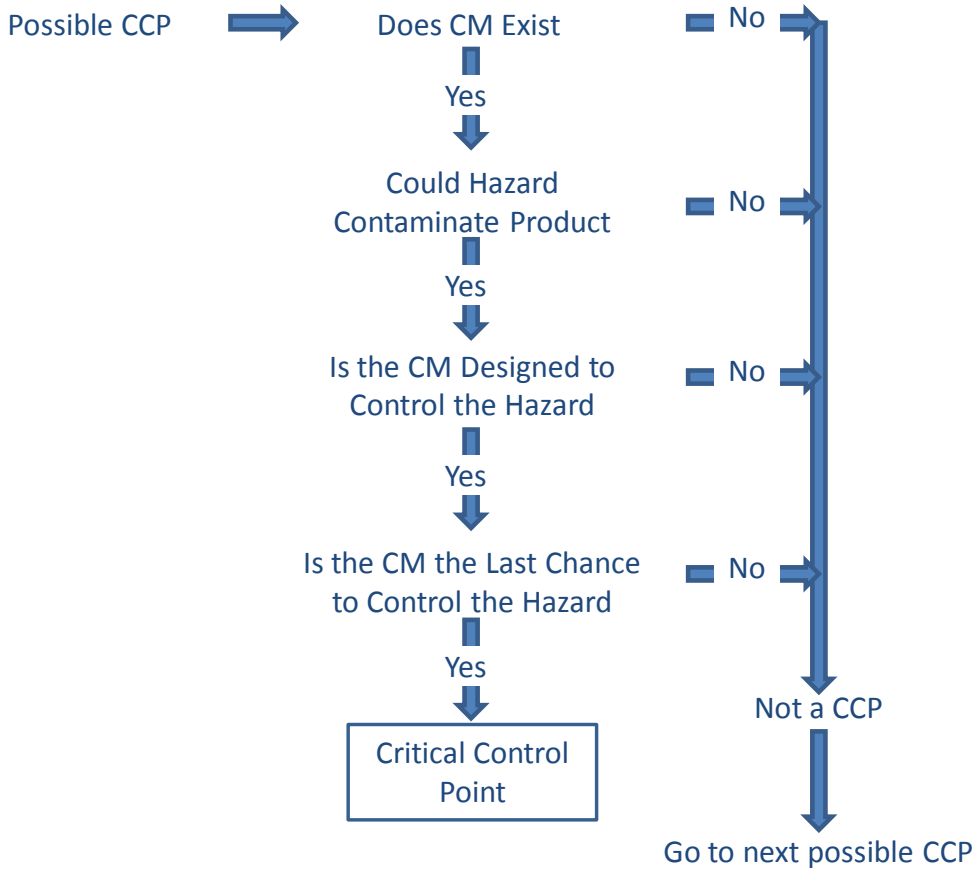
When first initiated it is particularly important to ensure that the HACCP system is working. As well, verification procedures must be made a priority wherever processing procedures or formulations are changed.

Figure 1: HACCP Decision Making Chart

1. Assess the Hazards



2. Determine CPPs



3. Establish Critical Limit for each CCP – see Part II for examples
4. Implement Procedures for Monitor CCPs and Record Data
5. Institute Corrective Action
6. Establish Record Keeping Systems
7. Verify that the HACCP System is Working

D. Summary

Since most meat plants are already performing many of the functions required for a HACCP system, the effort required to implement it should be minimized. Rather, it should be more a shift in emphasis and direction into the following areas:

a) Emphasize specifications for incoming ingredients.

b) Consider supplier qualifications in addition to just price.

c) Observe your process and operations.

d) Analyze the hazards and identify the critical control points.

e) Monitor the critical limits.

f) Keep careful track of material usage and production codes.

g) Systemize it all to keep it manageable.

h) Record the results and maintain them in an orderly manner.

By following the HACCP system, your approach to product safety is pro-active rather than reactive. It's implementation may not always be easy, but it will minimize the potential lawsuits, prosecutions, and recalls that a company can be exposing itself to if a HACCP system is not an integral part of it's operation. As well, for the plant manager, a HACCP system will result in overall higher quality and therefore more saleable and profitable product with less loss to spoilage and wastage.

Part II

The HACCP System - Critical Control Points in a Meat Plant

A. Introduction

Part II provides flow diagrams for different processes commonly found in meat plants. Following each flow diagram is a table describing the CCPs and the means to monitor them. Recommended monitoring frequencies, critical limits and actions for deviations for each CCP are provided.

Section 1 of Part II, **Meat Plant - Good Manufacturing Practices** identifies those hazards that are more effectively controlled through the assignment of Universal Control Points. As you have probably found when analyzing your process, there are many potential hazards that do not have specific identifiable control points. These types of hazards are more effectively controlled by the implementation of a GMP program. Process steps that effectively control them are called Universal Control Points (UCPs). Pest control is an example of a UCP. Pests are a hazard because they act as a source of contamination. They cannot be controlled at specific critical control points. Rather, an effective pest control program must prevent their entry into the plant. Other examples of Universal Control Points include:

- equipment maintenance
- worker education and training
- equipment inspection
- general environmental sanitation
- cross-contamination control

These and other examples of UCPs are presented first since their control is critical for safe processing in all types of meat plants.

The following charts and accompanying information have been provided to act as a model or building block for a HACCP system. Because procedures, equipment, and plant designs vary greatly between meat plants, the information provided in Part II will not necessarily include all hazards found in your meat plant. In order to implement an effective HACCP system, the meat plant manager must follow the steps outlined in Part I while using the information provided in Part II as a guide or model for a HACCP system.

B. Sections or Processes in a Meat Plant

1. Meat Plant - Good Manufacturing Practices

Universal Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
Step: Non-Meat Ingredients and Packaging Materials				
1. Receipt of Ingredients	Ensure each shipment is received in good condition.	Before accepting each shipment of ingredients.	Ingredient containers are intact. No signs of possible outside contamination (chemical or physical adulteration, pest infestation).	Reject any ingredients which may be compromised.
2. Supplier Standards	Obtain standards for each ingredient from supplier.	With every ingredient or supplier. Verify standards with supplier annually.	All ingredients are food grade. All ingredients meet microbiological/chemical standards for finished product.	Do not use any ingredients which do not meet standards.
3. Verification of Standards	Verify that ingredients comply with supplier standards.	Request test results from supplier for each lot received. Obtain independent test results.	Within supplier standards.	Do not use any ingredients which do not meet supplier standards. Contact supplier.
4. Storage of Ingredients and Packaging Materials	Store ingredients and packaging materials as recommended by supplier and away from potential contaminants.	As each shipment is received. Check storage areas monthly for contamination potential.	As recommended by supplier. Stored separately from any potential contaminating items (i.e. cleaners, petroleum).	Do not use any ingredient or packaging material which may be compromised.
5. Ingredients Listing - Allergen Control	Comparison between ingredients listing on package label and actual ingredients being used.	Ongoing, after any changes to formulations are made.	All ingredients actually used must be noted on the ingredients listing on the package label.	If ingredients are omitted on label, then finished product must be either relabelled, reworked, or disposed of.
6. Plant Water Supply	Water used in connection with processing is monitored for quality.	Tested twice annually or more frequently depending on source.	As recommended in *Guidelines for Canadian Drinking Water Quality* - Health Canada publication.	Do not use water that does not meet guidelines. Review or install water treatment systems.

1. Meat Plant - Good Manufacturing Practices

Universal Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
Step: Personnel				
1. Worker Health	Workers carry no communicable disease - medical check-up to verify. Observation for open cuts, sores, etc.	On hiring, ongoing.	Completed medical check-up must be clear of any communicable diseases. No open cuts, sores, etc.	Worker not to be employed.
2. Worker Training	Workers properly trained with regard to contamination of finished product (personal hygiene, handling of ingredients or product, equipment use).	On hiring, ongoing.	Training regimen must ensure all new and existing workers are adequately trained.	Train all workers. Modify existing training program.
3. Worker Attire	Workers are properly attired in processing area.	Ongoing.	Workers are equipped with suitable clothing (aprons,. hair covering, footwear). No jewellery to be worn.	Review and modify practices as necessary.
4. Worker Practices	Verify that worker practices do not compromise finished product quality.	Ongoing.	Occurrence of any practices that may compromise finished product quality. All procedures necessary for a risk free finished product are carried out.	Modify practices as necessary.

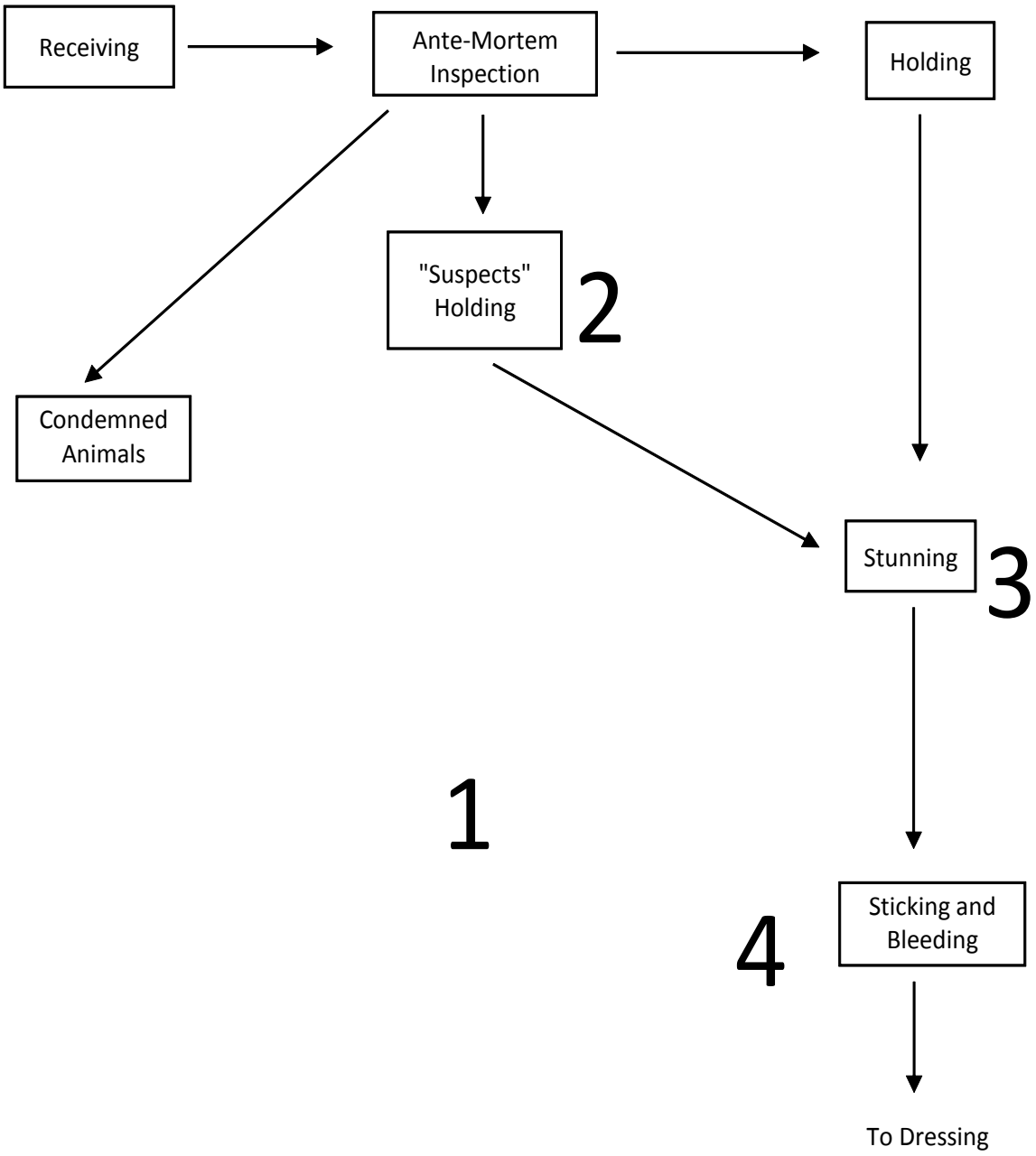
1. Meat Plant - Good Manufacturing Practices

Universal Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
Step: Sanitation				
1. Written Sanitation Program	Written sanitation program to include: a) Cleaning procedures for general environment (walls, floors, ceilings, overhead lines). b) Cleaning procedures for utensils and processing equipment. c) Cleaning frequencies. d) Cleaning agents, concentrations, temperatures, and cleaning equipment to be used. e) Personnel responsible for carrying out cleaning procedures.	Ongoing, after any installations or changes are made.	Complete written sanitation program available.	Completion of written sanitation program.
2. Equipment Inspection - Cleaning Effectiveness	Inspect all equipment to ensure that regular cleaning procedures are adequate for removal of all soil.	Ongoing, monthly.	All product contact surfaces are free of soil and chemical residues.	Review cleaning procedures. Adjust as necessary and monitor effectiveness after changes. Update sanitation program.
3. General Environment - Sanitary Condition & Design	Inspect general environment to ensure finished product quality cannot be compromised.	Ongoing, monthly.	General environment must be in a clean and sanitary condition. Ensure that plant design does not allow for leaks, splashes, etc. to enter product.	Review cleaning and sanitation procedures for general environment. Adjust as necessary. Update sanitation program.
4. Waste Disposal	Waste, debris, garbage, inedible and condemned materials are properly disposed of.	Ongoing, monthly.	Disposal program ensure: • methods, pick-up frequency, and personnel responsible are documented. • finished product quality is not compromised by methods used. • rodents/insects are not attracted to processing areas.	Review waste disposal methods. Adjust as necessary.
5. Chemical Storage	Cleaning and other chemicals are properly stored.	Ongoing, monthly.	All chemicals are stored such that they do not pose a risk of contamination to ingredients or finished product.	Review storage procedures and modify as necessary.

1. Meat Plant - Good Manufacturing Practices

Universal Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
Step: Pest Control				
1. Pest Control Methods	Verify that all procedures for excluding and eliminating pests are adequate.	Ongoing, monthly.	Absence of pest activity.	Review pest control procedures. Adjust as necessary and monitor effectiveness after changes.
2. Pest Control Chemical Usage	Verify that all precautions are taken to prevent contamination of food when insecticides, rodenticides, and fumigation agents are used.	Ongoing.	No chemical residues in finished product.	Review pest chemical usage procedures. Adjust as necessary. Possible product recall depending on chemical involved.
Step: Manufacturing Controls				
1. Date Coding	All lots or batches are coded by production date and lot number.	Ongoing.	Coding must identify production date and other relevant information (batch number, filler number, time of day, operator).	Review date coding procedures and adjust as necessary.
2. Ingredient Control	Ingredient lot numbers or codes are recorded for each batch produced.	Ongoing.	Each batch produced must have recorded the lot number or code of each ingredient used.	Review ingredient control procedures and modify as necessary.
3. Consumer Complaints	Consumer complaints are documented. Valid complaints are acted on in processing procedures.	Ongoing.	Changes are made to processing procedures to ensure similar complaint does not re-occur.	Review complaints procedure. If similar complaints re-occur, review procedures.
4. Recall System	Recall system must be in place.	Ongoing.	Recall system must ensure a prompt, effective and efficient recall of any product.	Review existing recall system. Modify as necessary.

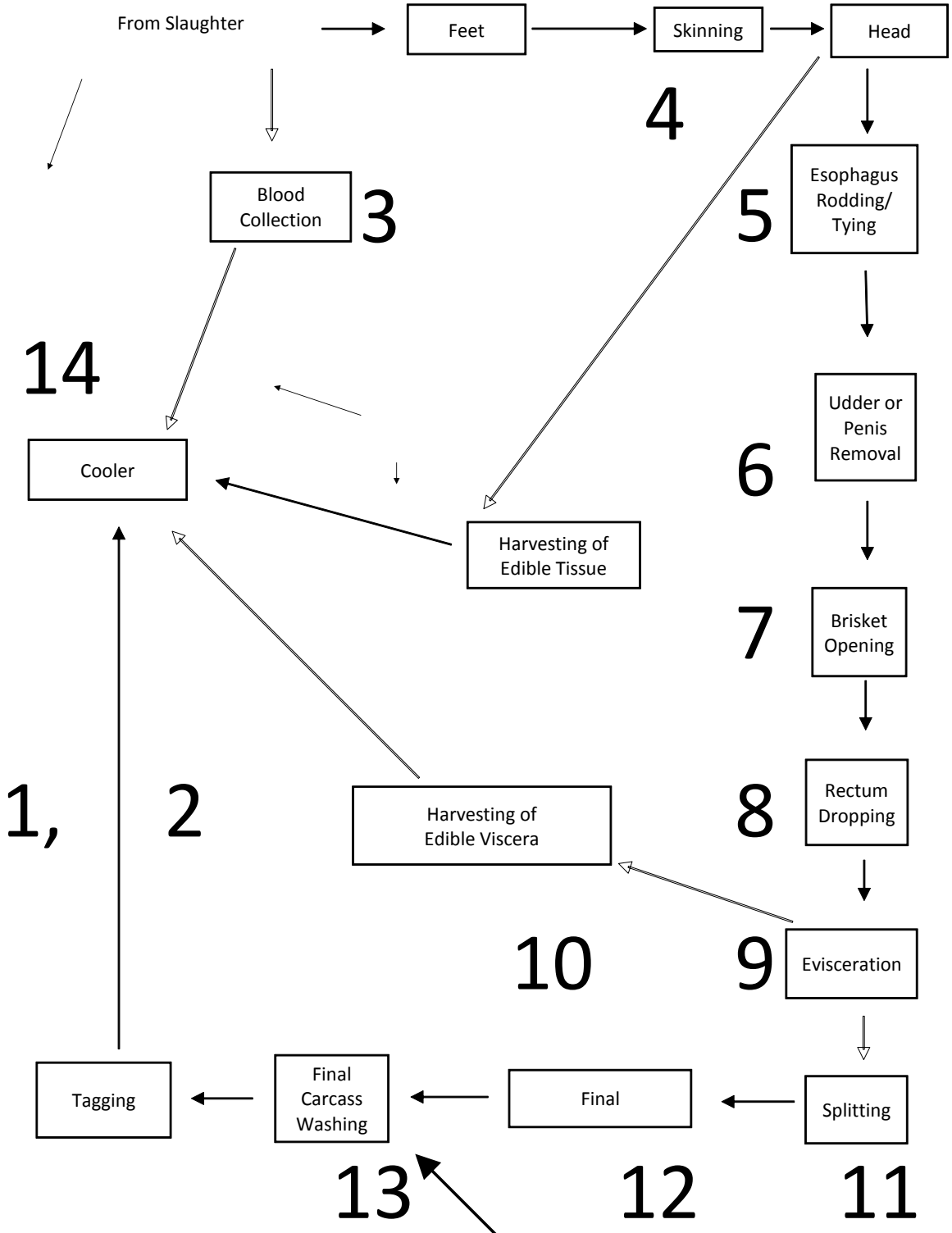
2. Receiving - Slaughter



2. Receiving and Slaughter Critical Control Point

Universal Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
1. Sanitation of Receiving, Holding and Stunning Areas	Sanitary inspection of the receiving, holding, and stunning areas.	Daily (pre-operational and ongoing).	Free from accumulation of manure, feathers, or any other unacceptable conditions.	Clean unsanitary area immediately.
2. "Suspects" Identification	All "suspects" must be properly identified throughout the slaughter process to the final inspection station.	Ongoing.	Identification of all "suspects".	Review existing identification procedures and modify.
3. Stunning Methods and Practices	Ensure that only approved stunning methods and practices are used.	Ongoing.	Electrical - all animals. CO_2 gas - hogs only. Mechanical - horses, cattle, calves, sheep, goats. In all cases, stunning personnel must be properly trained and skilled.	Use approved methods only. Train stunning personnel in proper use of methods and equipment.
4. Sticking and Bleeding	Ensure that only stunned animals are bled, only approved bleeding methods are used, and bleeding is performed in a sanitary manner.	Ongoing.	Animal must be completely stunned. In all cases, bleeding personnel must be properly trained and skilled. Sticking knife is sanitized after each use.	Use approved methods only. Train stunning personnel in proper use of methods and equipment.

3. Dressing – Cattle, Horses, Sheep Goats



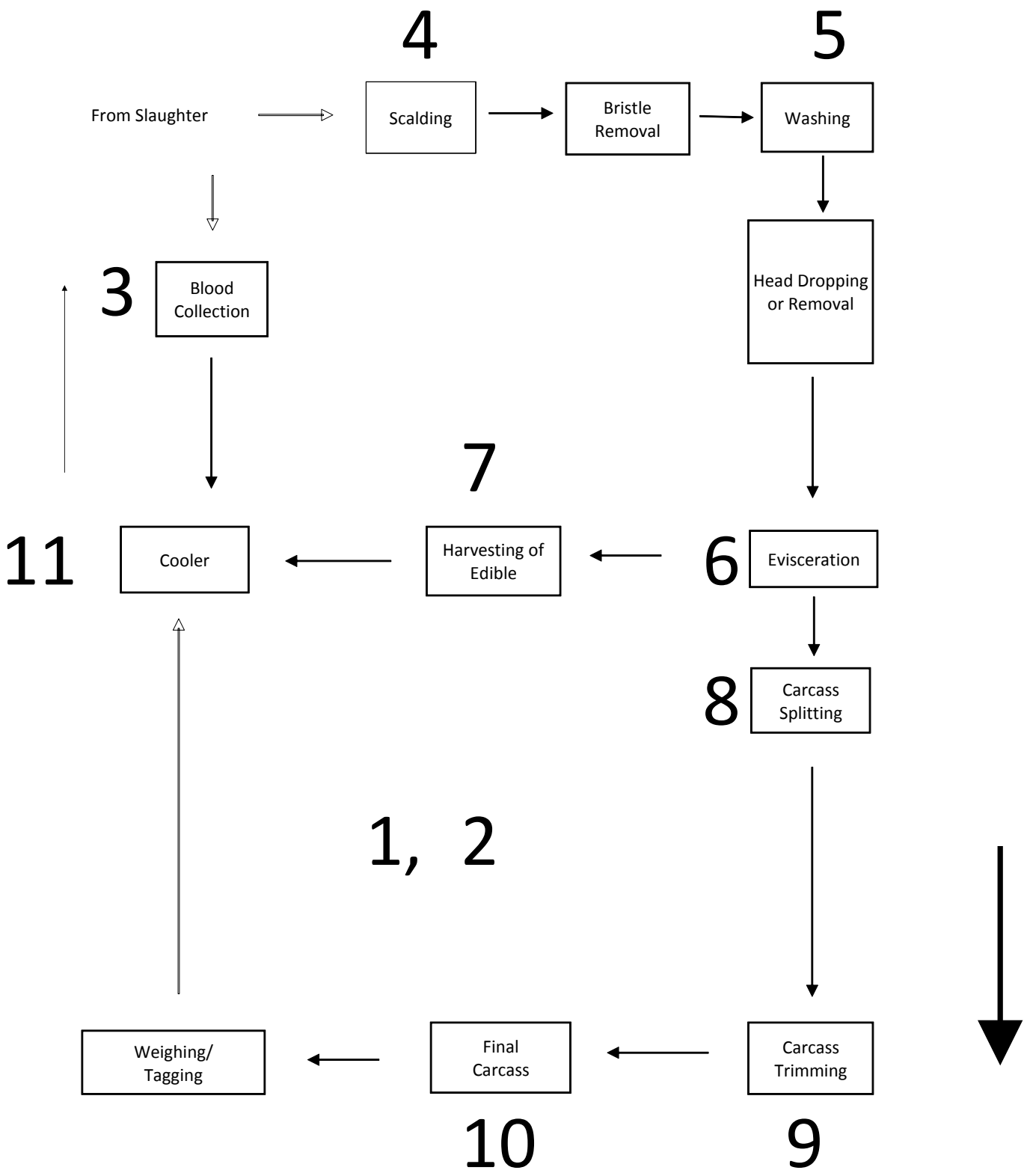
3. Dressing - Cattle, Horses, Sheep, and Goats: Critical Control Points

Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
1. General - Effectiveness of Invasive Equipment Sanitation Facilities	Ensure that facilities used for sanitizing invasive equipment (knives, saws, hooks, rods, picks, etc.) are adequate.	Daily, ongoing.	Hot water sanitizing: minimum 82°C. Chemical sanitizing: concentrations equal to or greater than minimum recommended levels. Adequate overflow where necessary.	Facilities are modified.
2. General - Sanitary Maintenance of Invasive Equipment	Ensure that all invasive equipment is maintained in a sanitary manner at all steps in the dressing procedure.	Ongoing.	All invasive equipment must be sanitary at all times. Adequate sanitation must occur on an "as needed" basis depending on the step in the process. Any equipment in contact with contaminated, condemned or held tissue must be adequately sanitized after each use.	All staff involved must be adequately trained in this area.
3. Blood Collection	Ensure that all blood saved for edible purposes is properly collected.	Ongoing.	Blood collected is not contaminated and can be identified with carcass.	Contaminated blood is discarded. Blood from a condemned carcass is discarded.
4. Skinning	Ensure that hide is properly removed.	Ongoing.	Carcass is not contaminated with hair and dirt. Employees performing the skinning must wash and sanitize after each carcass.	Trim away any contaminated tissue.
5. Rodding and Tying Esophagus	Ensure that esophagus is properly rodded and tied.	Ongoing.	Esophagus can be removed without rupture during evisceration. Rod is adequately sanitized between animals.	Any tissue contaminated by rumen contents is trimmed.
6. Udder or Penis Removal	Ensure that lactating udders or penis is properly removed.	Ongoing.	Lactating udders or penises must be removed without contaminating the carcass.	Any contaminated tissue is trimmed.
7. Opening the Brisket	Ensure the brisket is properly opened.	Ongoing.	The carcass must not be contaminated by punctured viscera material.	Any contaminated tissue is trimmed.
8. Rectum Dropping	Ensure the rectum is properly dropped.	Ongoing.	No contamination of the carcass by urine or fecal material.	Any contaminated tissue is trimmed.

3. Dressing - Cattle, Horses, Sheep, and Goats: Critical Control Points

Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
9. Evisceration	Ensure evisceration is properly done.	Ongoing.	The carcass or any edible viscera is not contaminated by punctured viscera material.	Contaminated tissue is trimmed.
10. Harvesting Viscera	Ensure that harvested viscera is handled properly	Ongoing.	Clean, harvested viscera is handled in a sanitary manner.	Discard contaminated viscera. Modify procedures.
11. Carcass Splitting	Carcass is split in a sanitary manner.	Ongoing.	The splitting saw must be sanitized after: a) Splitting a held carcass **OR** b) The saw is contaminated by an abscess or other similar condition.	Modify procedures.
12. Final Trimming of Carcass	Ensure that carcass is properly trimmed prior to final washing.	Ongoing.	All contaminated tissue is trimmed.	Management must ensure all staff involved in this step are properly trained in recognizing and trimming contaminated tissue.
13. Final Carcass Wash	Ensure that carcass is properly washed.	Ongoing.	All blood and bone dust is removed. Washing must be done to ensure there is no contamination from spray deflections (ie. floor to carcass, wall to carcass, carcass to carcass).	Management must ensure all staff are adequately trained in this step.
14. Carcass and Parts Cooler Storage	Ensure that all carcasses and parts are properly spaced and placed in cooler.	Daily, ongoing.	Carcasses and parts are placed and spaced in a cooler with adequate refrigeration capacity in order to ensure continuous cooling such that the surface reaches a temperature of $\leq 7°C$ within 24 hours of carcass dressing.	Modify refrigeration capacity or placement procedures.

4. Dressing - Hogs



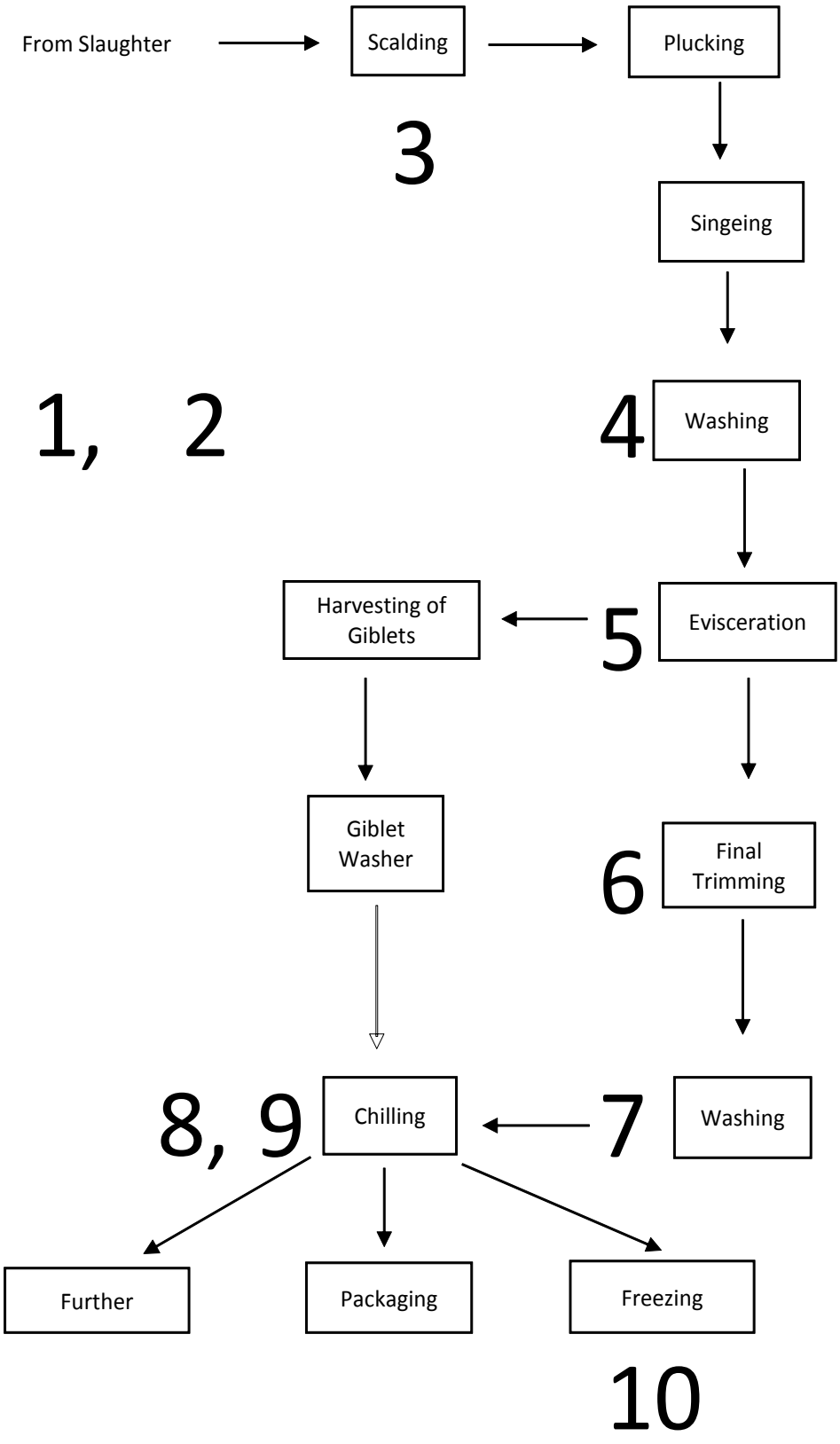
4. Dressing Hogs: Critical Control Points

Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
1. General - Effectiveness of Invasive Equipment	Ensure that facilities used for sanitizing invasive equipment (knives, saws, hooks, rods, picks, etc.) are adequate.	Daily, ongoing.	Hot water sanitizing: minimum 82^0 C. Chemical sanitizing: concentrations equal to or greater than minimum recommended levels. Adequate overflow where necessary.	Facilities are modified.
2. General - Sanitary Maintenance of Invasive Equipment	Ensure that all invasive equipment is maintained in a sanitary manner at all steps in the dressing procedure.	Ongoing.	All invasive equipment must be sanitary at all times. Adequate sanitation must occur on an "as needed" basis depending on the step in the process. Any equipment in contact with contaminated, condemned or held tissue must be adequately sanitized after each use.	All staff involved must be adequately trained in this area.
3. Blood Collection	Ensure that all blood saved for edible purposes is properly collected.	Ongoing.	Blood collected is not contaminated and can be identified with carcass.	Contaminated blood is discarded. Blood from a condemned carcass is discarded.
4. Scalding Tank-Water Temperature	Ensure the scalding tank water temperature is within effective range.	Daily, ongoing.	Temperature is high enough to loosen all bristles and prevent any bacterial growth but low enough to prevent carcass cooking and subsequent skin breakage.	Correct immediately.
5. First Washing	Ensure that first washing after bristle removal is effective.	Ongoing.	All dirt, bristle, and scurf is removed prior to the first incision (excluding bleeding). Washing must be done in such a manner that spray does not deflect onto already cleaned carcasses.	Re-wash carcass. Modify procedures.
6. Evisceration	Ensure evisceration is properly done.	Ongoing.	The carcass or any edible viscera is not contaminated by punctured viscera material.	Contaminated tissue is trimmed.
7. Harvesting Viscera	Ensure that harvested viscera is handled properly.	Ongoing.	Clean, harvested viscera is handled in a sanitary manner.	Discard contaminated viscera. Modify procedures.
8. Carcass Splitting	Carcass is split in a sanitary manner.	Ongoing.	The splitting saw must be sanitized after: a) Splitting a held carcass, OR b) The saw is contaminated by an abscess or other similar condition.	Modify procedures.

4. Dressing Hogs: Critical Control Points

Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
9. Final Carcass Trimming	Ensure that carcass is properly trimmed prior to final washing.	Ongoing.	All contaminated tissue is trimmed.	Management must ensure all staff involved in this step are properly trained in recognizing and trimming contaminated tissue.
10. Final Carcass Wash	Ensure that carcass is adequately washed.	Ongoing.	All blood and bone dust is removed. Washing must be done to ensure there is no contamination from spray deflections (i.e. floor to carcass, wall to carcass, carcass to carcass).	Management must ensure all staff are adequately trained in this step.
11. Carcass and Parts Cooler Storage	Ensure that all carcasses and parts are properly spaced and placed in cooler.	Daily, ongoing.	Carcasses and parts are placed and spaced in a cooler with adequate refrigeration capacity in order to ensure continuous cooling such that the surface reaches a temperature of $\leq$7°C within 24 hours of carcass dressing.	Modify refrigeration capacity or placement procedures.

5. Dressing - Poultry



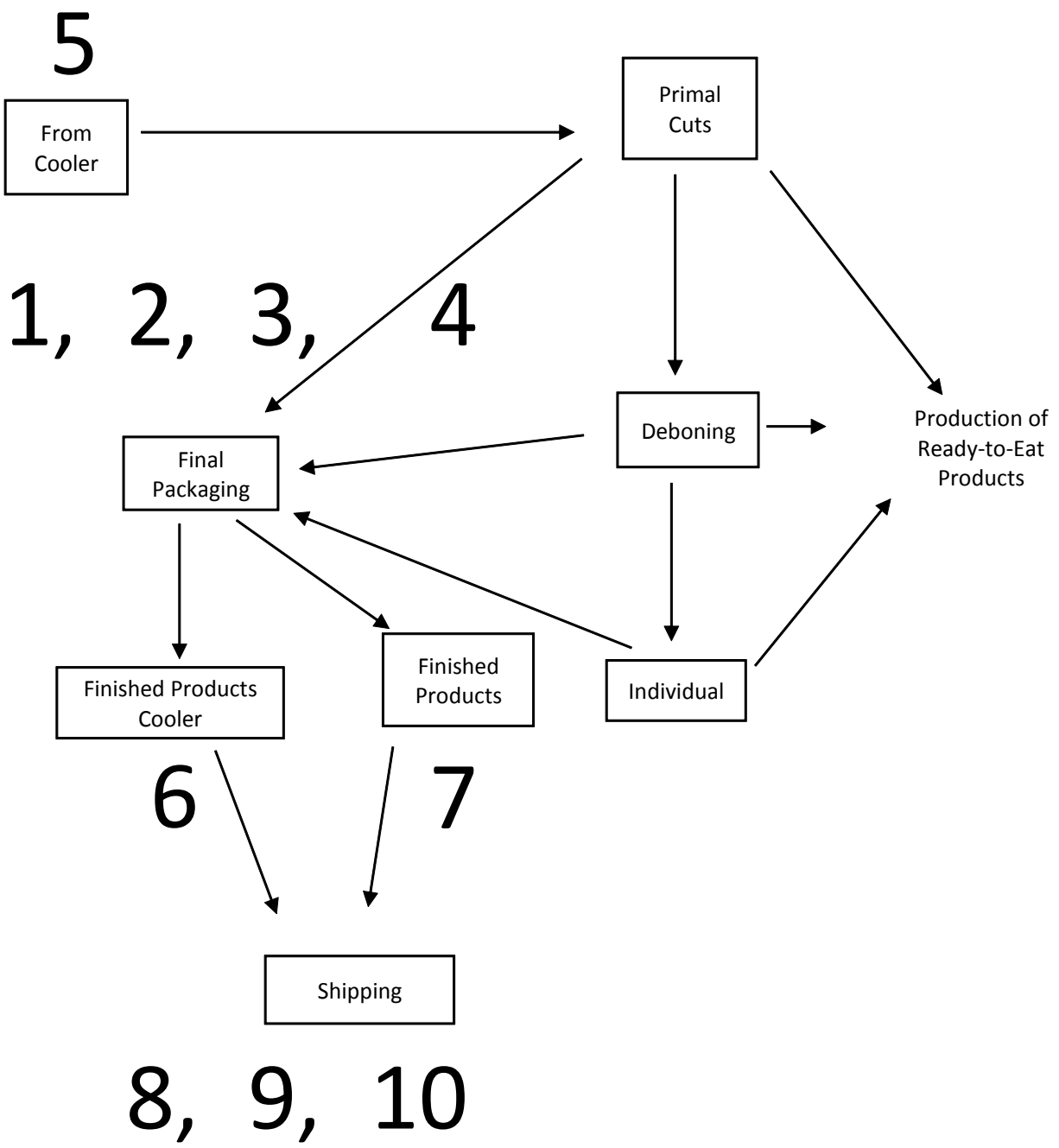
5. Dressing - Poultry: Critical Control Points

Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
1. General - Sanitary Maintenance of Invasive Equipment	Ensure that all invasive equipment is maintained in a sanitary manner throughout the process.	Ongoing.	All invasive equipment (knives, defeatherers, evisceration washers, etc.) is maintained in a sanitary manner throughout the process. Adequate sanitation must occur on an "as needed" basis depending on the step in the process.	All staff are properly trained in the proper sanitary maintenance of equipment.
2. General - Sanitary Maintenance of Personnel	Ensure that all personnel handling product do so in a sanitary manner.	Ongoing.	All personnel are to follow proper sanitary and hygienic practices.	All staff are properly trained in all sanitary and hygienic practices.
3. Scalding of Birds	Ensure scalding water temperature is within correct range.	Daily, ongoing.	Water temperature is high enough to loosen feathers and prevent bacterial growth but low enough to prevent cooking of flesh.	Adjust water temperature. Review water temperature control procedures or mechanisms.
4. Washing of Birds	Ensure birds are properly washed.	Daily, ongoing.	All hair, feathers, pinfeathers, dirt, scurf, etc. are removed.	Rewash any unclean birds. Review washing procedures or equipment and modify as necessary.
5. Evisceration	Ensure evisceration is properly performed.	Ongoing.	The carcass or edible viscera (giblets) is not contaminated by punctured viscera material.	Discard or trim contaminated carcasses or giblets.
6. Final Trimming	Ensure carcasses are properly trimmed prior to final washing.	Ongoing.	All contaminated tissue is trimmed (or carcass is discarded).	All staff in this step must be properly trained in recognizing and trimming, contaminated tissue.
7. Final Carcass Washing	Ensure carcasses are properly washed.	Ongoing.	All blood and contamination is removed. Washing must be done to ensure there is no contamination from spray deflections (i.e. floor to carcass, wall to carcass, carcass to carcass).	Review final wash procedures and modify as necessary.

5. Dressing - Poultry: Critical Control Points

Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
8. Chilling Carcasses	Ensure carcasses are properly chilled.	Daily, ongoing.	Carcasses are immediately chilled after washing. Upon exiting carcasses' internal temperature is 4°C or less.	If improperly chilled carcasses are satisfactory, rechill to correct temperature. If not satisfactory, then discard carcasses. Review chilling procedures and equipment and modify as necessary.
9. Chilling Giblets	Ensure giblets are properly chilled.	Daily, ongoing.	Giblets are immediately chilled to 4°C or less within 2 hours after evisceration.	If improperly chilled giblets are satisfactory, rechill to correct temperature. If not satisfactory, then discard giblets. Review chilling procedures and equipment and adjust as necessary.
10. Freezing	Ensure that chilled carcasses or giblets are properly frozen.	Daily, ongoing.	Carcasses or giblets are frozen to -18°C or lower within 24 hours.	Review freezing practices and/or equipment. Adjust as necessary.

6. Processing



6. Processing: Critical Control Points

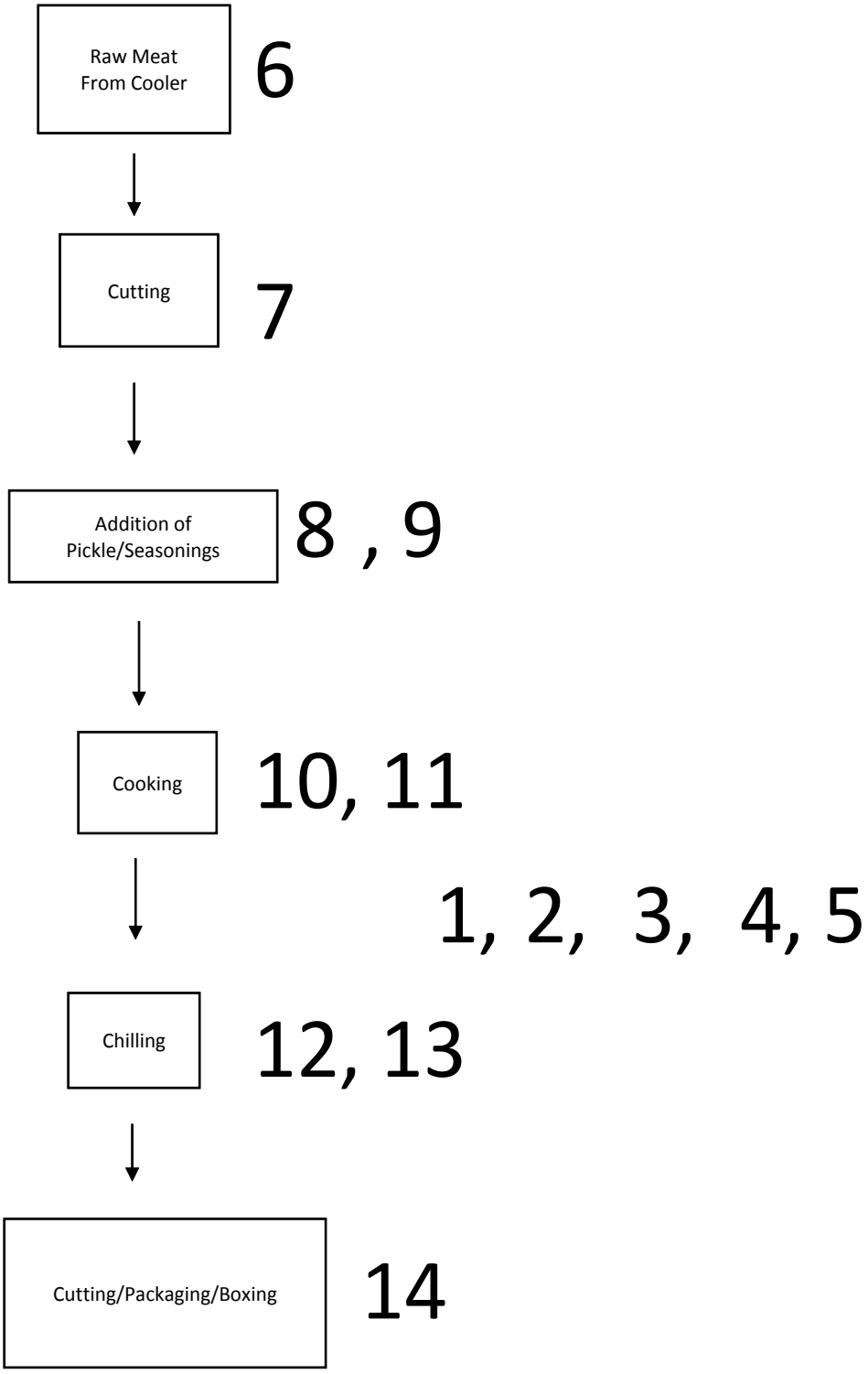
Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
1. General - Effectiveness of Invasive Equipment Sanitation Facilities	Ensure that facilities used for sanitizing invasive equipment (i.e. knives, saws, hooks, etc.) are adequate.	Daily, ongoing	Hot water sanitizing: minimum 82°C. Chemical sanitizing: concentrations equal to or greater than minimum recommended levels. Adequate over flow where necessary.	Modify facilities.
2. General - Sanitary Maintenance of Product Contact Surfaces	Ensure that all product contact surfaces are maintained in a sanitary manner throughout the process.	Ongoing.	All product contact surfaces (i.e. knives, saws, cutting tables, boards, etc.) must remain in a sanitary manner at all times. Adequate sanitation must occur on an "as needed" basis depending on the step in the process.	All staff are properly trained in the proper sanitary maintenance of equipment.
3. General - Sanitary Maintenance of Personnel	Ensure that all personnel handling product do so in a sanitary manner.	Ongoing.	All personnel are to follow proper sanitary and hygienic practices.	All staff are properly trained in all sanitary and hygienic practices.
4. Temperature of Processing Room	Ensure this room is maintained at an adequate temperature.	Daily, ongoing.	Maximum temperature: 10°C.	Modify facilities.
5. Temperature of Dressed Carcasses	Ensure that dressed carcasses are properly cooled prior to further processing.	Daily, ongoing.	Carcasses are 4°C or less.	Return carcasses to cooler until 4°C. Review carcasses cooler procedures and/or equipment.
6. Finished Products Cooler Temperature	Ensure the finished products cooler is maintained at an adequate temperature.	Daily, ongoing.	Maximum temperature: 4°C.	Modify facilities.
7. Finished Products Freezer Temperature	Ensure the finished products freezer is maintained at an adequate temperature.	Daily, ongoing.	Finished product is frozen to -18°C or lower within 24 hours.	Review freezing equipment and/or practices. Modify as necessary.

6. Processing: Critical Control Points

Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
8. Final Shipping	Ensure delivery vehicles are maintained in a sanitary manner.	Daily, ongoing.	Delivery vehicles are clean prior to loading. Delivery vehicles have not previously transported incompatible products (e.g. odorous products).	Wash vehicle. Refuse product for delivery.
9. Final Shipping: Refrigerated	Confirm delivery vehicles have adequate refrigeration.	Daily, ongoing.	Vehicles must have capacity to maintain product at 4°C or less.	Refuse product for delivery.
10. Final Shipping: Frozen	Confirm delivery vehicles have adequate freezing capability.	Daily, ongoing.	Vehicles must have capacity to maintain product at -18°C or less.	Refuse product for delivery.

7. Production of Ready-to-Eat Products

a) Cooked Beef and Cooked Corned Beef



7. Production of Ready-to-Eat Products – Critical Control Points

a) Cooked Beef and Cooked Corned Beef: Critical Control Points

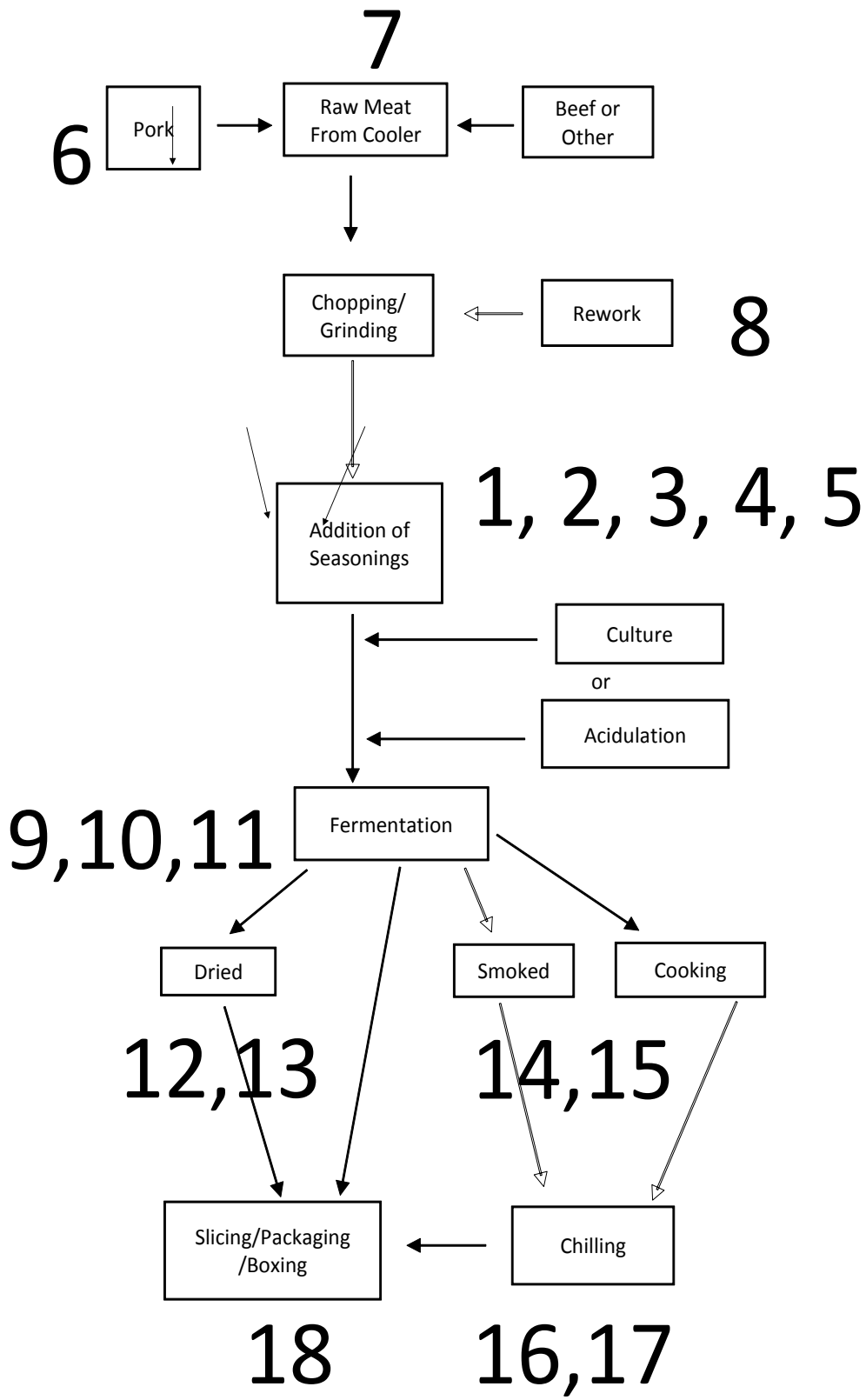
Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
1. General - Effectiveness of Sanitation Facilities	Ensure that facilities used for sanitizing equipment and personnel are adequate.	Daily, ongoing.	Hot water sanitizing: minimum 82^0 C. Chemical sanitizing: concentrations equal to or greater than minimum recommended levels. Adequate over flow where necessary.	Modify Facilities.
2. General - Sanitary Maintenance of Product Contact Surfaces	Ensure that all product contact surfaces are maintained in a sanitary manner throughout the process.	Ongoing.	All product contact surfaces must remain in a sanitary manner at all times. Adequate sanitation must occur on an "as needed" basis.	All staff are properly trained in the proper sanitary maintenance of equipment.
3. General - Sanitary Maintenance of Personnel	Ensure that all personnel handling product do so in a sanitary manner.	Ongoing.	All personnel are to follow proper sanitary and hygienic practices.	All staff are properly trained in all sanitary and hygienic practices.
4. Temperature of Production Area	Ensure this area is maintained at an adequate temperature.	Daily, ongoing.	Maximum temperature: 10^0C.	Modify facilities.
5. Cross-Contamination Control	Ensure that no cross-contamination between raw materials and finished cooked product occurs.	Daily, ongoing.	Plant layout must be such that areas used for cooked products are off limits to raw product. Use dedicated utensils for raw product and cooked products. No movement of personnel between raw product areas and cooked product areas unless smocks and clothing are changed, hands are sanitized, and boots washed.	If both products must be handled in same area, then cooked product must be handled first in the day, then uncooked products must follow. Modify procedures and practices.
6. Temperature of Raw Meat Prior to Processing	Ensure product is held at an adequate temperature.	Each lot or batch.	Maximum temperature: 4^0C.	If product enters production area over 4^0C, then cooking must begin within 2 hours.
7. Cutting of Meat	Ensure that meat is cut into uniform sized pieces.	Daily, ongoing.	Pieces should not exceed a two-pound weight range or vary by more than two inches in thickness.	Reject or re-cut non-uniform pieces. Modify procedures.

7. Production of Ready-to-Eat Products – Critical Control Points

a) Cooked Beef and Cooked Corned Beef: Critical Control Points

Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
8. Preparation of Pumping Pickle	Ensure that pumping pickle is prepared in a sanitary manner.	Daily, ongoing.	Only sanitary procedures are used. Left over pickle at end of day is discarded.	Modify procedures.
9. Dry Rub Seasonings	Ensure that dry rub seasonings are handled in a sanitary manner.	Daily, ongoing.	Dry rub seasonings are handled in a sanitary manner. Seasonings that have been in contact with raw product are not held over to the next day.	Modify procedures.
10. Cooking	Ensure that a minimum time/temperature process is used.	Each lot or cooker.	Minimum 63°C (145°F) from a probe in the thickest part of the heaviest pieces in the lot or a combination of approved temperature/times. See Appendix H for minimum internal temperature/time combinations for cooked meat.	Increase temperature and/or increase cooking time to achieve proper combination.
11. Calibration of Cooking Thermometer	Ensure that cooking thermometer is properly calibrated.	Daily.	Adjust thermometer calibration as needed.	Increase frequency if calibration is required daily. Replace equipment as necessary.
12. Chilling - Rapidity	Ensure that chilling is rapid.	Each lot or batch.	Product is continuously cooled from 54°C to 4°C within 7 hours.	Modify chilling facilities.
13. Chilling - Uniformity	Ensure that chilling is uniform.	Each lot or batch.	To achieve uniform cooling, the pieces must not touch or overlap.	Modify chilling procedures.
14. Cutting/ Packaging/ Boxing	Prior to this step, product must be adequately chilled.	Each lot or batch.	Product must be 4°C or less.	Continue chilling until product is 4°C.

b) Fermented Dry and Semi-Dry Sausage



7. Production of Ready-to-Eat Products – Critical Control Points

b) Fermented Dry and Semi-Dry Sausage: Critical Control Points

Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
1. General - Effectiveness of Sanitation Facilities	Ensure that facilities used for sanitizing equipment and personnel are adequate.	Daily, ongoing.	Hot water sanitizing: minimum 82°C. Chemical sanitizing: concentrations equal to or greater than minimum recommended levels. Adequate over flow where necessary.	Modify facilities.
2. General - Sanitary Maintenance of Product Contact Surfaces	Ensure that all product contact surfaces are maintained in a sanitary manner throughout the process.	Ongoing.	All product contact surfaces must remain in a sanitary manner at all times. Adequate sanitation must occur on an "as needed" basis.	All staff are properly trained in the proper sanitary maintenance of equipment.
3. General - Sanitary Maintenance of Personnel	Ensure that all personnel handling product do so in a sanitary manner.	Ongoing.	All personnel are to follow proper sanitary and hygienic practices.	All staff are properly trained in all sanitary and hygienic practices.
4. Temperature of Production Area	Ensure this area is maintained at an adequate temperature.	Daily, ongoing.	Maximum temperature: 10°C.	Modify facilities.
5. Cross-Contamination Control	Ensure that no cross-contamination between raw materials and finished cooked product occurs.	Daily, ongoing.	Plant layout must be such that areas used for cooked products are off limits to raw product. Use dedicated utensils for raw product and cooked products. No movement of personnel between raw product areas and cooked product areas unless smocks and clothing are changed, hands are sanitized and boots washed.	If both products must be handled in same area, then cooked product must be handled first in the day, then uncooked products must follow. Modify procedures and practices.
6. Pork Products - "Trichinella spiralis" Control	Ensure that all pork used has been "Trichina treated".	Each lot or batch.	If sausages are not destined for further step(s) designed to destroy parasites, then pork ingredients must be "Trichina treated" according to Appendix B.	Reprocess pork ingredients or finished sausage to ensure parasites are destroyed.
7. Temperature of Raw Meat Prior to Processing	Ensure product is held at an adequate temperature.	Each lot or batch.	Maximum temperature: 4°C.	If product enters production area over 4°C, then fermentation step must begin within 2 hours.

7. Production of Ready-to-Eat Products – Critical Control Points

b) Fermented Dry and Semi-Dry Sausage: Critical Control Points

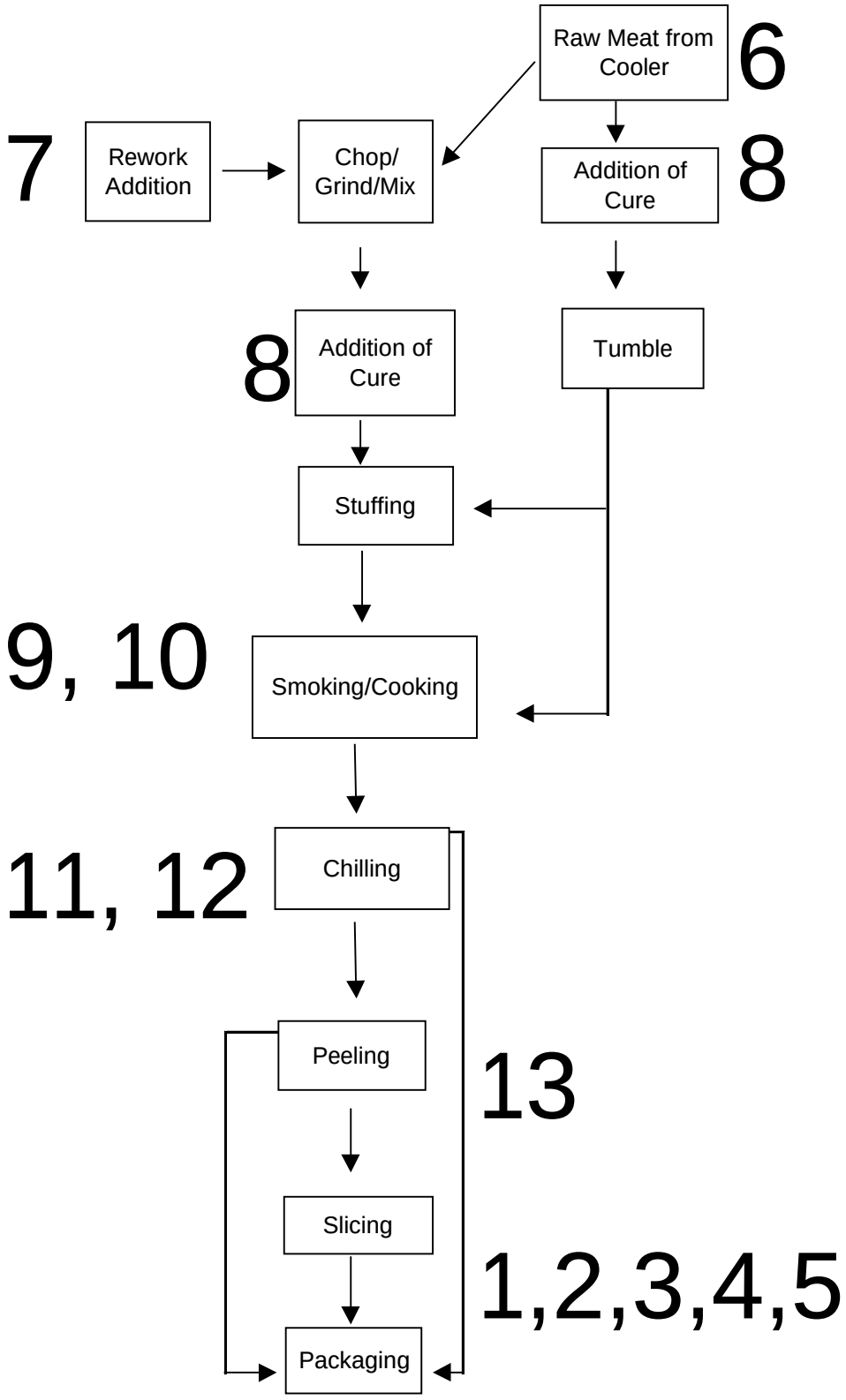
Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
8. Rework Ingredients	Ensure that rework ingredients are included on finished sausage ingredients listing.	Each lot or batch.	All ingredients present in any rework used must be listed on the finished sausage ingredients listing (i.e. species, preservatives, coloring, flavorings, etc.).	If ingredients are omitted on listing, then finished product must be either relabeled, reworked, or disposed of.
9. Fermentation Acid Development	Ensure that acid development is within specified times.	Each lot or batch.	pH of 5.3 or less using one of the following criteria: 2. Fewer than 665 degree - hours at less than 33°C. Fewer than 555 degree - hours at 33°-37°C. Fewer than 500 degree - hours at greater than 37°C. * See Appendix G for further explanations and calculations.	Analyze samples for presence of S. aureus, S. aureus enterotoxin, and principal pathogens: If results are as follows: 1) If less than 10^4 S. aureus per gram, no enterotoxin detected and no pathogens, then product can be sold provided it is labelled as requiring refrigeration. 2) If greater than 10^4 S. aureus per gram, no enterotoxin detected, or some pathogens are present, then product can be used in production of product that is to be cooked to destroy pathogens. 3) If enterotoxin is detected, then product must be destroyed.
10. Calibration of pH Monitoring Device	Ensure that pH monitoring device is properly calibrated.	Daily.	Measure pH of control buffer solutions. Calibrate pH monitoring device.	Increase frequency if calibration is daily. Replace equipment if necessary.
11. Calibration of Fermentation Room Thermometer	Ensure thermometer is properly calibrated.	Daily.	Adjust thermometer calibration as needed.	Increase frequency if calibration is daily. Replace equipment if necessary.

7. Production of Ready-to-Eat Products – Critical Control Points

b) Fermented Dry and Semi-Dry Sausage: Critical Control Points

Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
12. Drying - Moisture Level	If product is to be sold as shelf stable, then minimum a_w must be achieved.	Each lot or batch.	Achieve a_w of .85 or less. See Appendix G for other options.	Continue drying to a_w of $\leq$.85 or label product as requiring refrigeration.
13. Calibration of Moisture Measuring Device	Ensure device is properly calibrated.	Daily.	Adjust calibration of device as necessary.	Increase frequency if calibration is daily. Replace equipment if necessary.
14. Smoking, Cooking: Heat Treatment	If finished product requires heat treatment (smoking or cooking for destruction of pathogens), then minimum heat treatment must be ensured.	Each lot or batch.	Minimum 63°C for 4 minutes from a probe in the thickest part of the heaviest pieces in the lot or a combination of approved temperature/times. See Appendix G, options 1 for minimum internal temperature/time combinations for cooked meat. Appendix G provides 3 other options for uncooked meat.	Increase temperature and/or increase cooking time to achieve proper combination.
15. Calibration of Cooking/ Smoking Thermometer	If finished product requires heat treatment (cooking or smoking for destruction of pathogens) then ensure cooking/smoking thermometer is properly calibrated.	Daily.	Adjust thermometer calibration as needed.	Increase frequency if calibration is required daily. Replace equipment as necessary.
16. Chilling - Rapidity	Ensure that cooked/smoked products are properly cooled.	Each lot or batch.	Product is continuously cooled from 54°C to 4°C within 7 hours.	Modify chilling facilities.
17. Chilling - Uniformity	Ensure that chilling is uniform.	Each lot or batch.	To achieve uniform cooling, the items must not touch or overlap.	Modify chilling procedures.
18. Slicing/ Packaging/ Boxing	Ensure that products requiring refrigeration are adequately chilled.	Each lot or batch.	Product is chilled to 4°C or less.	Chill product to $\leq$ 4°C prior to packaging.

c) Cured Meats - Cooked



7. Production of Ready-to-Eat Products – Critical Control Points

c) Cured Meats - Cooked

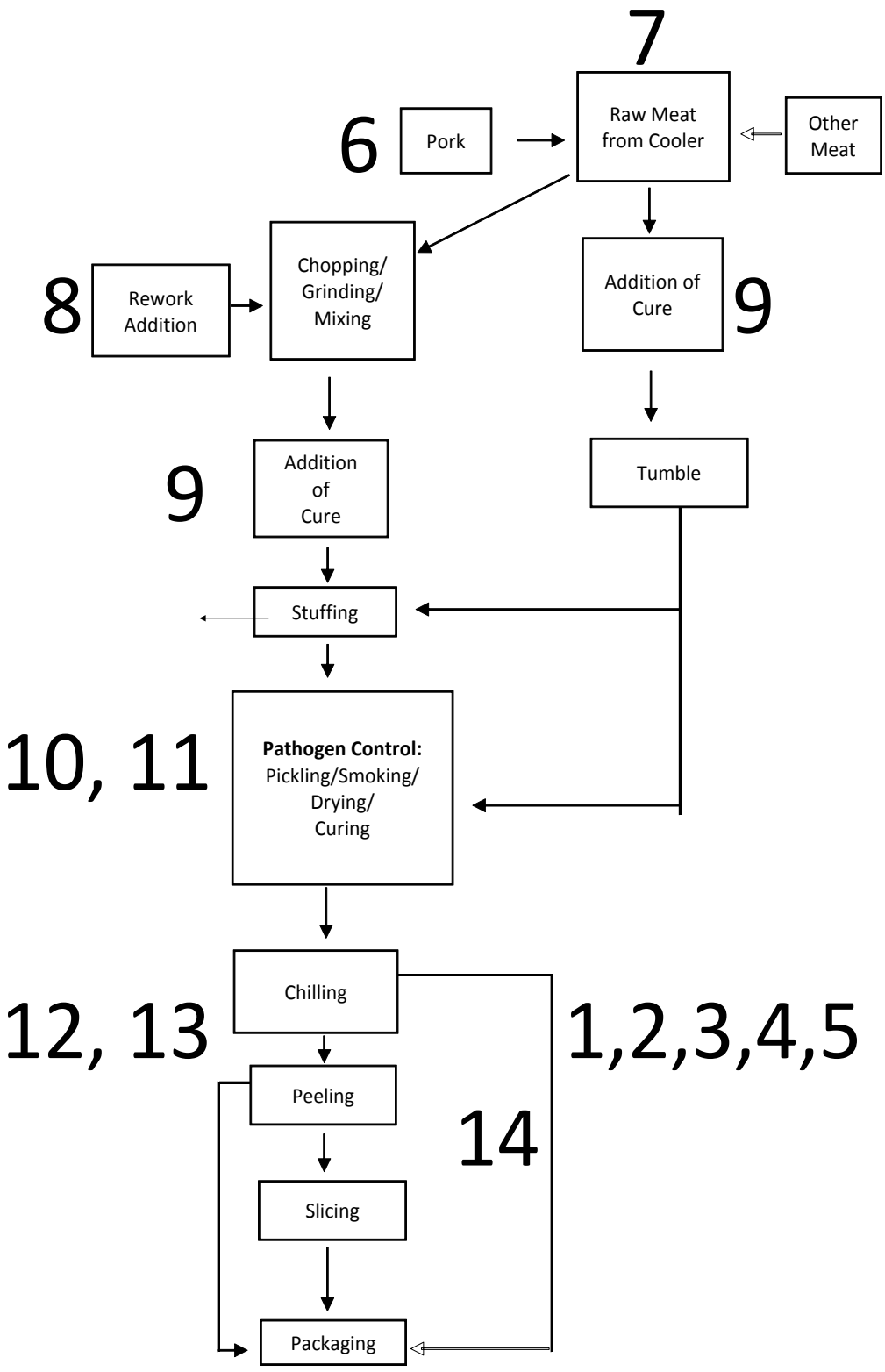
Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
1. General - Effectiveness of Sanitation Facilities	Ensure that facilities used for sanitizing equipment and personnel are adequate.	Daily, ongoing.	Hot water sanitizing: minimum 82°C. Chemical sanitizing: concentrations equal to or greater than minimum recommended levels. Adequate over flow where necessary.	Modify facilities.
2. General - Sanitary Maintenance of Product Contact Surfaces	Ensure that all product contact surfaces are maintained in a sanitary manner throughout the process.	Ongoing.	All product contact surfaces must remain in a sanitary manner at all times. Adequate sanitation must occur on an "as needed" basis.	All staff are properly trained in the proper sanitary maintenance of equipment.
3. General - Sanitary Maintenance of Personnel	Ensure that all personnel handling product do so in a sanitary manner.	Ongoing.	All personnel are to follow proper sanitary and hygienic practices.	All staff are properly trained in all sanitary and hygienic practices.
4. Temperature of Production Area	Ensure this area is maintained at an adequate temperature.	Daily, ongoing.	Maximum temperature: 10°C.	Modify facilities.
5. Cross-Contamination Control	Ensure that no cross-contamination between raw materials and finished cooked product occurs.	Daily, ongoing.	Plant layout must be such that areas used for cooked products are off limits to raw product. Use dedicated utensils for raw product and cooked products. No movement of personnel between raw product areas and cooked product areas unless smocks and clothing are changed, hands are sanitized, and boots washed	If both products must be handled in same area, then cooked product must be handled first in the day, then uncooked products must follow. Modify procedures and practices.
6. Temperature of Raw Meat Prior to Processing	Ensure raw product is held at an adequate temperature.	Daily, ongoing.	Maximum temperature: 4°C.	If product enters production area over 4^0C, then cooking/smoking step must begin within 2 hours.
7. Rework Ingredients	Ensure that rework ingredients are included on finished product ingredients listing.	Each lot or batch.	All ingredients present in any rework used must be listed on the finished product ingredients listing (i.e. species, preservatives, coloring, flavourings, etc.).	If ingredients are omitted on listing, then finished product must be either relabelled, reworked, or disposed of.

7. Production of Ready-to-Eat Products – Critical Control Points

c) Cured Meats - Cooked

Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
8. Addition of Curing Agents	Ensure that addition of curing agents is correctly done.	Each lot or batch.	Only approved compounds used in quantities as allowed by the Canadian *Food and Drug Act*. Examples are found in Appendix A. Quantities of curing agents found in rework must be accounted for.	If possible, rework product. If not, then dispose of product. Modify procedures.
9. Smoking/ Cooking	Ensure that a minimum time/temperature process is used.	Each lot or batch.	Minimum 63°C (145°F) from a probe in the thickest part of the heaviest pieces in the lot or a combination of approved temperature/times. See Appendix H for minimum internal temperature/time combinations for cooked meat.	Increase temperature and/or increase smoking/cooking time to achieve proper combination.
10. Calibration of Cooking/ Smoking Thermometer	Ensure that cooking/smoking thermometer is properly calibrated.	Daily.	Adjust thermometer calibration as needed.	Increase frequency if calibration is required daily. Replace equipment as necessary.
11. Chilling - Rapidity	Ensure that cooked/smoked products are properly chilled.	Each lot or batch.	Product is continuously cooled from 54°C to 4°C within 7 hours.	Modify chilling facilities.
12. Chilling - Uniformity	Ensure that chilling is uniform.	Each lot or batch.	To achieve uniform cooling, the items must not touch or overlap.	Modify chilling procedures.
13. Peeling/Slicing/ Packaging	Ensure products are adequately chilled prior to these steps.	Each lot or batch.	Product is chilled to 4°C or less prior to any of these steps.	Continue chilling until product is 4°C.

d) Cured Meats - Uncooked



7. Production of Ready-to-Eat Products – Critical Control Points

c) Cured Meats - Uncooked

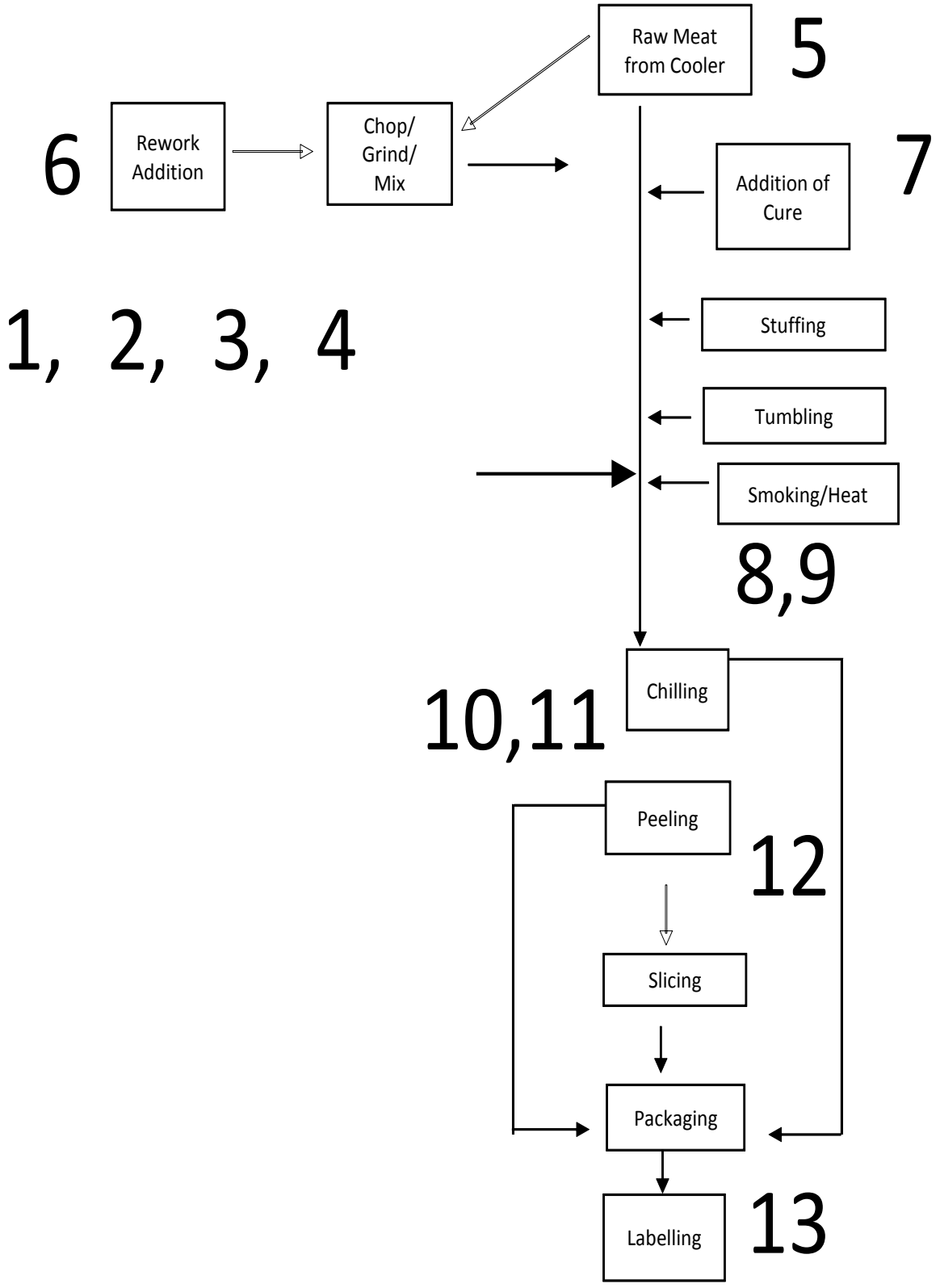
Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
1. General - Effectiveness of Sanitation Facilities	Ensure that facilities used for sanitizing equipment and personnel are adequate.	Daily, ongoing.	Hot water sanitizing: minimum 82°C. Chemical sanitizing: concentrations equal to or greater than minimum recommended levels. Adequate over flow where necessary.	Modify facilities.
2. General - Sanitary Maintenance of Product Contact Surfaces	Ensure that all product contact surfaces are maintained in a sanitary manner throughout the process.	Ongoing.	All product contact surfaces must remain in a sanitary manner at all times. Adequate sanitation must occur on an "as needed" basis.	All staff are properly trained in the proper sanitary maintenance of equipment.
3. General - Sanitary Maintenance of Personnel	Ensure that all personnel handling product do so in a sanitary manner.	Ongoing.	All personnel are to follow proper sanitary and hygienic practices.	All staff are properly trained in all sanitary and hygienic practices.
4. Temperature of Production Area	Ensure this area is maintained at an adequate temperature.	Daily, ongoing.	Maximum temperature: 10°C.	Modify facilities.
5. Cross-Contamination Control	Ensure that no cross-contamination between raw materials and finished cooked product occurs.	Daily, ongoing.	Plant layout must be such that areas used for cooked products are off limits to raw product. Use dedicated utensils for raw product and cooked products. No movement of personnel between raw product areas and cooked product areas unless smocks and clothing are changed, hands are sanitized, and boots washed.	If both products must be handled in same area, then cooked product must be handled first in the day, then uncooked products must follow. Modify procedures and practices.
6. Pork Products - "Trichinella spiralis" Control	Ensure that all pork used has been "Trichina treated".	Each lot or batch.	If pork containing products are not destined for further step(s) designed to destroy parasites, then pork ingredients must be "Trichina treated" according to Appendix B.	Reprocess pork ingredients or finished product to ensure parasites are destroyed.
7. Temperature of Raw Meat Prior to Processing	Ensure raw product is held at an adequate temperature.	Daily, ongoing.	Maximum temperature: 4°C.	If product enters production area over 4°C, then pathogen control step must begin within 2 hours.
8. Rework Ingredients	Ensure that rework ingredients are included on finished products ingredients listing.	Each lot or batch.	All ingredients present in any rework used must be listed on the finished product ingredients listing (i.e. species, preservatives, coloring, flavourings, etc.).	If ingredients are omitted on listing, then finished product must be either relabelled, reworked, or disposed of.

7. Production of Ready-to-Eat Products – Critical Control Points

c) Cured Meats - Uncooked

Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
9. Addition of Curing Agents	Ensure that addition of curing agents is correctly done.	Each lot or batch.	Only approved compounds used in quantities as allowed by the *Canadian Food and Drug Act*. Quantities of curing agents found in rework must be accounted for.	If possible, rework product. If not possible, then dispose of product. Modify procedures.
10. Pathogen Control	Ensure that an approved and effective means of controlling all pathogens is accomplished.	Each lot or batch.		Reprocess product to ensure pathogen control. Alternatively, product can be labelled stating that cooking is required.
11. Calibration of Process Monitoring Devices	Ensure that all devices monitoring those parameters crucial to pathogen control are properly calibrated.	Daily.	Calibrate all process parameter devices. This can include salometers, pH meters, thermometers, and others.	Increase frequency of calibration if devices require frequent calibration. Replace equipment as necessary.
12. Chilling - Rapidity	Ensure that products are properly chilled.	Each lot or batch.	Product is continuously cooled from 54°C to 4°C within 7 hours.	Modify chilling facilities.
13. Chilling - Uniformity	Ensure that products are properly chilled.	Each lot or batch.	To achieve uniform cooling, the items must not touch or overlap.	Modify chilling procedures.
14. Peeling/Slicing/ Packaging	Ensure products are adequately chilled prior to these steps.	Each lot or batch	Product is cooled to 4°C or less prior to any of these steps.	Continue chilling until product is 4°C.

8. Production of Products Requiring Cooking



8. Production of Processed Products Requiring Cooking – Critical Control Points

Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
1. General - Effectiveness of Sanitation Facilities	Ensure that facilities used for sanitizing equipment and personnel are adequate.	Daily, ongoing.	Hot water sanitizing: minimum 82°C. Chemical sanitizing: concentrations equal to or greater than minimum recommended levels. Adequate over flow where necessary.	Modify facilities.
2. General - Sanitary Maintenance of Product Contact Surfaces	Ensure that all product contact surfaces are maintained in a sanitary manner throughout the process.	Ongoing.	All product contact surfaces must remain in a sanitary manner at all times. Adequate sanitation must occur on an "as needed" basis.	All staff are properly trained in the proper sanitary maintenance of equipment.
3. General - Sanitary Maintenance of Personnel	Ensure that all personnel handling product do so in a sanitary manner.	Ongoing.	All personnel are to follow proper sanitary and hygienic practices.	All staff are properly trained in all sanitary and hygienic practices.
4. Temperature of Production Area	Ensure this area is maintained at an adequate temperature.	Daily, ongoing.	Maximum temperature: 10°C.	Modify facilities.
5. Temperature of Raw Meat Prior to Processing	Ensure raw product is held at an adequate temperature.	Daily, ongoing.	Maximum temperature: 4°C.	If product enters production area over 4°C, then processing step(s) must begin within 2 hours.
6. Rework Ingredients	Ensure that rework ingredients are included on finished products ingredients listing.	Each lot or batch.	All ingredients present in any rework used must be listed on the finished product ingredients listing (i.e. species, preservatives, coloring, flavourings, etc.).	If ingredients are omitted on listing, then finished product must be either relabelled, reworked, or disposed of.
7. Addition of Cure	Ensure that addition of curing agents is correctly done.	Each lot or batch.	Only approved compounds used in quantities as allowed by the *Canadian Food and Drug Act*. Quantities of curing agents found in rework must be accounted for.	If possible, rework product. If not possible, then product must be disposed of. Modify procedures.
8. Smoking/Heat Processing	Ensure that time/temperature process reduces the number of pathogens.	Each lot or batch.	Verified pathogen reduction time/temperature combination to be used consistently.	Increase temperature and/or increase smoking/heat processing time to achieve pathogen reduction.
9. Calibration of Smoking/Heat Processing Thermometer	Ensure that smoking/heat processing thermometer is properly calibrated.	Daily.	Adjust thermometer calibration as needed.	Increase frequency if calibration is required daily. Replace equipment as necessary.

8. Production of Processed Products Requiring Cooking – Critical Control Points

Critical Control Point	Monitoring Steps	Monitoring Frequency	Critical Limits	Action on Deviations
10. Chilling - Rapidity	Ensure that products are properly chilled.	Each lot or batch.	Product is continuously cooled from 54°C to 4°C within 7 hours.	Modify chilling facilities.
11. Chilling - Uniformity	Ensure that chilling is uniform.	Each lot or batch.	To achieve uniform cooling, the items must not touch or overlap.	Modify chilling procedures.
12. Peeling/Slicing/ Packaging	Ensure products are adequately chilled prior to these steps.	Each lot or batch.	Product is chilled to 4°C or less prior to any of these steps.	Continue chilling until product is 4°C.
13. Labelling	Ensure finished products are properly labelled.	Each lot or batch.	Each individual package of finished products requiring further cooking must be labelled as such.	Re-label incorrectly labelled finished products.

APPENDIX A

Approved Processes for the Production of Cured Meats Products

Note: As science develops, alternate methods of processing cured meats may become available. New approved methods will be published first in Chapter 4 of the Meat Hygiene Manual of Procedures available on the Canadian Food Inspection website.

Curing

Curing is the treatment of meat products with nitrite or nitrate salts or both, and in combination with salt (NaCl) and other curing aids to improve colour, texture and flavour and to prevent or delay undesirable microbial growth and toxin production.

Cured meat products are subsequently heated, i.e. cooked or smoked (wieners, loaves, bologna, bacon, etc.). **The heating process should be sufficient to destroy vegetative forms of pathogens.** Heating to 69°C or maintaining temperatures above 60°C for an adequate period of time generally achieves this purpose.

With the exception of shelf stable meat products such as commercially sterile meat products in hermetically sealed containers, fermented, acidified and dried meat products, cured meat products rely on refrigeration for preservation.

It is advisable to conduct microbiological testing of meat products of unknown quality prior to subjecting them to a curing process which does not involve heating.

Use of nitrite and nitrate salts (Sodium nitrite, potassium nitrite, sodium nitrate, and potassium nitrate)

N.B. Whenever potassium nitrite or nitrate salt is used instead of sodium nitrite or nitrate salt, multiply the amount indicated with a factor of 1.23.

In the curing of meat products other than side bacon, the maximum input level of sodium nitrite salts is 20g per 100kg of meat product, i.e. 200ppm. In the curing of side bacon, the maximum input level of sodium nitrite salts is 12g per 100kg of pork bellies, i.e. 120ppm.

In the production of slow cured meat products, sodium nitrate salt at a maximum input level of 20g per 100kg of meat products, i.e. 200ppm, may be used in addition to the nitrite salts.

N.B. In the formulation of a cured meat product, the use of a previously cured meat product as ingredient in excess of 10% will necessitate recalculation of the nitrite/nitrate input to account for the contribution from those ingredients.

In the production of dry rub cured meat products on racks, the maximum level of use is 62g of sodium nitrite salts and 186g of nitrate salts per 100kg of meat product.

Calculation of nitrite/nitrate salt input levels:

1) Calculation of nitrite in sausage emulsion

Example A: Formulation:

114kg sausage mix
23g sodium nitrite (bulk)
114.023kg emulsion

Formula 1:

$$\text{ppm nitrite} = \frac{\text{sodium nitrite (g)} \times 1000\ \text{mg/g}}{\text{wt of emulsion (kg)}}$$

Calculation:

$$= \frac{23\text{g} \times 1000\text{mg/g}}{114.023\text{kg}}$$

$$= \frac{23{,}000\text{mg}}{114.023\text{kg}}$$

$$= 201.71\text{mg/kg}$$

$$= 201.71\text{ppm}$$

Formula 2:

$$\text{ppm nitrite} = \frac{\text{sodium nitrite (kg)} \times 106}{\text{wt of emulsion (kg)}}$$

Calculation:

$$= \frac{.023\text{kg} \times 106}{114.023\text{kg}}$$

$$= \frac{23{,}000\text{kg}}{114.023\text{kg}}$$

$$= 201.71\text{ppm}$$

Example B: Formulation:

114kg sausage mix
350g Prague Powder
114.35kg emulsion

N.B.

Prague Powder = 6.25% sodium nitrite

350g Prague Powder = 21.875g sodium nitrite

Formula 2:

$$\text{ppm nitrite} = \frac{\text{sodium nitrite (kg)} \times 106}{\text{wt of emulsion (kg)}}$$

Calculation:

$$= \frac{.021875\text{kg} \times 106}{114.35\text{kg}}$$

$$= \frac{21{,}875\text{kg}}{114.35\text{kg}}$$

$$= 191.30\text{ ppm}$$

2) Calculation of nitrite in injected product

Example:

Formulation:

Cure unit:

Sodium tripolyphosphate	6.41 kg
Sodium nitrite	0.28 kg
Sodium erythorbate	0.84 kg
Spices	0.70 kg
Total	**8.23 kg Cure unit**
Cure Unit	8.23 kg
Water	134.00 kg
Salt	40.00 kg
Total	**182.23 kg Brine**

% Pump (gain) = 15

Formula 1:

$$\text{ppm nitrite} = \frac{\text{wt of nitrite (kg) x gain x 106}}{\text{wt of brine (kg) (gain + 100)}}$$

Calculation:

$$= \frac{0.28\text{kg} \times (15 \times 106)}{182.23\text{kg} \quad 115}$$

$$= 0.0015365 \times 0.130 \times 106$$

$$= 200\text{ppm}$$

Formula 2:

$$\text{ppm nitrite} = \frac{\text{wt of nitrite (g) x gain (kg)}}{\text{wt of brine (kg)}}$$
$$100\text{ (kg)} + \text{gain (kg)}$$

N.B.

Assume weight before injection = 100kg

Gain = 15kg

weight after injection = 115kg

Calculation:

$$= \frac{280\text{g} \times 15\text{kg}}{\frac{182.23\text{kg}}{115\text{kg}}}$$

$$= \frac{23.047\text{g}}{115\text{kg}}$$

$$= .200\text{g/kg}$$

$$= 200\text{mg/kg}$$

$$= 200\text{ppm}$$

Curing aids

A number of curing aids are used in the curing process. Salt (NaCl) must be used. Other curing aids permitted are phosphates, class I preservatives, gluconodelta-lactone, citric acid, sodium citrate, vinegar, sweetening agents, sodium bicarbonate, sodium hydroxide, potassium hydroxide, seasoning and spices (See Bl4.009 of the *Food and Drug Regulations*).

Forms of phosphate for use in meat products

Form	Chemical formula	Mol. wt	* Factor
Disodium phosphate	Na2HPO4	141.98	1.0
Monosodium phosphate	NaH2PO4	119.98	1.18
Sodium hexametaphosphate	(NaPO3)X	611.17	1.39
Sodium tripolyphosphate	Na5P3O10	367.85	1.16
Tetrasodium pyrophosphate	Na4P2O7	265.94	1.07
Sodium acid pyrophosphate	Na2H2P2O7	221.97	1.28

**The factor converts other chemical forms of phosphate into disodium phosphate.*

Calculation of phosphate salts input levels

Example:

Cure unit:

Sodium tripolyphosphate	6.41 kg
Sodium nitrite	0.28 kg
Sodium erythorbate	0.84 kg
Spices	0.70 kg
Total	**8.23 kg Cure unit**
Cure unit	8.23 kg
Water	134.00 kg
Salt	40.00 kg
Total	**182.23 kg Brine**

% Pump (gain) = 15

Formula 1:

$$\text{\% added disodium phosphate} = \frac{\text{wt of phosphate (kg)}}{\text{(in disodium phosphate equivalent) x 100 x } \frac{\text{gain}}{\text{gain x 100}}}{\text{wt of brine (kg)}}$$

Calculation:

$$= \frac{\text{(6.41 kg x 1.16) x 100 x } \frac{15}{115}}{\text{182.23 kg}}$$

= 7.43 kg

= .53% added disodium phosphate

Formula 2:

1) Determine initial % phosphate in brine (in disodium phosphate equivalent)

$$= \frac{\text{(wt phosphate x conversion factor)}}{\text{wt of brine}} \text{ x } 100$$

2) % of phosphate based on initial wt of product:

$$= \frac{\text{100 x \% pump x \% phosphate}}{\text{100 x 100}}$$

3) % Yield:

$$= \frac{\text{(wt final prod. - wt initial prod.) x 100}}{\text{wt of initial product}}$$

4) % added disodium phosphate in final product

$$= \frac{\text{\% phosphate based on initial wt of product x 100}}{\text{wt of initial product + \% yield}}$$

Calculation

1) $\frac{\text{6.41 kg x 1.16 x 100}}{\text{182.23 kg}}$ = 4.08% disodium phosphate in brine

2) $\frac{\text{100 x 15 x 4.08}}{\text{100 x 100}}$ = 0.612%

3) $\frac{\text{(115 - 100)100}}{\text{100}}$ = 15%

4) $\frac{\text{0.612\% x 100}}{\text{100 + 15}}$ = 0.53% added disodium phosphate

N.B. Establishments that store bulk nitrite or nitrate salts rather than premixes shall keep those salts under lock and key and account for their use to prevent an accidental misuse of those potentially dangerous compounds. Binder units must have curing salts packaged separately in a coloured bag.

It is not necessary to make adjustments for the addition of rework, provided the quantity of "rework" material is not more than 10% of the batch weight.

In the case of bone-in meat cuts, the pumping percentage will be calculated on a boneless basis. The amount of bone in a bone-in ham is approximately 15% by weight.

In the case of injected products with rind on (ham, bacon, etc.), no consideration is necessary for the weight of the rind. Rind may be considered as meat. Meat particles injection in solid meat cuts.

The incorporation of ground meat or poultry pieces with intact muscle cuts is accomplished by either mixing or tumbling the ground meat with the larger pieces. The cure or brine can be added to the tumbler mixer and be incorporated into the product by the physical action of tumbling. Another method that is currently used is the incorporation of the cure or brine by injecting the solution into large meat pieces then by mixing the ground meat with the injected meat. To improve the appearance of the finished product some tumbler mixers have been modified by adding blades or spikes in the tumblers so that during the tumbling action, the ground meat and cure is pushed into the solid meat cuts. This process accelerates the cure process and enhances the appearance of the finished product.

A third process can be used. That new process consists in emulsifying trimmings or ground pork, beef or poultry, and injecting these meat particle suspensions into solid muscle cuts along with the brine and then placing these meat pieces into a mixer or tumbler.

This practice is acceptable providing:

1) The ground or emulsified trimmings originate from like cuts of meat (e.g., emulsified round trimmings used in a "Boneless roast beef round" or emulsified turkey breast meat trimmings injected into "Boneless roasted turkey breast", etc). The exact source and quantities of ground meat must be indicated in the product formulation on label submittals.

2) If poultry skin is used to produce poultry trimmings, it may not exceed the natural proportions as indicated in Annex I of the *Meat Inspection Regulations*.

3) That the amount of ground or emulsified trimmings may be injected in a quantity up to 15% of the fresh (green) weight at the time of formulation (e.g. 170 kg of intact muscle and 30 kg of trimmings) without having to be declared on the label. Products containing more than 15% of ground or emulsified trimmings must be labelled to indicate the presence of ground trimmings into the whole muscle piece of meat.

4) This emulsified suspension cannot be stored overnight i.e., must be used during the same production day unless the establishment is recognized as operating under HACCP by the CFIA and the overnight storage of this emulsion is a validated CCP in the establishment's HACCP plan(s).

5) The establishment must submit in writing their detailed process prior to use, when they do the label registration. The process description is to include the origin of the ground or emulsified trimmings, the amount added, the quantity of poultry skin and the method of preparation, cooking and chilling.

APPENDIX B

Curing Methods to Ensure The Destruction of Trichinella

In Sausages and Other Meat Products Containing Striated Pork Muscle Tissues

WARNING: The curing methods described in this annex are designed only to ensure that viable Trichinella are destroyed in sausages and meat products containing striated pork muscle tissues. These methods do not guarantee the safety of product in terms of other pathogens such as *Salmonella sp.*, *Toxoplasma gondii*, *E. coli* and *L. monocytogenes*, etc. When any of these methods are used in the production of ready-to-eat meat products, it is the operators responsibility to undertake all other additional manufacturing procedures required to ensure product safety.

1. SAUSAGES

Sausage may be stuffed in animal casings, hydrocellulose casings, or cloth bags. Except as specified in method #5, casings are not to be coated with paraffin or a like substance at any stage during the Trichinella destruction process, nor shall they be washed during any prescribed period of drying.

Several curing methods are acceptable. They are:

1.1 Method # 1 (Cured and Dried Sausages)

Meat shall be ground or chopped into pieces of no more than 1.9 cm (¾ inch) maximum in diameter. A minimum of 3.33% of salt per weight of unstuffed sausage material shall be mixed thoroughly with the ground or chopped meat.

i. Pepperoni sausages stuffed into casings of 3.5 cm (1⅜ inches) diameter or less as measured at the time of stuffing shall be held in a drying room for a minimum of 15 days at a temperature not lower than 7.3°C. In no case however, shall the sausage be released from the drying room less than 20 days from the time the curing materials are added.

ii. Sausage having a diameter not exceeding 8.8 cm (3½ inches) measured at the time of stuffing shall be held in a drying room for a minimum of 20 days at a minimum temperature of 7.3°C. In no case, however, shall the sausage be released from the drying room less than 25 days from the time the curing materials are added.

iii. Sausage in casings exceeding 8.8 cm (3½ inches) but not exceeding 10.2 cm (4 inches) in diameter at the time of stuffing shall be held in a drying room for a minimum of 35 days at a minimum temperature of 7.3°C. In no case shall the sausage be released from the drying room less than 40 days from the time the curing materials are added to the meat.

1.2 Method # 2 (Cured, smoked and Dried Sausages)

Meat shall be ground into pieces of 1.9 cm (¾ inch) maximum diameter or less. A dry-curing mixture containing a minimum of 3.33% of salt per weight of unstuffed sausage material shall be mixed thoroughly with the ground or chopped meat. After stuffing, sausage shall be smoked a minimum of **40 hours** at a temperature not lower than **26.7°C**.

i. After smoking, sausage having a diameter not exceeding 8.8 cm (3½ inches), measured at the time of stuffing, shall be held in a drying room for a minimum of 10 days at a minimum temperature of 7.3°C. In no case, however, shall the sausage be released from the drying room less than 18 days from the time curing materials are added to the meat.

ii. After smoking, sausage in casings exceeding 8.8 cm (3½ inches) but not exceeding 10.2 cm (4 inches) in diameter at the time of stuffing shall be held in a drying room for a minimum of 25 days at a minimum temperature of 7.3°C. In no case shall the sausage be released from the drying room less than 33 days from the time the curing materials are added to the meat.

1.3 Method # 3 (Cured and Smoked Sausages)

Meat shall be ground or chopped into pieces of 1.9 cm (¾ inch) maximum diameter or less. A dry-curing mixture containing a minimum of 3.33% of salt per weight of unstuffed sausage material shall be mixed thoroughly with the ground or chopped meat.

Total curing time shall be no less than six days; this **six-day** period must include:

a. a minimum 36 hour holding period before stuffing of casings (calculated from the admixture of salt and curing material), where the mixture is held at a temperature not lower than 1.2°C ;

b. an additional period of time, after stuffing, sufficient to attain the minimum curing period of six days. During this period, sausages shall either be held at a temperature not lower than 1.5°C **OR** placed in a pickle-curing medium of a minimum strength of 50° (salimeter reading) at a minimum temperature of 6.7°C.

Smoking of sausages is mandatory in this process:

i. Sausages having a diameter of 8.8 cm (3½ inches) or less, measured at the time of stuffing, shall be smoked after the prescribed curing, for a minimum period of 12 hours during which time:

- the temperature shall be maintained at 32.3°C minimum; and
- the temperature shall be gradually raised (over a period of no less than four hours) and maintained for at least four consecutive hours at a minimum temperature of **53.4°C.**

ii. Sausage in casings exceeding 8.8 cm (3½ inches) but not exceeding 10.2 cm (4 inches) in diameter, measured at the time of stuffing, shall be smoked, following the prescribed curing, for a minimal period of **15 hours** during which time:

- the temperature shall be maintained above a minimum of **32.3°C**; and
- the temperature shall be gradually raised (over a period of no less than four hours) and maintained for at least seven consecutive hours at a minimum temperature of **53.4°C.**

1.4 Method # 4 (Cured and Dried Sausages with Optional Cooking or Smoking)

Meat shall be ground or chopped into pieces of 0.6 cm (¼ inch) maximum diameter. A dry-curing mixture containing a minimum of **2.5%** of salt per weight of unstuffed sausage material shall be mixed thoroughly with the ground or chopped meat.

After admixture with the curing salts and before stuffing, the ground or chopped meat shall be held as a compact mass of a depth of 15.2 cm (6 inches) or less at a minimum temperature of 2.3°C for a minimum of ten days. At the end of this holding period, the sausage shall be stuffed in casings or cloth bags not to exceed a maximum diameter of 8.5 cm (3⅓ inches), as measured at the time of stuffing.

At any time after stuffing, if the operator so wishes, the product may be heated in a water bath for a period not to exceed three hours, at a temperature no lower than 29.5°C, or may be smoked at a minimum temperature of 26.7°C, during a period not to exceed three hours, or may be both heated and smoked as specified.

After stuffing, the sausage shall be held in a drying room at a minimum temperature of 7.3°C for the remainder of a **35-day period**, measured from the time curing materials were added to the meat. The time spent smoking or heating the sausage shall not be included in the 35-day holding/drying period calculation.

1.5 Method # 5 (Sausages with Coated Casings or Coverings)

Meat shall be ground or chopped into pieces of 1.9 cm (¾ inch) maximum diameter. A dry-curing mixture containing a minimum of 3.33% of salt per weight of unstuffed sausage material shall be mixed thoroughly with the ground or chopped meat.

After stuffing, the sausage shall be held in a drying room at a temperature no lower than 7.3°C for a minimum period of 65 days.

The casings or coverings for sausages prepared according to this method may be coated, before or during the drying period, with paraffin or other substance listed in the "Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products".

1.6 Method # 6 (Dry Cured Sausage; Optional Cooking or Smoking; Optional Reduced Salt Formulation)

1.6 (a) General requirements:

Meat shall be ground or chopped into pieces of 1.9 cm (¾ inch) maximum diameter. A dry-curing mixture containing a minimum of 3.33% salt per weight of unstuffed sausage material, ***excluding the weight of dry ingredients***, shall be mixed thoroughly with the ground or chopped meat. Salt concentration for this method is calculated with the following formula:

$$\text{Salt conc.} = \frac{\text{wt. of salt in sausage formula}}{\text{wt. of sausage formula - wt. of dry ingred.}} \times 100$$

The result is rounded down to the next lowest 0.1%

Example:

Formula: 120 kg pork, 3.56 kg salt, 2 kg spice, 0.5 kg wine, 1 kg water and starter culture, 0.8 kg sugar, 0.012 kg sodium nitrite.

$$\text{Salt conc.} = \frac{\text{wt. of salt (3.56kg)}}{\text{wt. of formula (127.872kg) - wt. dry ingred. (6.372kg)}} \times 100$$

= 0.0293 or 2.93%; 2.9%

After mixing, the sausage shall be held for two time periods:

- a minimum 48 hour holding period in a room maintained at a temperature of no lower than 1.7°C; **and**
- a drying period, in a room maintained at a temperature no lower than 10.0°C, of a duration equal to, or greater than, the minimum number of drying days obtained by the following formula:

Baseline value for minimum number of drying days for the type of sausage (ref. table 1.6 (a))

- Number of days, which can be reduced from the drying period because of a smoking or fermentation of the sausage during the holding period (ref. section 1.6 (b))

\+ Number of days which must be added to the drying period because of a sausage formulation which has a reduced salt content (ref. section 1.6 (c))

Minimum number of drying days

N.B.: The 48 hour holding period can take place entirely or partially before the beginning of the drying period; if the holding period is not completed before the beginning of the drying period, that part which remains must be completed either after the end of the drying period or as an extension of the drying period.

TABLE 1.6 (a)
SAUSAGE DRYING TIMES BY METHOD # 6
(baseline table)

Maximum diameter of casing at time of Stuffing in cm (inches)[1]	Minimum holding time in drying room temperature (7°C)[1]	Minimum number of Days in Drying Room[2]
2.5 cm (1.0")	48 Hours	14 days
3.8 cm (1.5")	48 Hours	15 days
5.0 cm (2.0")	48 Hours	16 days
6.3 cm (2.5")	**48 Hours**	18 days
7.6 cm (3.0")	48 Hours	20 days
8.8 cm (3.5")	48 Hours	23 days
10.1 cm (4.0")	48 Hours	25 days
11.4 cm (4.5")	**48 Hours**	30 days
12.7 cm (5.0")	48 Hours	35 days
13.4 cm (5.5")	48 Hours	43 days
15.2 cm (6.0")	48 Hours	50 days

[1] The drying time for flattened or oval sausages shall be calculated from a diameter derived by measuring the circumference and divided by 3.14 (pi).

1.6 (b) Reduction in the number of Drying Days for sausages, which are smoked or fermented during the holding period:

Sausages fabricated according to the methods outlined in section 1.6 (a) and 1.6 (c) may be smoked or fermented between the time curing materials are added and the time drying commences. If the internal temperature of the product is increased to 21.1°C or higher during the 48 hours holding period and maintained according to one of the time/temperature combinations described in table 1.6 (b) below, the drying time prescribed for the product may be reduced.

No interpolation of values is permissible.

Table 1.6 (b)

SAUSAGES MANUFACTURED ACCORDING TO METHOD 6 WHICH ARE SMOKED OR FERMENTED DURING THE HOLDING PERIOD - REDUCTION (%) OF THE DRYING PERIOD ACCORDING TO THE TEMPERATURE AND THE DURATION OF THE SMOKING OR FERMENTATION PERIOD

Minimum number of hours during which the sausage is held at a temperature no lower than:

Minimum period	INTERNAL TEMPERATURE OF PRODUCT (minimum) [1]									
	21.1°C 70°F	23.9°C 75°F	26.7°C 80°F	29.5°C 85°F	32.2°C 90°F	35.0°C 95°F	37.9°C 100°F	40.6°C 105°F	43.3°C 110°F	48.9°C 120°F
24 hrs	4%	5%	8%	10%	15%	23%	37%	57%	90%	100%[2]
48 hrs	9%	12%	18%	25%	35%	49%	88%	100%[2]	100%[2]	100%
72 hrs	14%	19%	28%	39%	55%	74%	100%[2]	100%	100%	100%
96 hrs	19%	26%	38%	53%	75%	98%	100%[2]	100%	100%	100%
120 hrs	24%	33%	48%	67%	95%	100%[2]	100%	100%	100%	100%

1. Internal product temperature shall be used for all types of sausages with the exception of dry cured fermented sausages (e.g. sausages with a pH 5.3 at the end of the fermentation period and an a_w of 0.90 or less at the end of drying); in these cases room temperature or product temperature shall be used.

2. Trichinella will be destroyed during fermentation or smoking at the temperature and length of time indicated. Therefore, no drying room period is required for Trichinella destruction for products so treated. However, the total holding period must last at least 48 hours.

How to use table 1.6 (b):

1) Determine how long and at which temperature the sausage will be fermented or smoked (N.B.: the heat treatment must take place during the holding period);

2) Identify the appropriate row and column for these values in the table: when the time and/or temperature values used in the preparation of the product are not listed, select the **next lowest value(s)**. (See example below);

3) Find the % in reduction time using the table above;

4) To obtain the number of days by which the minimum drying period can be reduced, multiply the % in reduction value by the baseline minimum number of drying days for the type of sausage (ref table 1.6 (a)) and round this value to the **next lower integer** number of days;

Example:

A 7.6 cm (3 inches) diameter sausage fermented at 29°C for 60 hours.

1) The exact temperature is not in the table; the next lowest value in the table is 26.7°C

2) The exact time is not in the table; the next lowest value in the table is 48 hours.

3) The percentage of reduction found in the table with 26.7°C and 48 hours is 18%.

4) According to table 1.6(a), the baseline number of minimum drying days for the type of sausage of 7.6 cm diameter, is 20 days. The number of days by which the minimum drying period can be reduced is:

   20 days X 18% = 3.6 days round to three days (nearest lowest number)

   Therefore, a reduction of three days to the number of drying days is allowed; the minimum number of drying days for this type of sausages is 20 days - three days = 17 days.

1.6 (c) Reduced Salt Content: Increase in Drying Room Times

Sausages prepared according to the general requirements in 1.6 (a) but with a recipe using less than 3.33% of salt per weight of unstuffed sausage material excluding the weight of dry ingredients (such as salts, sugars and spices) may be permitted provided the drying time is increased according to the schedule contained in table 1.6 (c).

Table 1.6 (c)
INCREASE IN INCREASE IN DRYING ROOM TIMES FOR REDUCED SALT CONTENT SAUSAGES PREPARED ACCORDING TO METHOD 1.6 (a)

Minimum % of Salt in Sausage[1]	Increase in Drying Room Time (%)
3.3	1
3.2	4
3.1	7
3.0	10
2.9	13
2.8	16
2.7	19
2.6	22
2.5	25
2.4	28
2.3	31
2.2	34
2.1	37
2.0	40

[1] Calculated on the base of the weight of sausage materials excluding dry ingredients (see section 1.6(a))

How to use table 1.6 (c):

1) Calculate the percentage of salt in the sausage with the formula in section 1.6 (a).
2) With table 1.6 (c) above, find the percentage by which the drying period must be extended.
3) To obtain the number of days by which the drying period must be extended, multiply the % by the baseline minimum number of drying days specified in table 1.6 (a) for the type of sausage in question and round this value to the **nearest greater integer**.

Example:

A 5.0 cm (2 inches) diameter sausage with 2.0% salt requires a 40% increase in drying time according to table 1.6 (c).

1) & 2) According to table 1.6 (c), an increase of 40% in the drying time is required for sausages containing 2.0% salt.

3) The formula used is: 40% X 16 days = 6.4 days (round to next highest integer) **seven days**

(The baseline number of drying days for a 2 inch sausage (ref. table 1.6 (a)) is 16 days).

Therefore an extension to the drying period of 7 days is required; the minimum number of drying days for the sausage in this example is 16 days + 7days = **23 days**.

1.7 Method # 7 (Dry Sausages)

Meat shall be ground or chopped into pieces of a maximum 0.6 cm (¼ inch) diameter or less. A minimum of 2.7% of salt per weight of **sausage meat** shall be uniformly mixed with the ground or chopped meat.

Depending on the size of the sausages, the treatment shall be as follows:

i. Sausages with a diameter of 10.5 cm (4⅛ inches) or less at the time of stuffing shall be subjected to the following 23-hour process schedule after stuffing.

Table 1.7 (i)

PROCESS SCHEDULE FOR HEAT TREATED DRY SAUSAGE OF A DIAMETER OF 10.5 CM (4 1/8 INCHES) OR LESS

Step	Minimum Room temperature	Minimum time (hours)
1	10.0°C / 50°F	12 hours
2	32.2°C / 90°F	1 hour
3	37.8°C / 100°F	1 hour
4	43.3°C / 110°F	1 hour
5	48.9°C / 120°F	1 hour
6	51.7°C / 125°F	7 hours
TOTAL TIME:		**23 HOURS**

The sausages shall then be **dried** at a minimum temperature of 10°C for not less than 7 days.

Alternatively, sausages with a diameter of 5.5 cm (2⅛ inches) or less at the time of stuffing, are to be subjected to the following 19 hour process schedule:

Table 1.7 (ii)

PROCESS SCHEDULE FOR HEAT TREATED DRY SAUSAGE OF A DIAMETER OF 5.5 CM (2 1/8 INCHES) OR LESS

STEP	Minimum Room temperature	Minimum time (hours)
1	10.0°C / 50°F	12 hours
2	37.8°C / 100°F	1 hour
3	51.7°C / 125°F	6 hours
TOTAL TIME:		**19 HOURS**

The sausages shall then be **dried** at a minimum temperature of 10°C for not less than 4 days.

SUMMARY TABLE OF APPROVED CURING METHODS FOR SAUSAGE TO ENSURE THE DESTRUCTION OF TRICHINELLA IN SAUSAGE CONTAINING STRIATED PORK MUSCLE

Method	Maximum diameter of Meat particles (cm)	Minimum % of salt per weight of sausage material	Diameter of sausage at time of stuffing (cm)	Minimum curing time cure room temperature 3°C (days)	Minimum smoking period		Minimum holding time in drying room temperature 7.3°C (Days)	Minimum time between addition of cure and release from the drying room (Days)
					Time (Hrs)	Smokehouse temperature (°C)		
1	1.9	3.33	<3.5[1]	N/A	N/A	-	15	20
1	1.9	3.33	<8.8	N/A	N/A	-	20	25
1	1.9	3.33	8.8 – 10.2	N/A	N/A	-	35	40
2	1.9	3.33	<8.8	N/A	40		10	18
2	1.9	3.33	8.8 – 10.2	N/A	40		25	33
3	1.9	3.33	<8.8	6[2]	12		N/A	N/A
3	1.9	3.33	8.8 – 10.2	6[2]	15		N/A	N/A
4	1.6	2.5	<8.5	10[5]	SEE[6]	-	N/A	35[6]
5[7]	1.9	3.33	N/A	N/A	N/A	N/A	65	N/A
6	1.9	SEE[8]	2.5 – 15.0[9]	2[10]	SEE[11]	-	SEE[12]	N/A
7	0.6	SEE[13]	<10.5	N/A	SEE[14]	-	7	N/A
7	0.6	SEE[13]	<5.5	N/A	SEE[15]	-	4	N/A

N/A: Not applicable OR no minimum standard specified.

1. Sausages of the Pepperoni variety.
2. This 6-day curing period includes a minimum 36 hour period, prior to stuffing, where the mixture shall be held at a temperature of 1.2°C or higher; sausage may either be held at 1.5°C or more OR placed in a pickle-cure of 50° (salimeter reading) or more at a temperature of 6.7°C or more for the remainder of the 6 days.
3. During this 12-hour period, the smokehouse temperature shall be gradually raised (over a minimum period of 4 hours) and maintained (for a minimum of 4 additional hours) at 53.4°C or higher.
4. During this 12-hour period, the smokehouse temperature shall be gradually raised (over a minimum period of 4 hours) and maintained (for a minimum of 7 additional hours) at 53.4°C or higher.
5. This 10 day curing period must take place before stuffing; product must be stored at 2.3°C or more as a compact mass of a depth not to exceed 15.2cm.
6. A maximum of 3 hours cooking in a 29.5°C water bath and/or maximum 3 hours smoking at 26.7°C is permitted; if either option is used, the drying time must be extended by a period of time equivalent to the time taken to cook and/or smoke the sausage.
7. The coverings of these sausages may be coated with paraffin or other substance listed in the *"Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products"* before or during the drying period.
8. Salt content (%) is calculated on the basis of the unstuffed sausage weight, exclusive of the weight of the dry ingredients. The baseline value of salt % is 3.33%. Salt content may be reduced; see section 1.6 (c).
9. See section 1.6 (a) for specific information regarding this method.
10. The 48-hour holding period at 1.7°C, may be partly or entirely completed before the end of the drying period, if the holding period is not entirely completed before the drying period, the remainder can be completed after the end of drying, or as an extension of the drying process.
11. Smoking of sausage is optional and may be used to lower the drying time; ref. section 1.6 (b).
12. This value is to be determined in accordance to the exact process used; ref. section 1.6.
13. This percentage is calculated on the basis of the sausage meat only (2.7%).
14. Sausage must be processed according to the method prescribed in table 1.7 (a).
15. Sausages must be processed according to the method prescribed in table 1.7 (b).

2. CAPICOLA (CAPOCOLLO, CAPACOLA) AND COPPA

Capicola, Capocollo and Capacola are dry-cured smoked boneless pork shoulder butts.

Coppa is a dry-cured unsmoked boneless pork shoulder butt.

Boneless pork butts used for coppa or capicola (or Capocolo or Capacola) shall be dry-cured using a mixture containing a minimum 4.5kg of salt per 100kg of fresh meat (weight before curing). Product must be cured and dried according to the schedule set out in table 2.1 below.

If curing materials are applied by the "churning" process, a small amount of pickle may be added. During the curing period, butts may be overhauled, e.g. turned over for application of additional pickle or dry salt, during the process.

In addition, capicola, capocollo and capacola shall be smoked for a minimum temperature of 26.7°C for a minimum period of 30 hours.

Butts shall not be treated in any manner designed to remove salt from the meat during or after curing; superficial washing of the butts may however be permitted.

Table 2.1 - Minimum treatments for ensuring the destruction of Trichinella in Coppa, Capicola, etc.

Type of Product	Curing period at temperature not lower than 2.3°C (36°F) (days)	Smoking time at temperature not lower than 26.7°C (80°F) (hours)	Drying time at temperature not lower than 7.3°C (45°F) (days)
Capicola, Capocollo, Capacola	25	30	20
Coppa	18	N/A	35

3. HAMS AND PORK SHOULDERS PICNICS

In the curing of hams and pork shoulder picnics, one of the following methods shall be used to destroy trichinella.

3.1 Method #1

Hams and pork shoulder picnics shall be laid down in salt, in a ratio of at least 4.0kg of salt for each 100kg of fresh meat (before curing) for a minimum of 40 days in a room maintained at a temperature not lower than 2.3°C.

Salt is to be applied in a thorough manner to the lean meat of each item. When placed in cure, product may be pumped with pickle. At least once during the curing process, products are to be overhauled (turned over for application of additional cure) and additional salt applied, if required, to thoroughly cover the lean meat of each item.

At the end of the curing period, product may be soaked up to a maximum of 15 hours in water at a temperature not to exceed 21°C (70°F). The water may be changed only once during this 15-hour period. The product shall not be treated, except for superficial washing, in any other manner designed to remove salt from the meat.

Product shall finally be dried or smoked at a time and temperature as specified in Table 3 which is at the end of this section.

3.2 Method # 2 ["Reserved"]

3.3 Method # 3

(a) Traditional Dry Curing:

Hams and shoulders shall have all exposed muscle tissue covered and the hock region packed with a cure mixture containing a minimum of 70% salt (by weight of the curing mixture).

Curing shall consist of:

A mandatory cure contact time of a minimum 28 days but no less than 3.3 *days/kg* of uncured product (whichever period is longest) at a room temperature between 1.7°C and 7.3°C; **and**

An optional cure equalization time at a room temperature no lower than 1.7°C and no higher than 15.6°C to permit the cure mixture to penetrate deeply into the muscle tissues of the product.

The number of days obtained using *days/kg*, is calculated by multiplying the value of *#days/kg* by the weigh in kilograms of the **heaviest** piece of the lot (as weighed prior to the addition of cure materials).

The total curing time (between application of cure and entry into the drying room) shall be at least 40 days and in no case less than *4.4 days/kg* of uncured ham or shoulder.

During the mandatory cure time, exposed muscle tissue must stay coated with the cure mixture. After this period, the operator may remove excess cure from the product's surface either mechanically or by a water rinse of a maximum duration of 60 seconds, and allow the product to rest in order to permit salt to permeate the product's inner tissues (equalization). Soaking of hams to remove cure is not permitted.

Product is to be dried in accordance with Table 3.

(b) Bag curing:

Hams and cure mixture are wrapped together in uncoated kraft paper and hung individually. Reapplication of salt is not necessary since the wrapping keeps the cure mixture in close contact with the product.

Exposed muscle tissue shall be rubbed and hocks packed with a cure mixture containing at least 6kg of salt for each 100kg of uncured meat (weighed before the addition of curing material), any remaining cure mixture shall be used in wrapping the product in the paper bag.

Product shall remain wrapped during a minimum curing period of at least 40 days but not less than 4.4 days per kg of uncured ham or shoulder (which ever period is longest) at a room temperature between 1.7°C and 7.3°C. It may be unwrapped during the drying period.

The number of days obtained using *days/kg*, is calculated by multiplying the value of *#days/kg* by the weigh in kilograms of the **heaviest** piece of the lot (as weighed prior to the addition of cure materials).

Product is to be dried in accordance with Table 3.

3.4 Method # 4

Hams and shoulders shall be cured with a cure mixture containing a minimum of 71.5% salt by weight. The operator may substitute potassium chloride (KCl) for up to half of the required salt on an equal weight basis.

Cure shall be applied at a minimum rate of 5.72kg of cure for each 100kg of fresh meat (weighed before addition of the curing materials). The hock region is to be packed and all exposed muscle tissue covered. The cure shall be applied in either three or four approximately equal amounts (three or four overhauls) at separate times during the first 14 days of curing.

The product shall be kept in contact with the cure mixture at a minimum temperature of 1.7°C for a minimum period of 4.4 days/kg of uncured product but for at least 30 days, whichever period is longest.

The number of days obtained using *days/kg*, is calculated by multiplying the value of *#days/kg* by the weigh in kilograms of the heaviest piece of the lot (as weighed prior to the addition of cure materials).

At the end of the cure contact period, excess cure mixture may be removed either by rinsing for a maximum of 60 seconds with water or by mechanically removing the excess from the products surface; soaking is not allowed.

After the cure contact period has ended and the excess cure has been removed, an additional period of a minimum 2.2 days/kg of uncured product but at least 14 days, whichever period is longest, shall be provided to allow the cure to permeate the deeper muscle masses. Additional cure contact days may be substituted for an equal number of equalization days.

Drying cannot begin until the end of the equalization period. Drying is to be performed according to one of the methods described in Table 3.

Table 3
MINIMUM DRYING TIME/TEMPERATURE COMBINATIONS TO ENSURE THE DESTRUCTION OF TRICHINELLA IN DRY CURED HAMS

Minimum Drying Temperature		Minimum Days at Drying Temperature	Fractional Period/ Drying Day
(°F)	(°C)		
130	54.4	1.5	0.67
125	51.7	2	0.50
120	48.9	3	0.33
115	46.1	4	0.25
110	43.3	5	0.20
105	40.6	6	0.17
100	37.8	7	0.14
95	35.0	9	0.11
90	32.2	11	0.091
85	29.4	18	0.056
80	26.7	25	0.040
75	23.9	35	0.029

How to use table 3:

i. Drying at a single constant temperature:

Determine the lowest temperature attained/which will be attained during the drying period. Using the table, select the appropriate row (if the drying room temperature is not in the table,

select the row with the next lowest temperature value) and determine the "Minimum Days at drying temperature" in column 3.

ii. Drying at two or more different temperatures:

Using the drying schedule, determine, for each day of drying, the lowest temperature reached/which will be reached. With the table, determine the fractional period contributed by each drying day using the lowest drying temperature for each day. In order for the process to be acceptable, the sum of these fractions must be greater than 1.5.

Interpolation of these times or temperatures is not acceptable.

4. Boneless Pork Loins and Loin Ends

In lieu of heat or cold treatment, curing may be used to ensure the destruction of *trichinella* in boneless loins.

Loins are cured for a minimum period of 25 days at a temperature not lower than of 2.3°C using one of the following methods:

i) Application of a dry-salt curing mixture containing a minimum of 5kg of salt per 100kg of fresh meat (weighed prior to the addition of curing materials);

ii) Application of a pickle solution (minimum 80° strength on the salimeter) at a ratio of 60kg of pickle for each 100kg of fresh meat (weighed prior to the addition of curing materials);

iii) Application of a pickle solution added to the dry-salt cure prescribed as method i) above, provided the pickle solution is not less than 80° strength (salimeter).

Loins may be soaked in maximum 21°C temperature water for a maximum duration of one hour, or washed under a spray. Product shall not be subjected, during or after curing, to any other treatment designed to remove salt.

Loins shall be smoked for a minimum of 12 hours. The smokehouse temperature shall be maintained above a minimum temperature of 37.8°C during the entire smoking process. In addition, within the 12 hours smoking period, the smokehouse temperature shall be maintained at a minimum temperature of 51.7°C for at least four consecutive hours.

Smoked product shall then be held in a drying room maintained at a temperature of not less than 7.3°C for a minimum period of 12 days.

APPENDIX C

Bacterial Hazards in Meat

Meat is an ideal growth medium for many bacteria. It is high in moisture, contains the necessary nutrients required for growth for most bacteria, and has a favourable pH or acidity level. Therefore, bacterial hazards in meat pose a significant public health risk and must be controlled.

The muscle tissue of healthy animals usually contains no bacteria. However, after the death of the animal, the natural defences against bacteria are gone. Therefore, bacterial contamination of the meat occurs after slaughter. Meat may be contaminated by contact with the hide, feet, stomach and intestinal contents, milk from the udders, plant equipment, hands and clothing of personnel, water used for washing carcasses and equipment, as well as the air in the processing and storage areas.

Because meat has many properties which make it ideal for bacterial growth, it is important to understand how these properties can be manipulated to control the growth of bacteria:

1) Temperature: Most bacteria grow most rapidly between 20°C – 50°C. Even below 20°C, many disease-causing bacteria are capable of significant growth. Because most bacteria cannot grow below 4°C, it is important to rapidly chill, and maintain products at or below this temperature.

2) Water Activity (aw): Water activity or a_w refers to the amount of free water in a product. Distilled water has an a_w level of 1.00. Oven dried sand would have an a_w of 0.00. Disease causing bacteria require an a_w of .85 or higher in order to grow. Unfortunately, unprocessed meat has an a_w of .99 thus providing any contaminating bacteria ample water for growth. Processing steps such as salting, drying, curing, pickling, etc. all lower the a_w below the point where most bacteria can grow. Proper control of these steps is critical in ensuring a safe product.

3) Acidity or pH: The acidity or pH of meat ranges from 5.0 - 7.0. Most disease causing bacteria grow extremely well in the pH 6.0 - 7.0 range. Processing steps such as fermentation and pickling lower the pH to a point where disease-causing bacteria cannot grow.

As discussed, the bacteria causing food-borne disease find their way into the meat through cross-contamination in the slaughter or processing operations. Examples of disease-causing bacteria found in meat are:

1) E. coli
2) Clostridium perfringens
3) Salmonella
4) Campylobacter
5) Staphylococcus aureus
6) Listeria monocytogenes
7) Clostridium botulinum

Since growth and other characteristics vary among the species of bacteria, it is important to understand how these differences can affect various meat products. The following section describes each bacterium and some of those characteristics:

1) *E. Coli*: is the most common bacteria found in the intestine and feces of mammals. Because of cross-contamination during the slaughter and dressing steps, *E. coli* is often found in raw meat. These bacteria are destroyed by proper cooking but can produce a toxin which is heat stable. Most *E. coli* disease outbreaks were caused by meat that had been contaminated, handled improperly, and then subsequently consumed without proper cooking.

2) *Clostridium perfringens*: is widely found in the environment (soil, sludge, etc.). In its spore state, *C. perfringens* can survive regular cooking temperatures. Once a product cools to less than 50°C, growth is extremely rapid. Concentrations of bacteria can reach food poisoning levels in a short period of time. At temperatures below 15°C, growth stops. Because *C. perfringens* grow best in an absence of oxygen, most food poisoning outbreaks have involved large pieces of meat (i.e. roast beef) or in large gravy dishes.

3) *Salmonella*: is a serious cause of foodborne illness. In particular it can endanger the lives of infants or people with a weakened health status. Poultry is the most common source of Salmonella. Other meat animals are also carriers. This organism can thrive in farm environments where intensive animal production is practiced. *Salmonella* is destroyed by normal cooking temperatures. Refrigeration temperatures and salt levels used in cured meats will inhibit its growth. Prior to slaughter it is easily spread between animals. During slaughtering and dressing operations it is easily spread via workers hands, tools, hooks, knives, etc.

4) *Campylobacter*: these foodborne disease outbreaks are usually caused by the consumption of raw or under cooked meat and poultry. Like *Salmonella*, an infection caused by *Campylobacter* can be very serious. The organism is easily killed by normal cooking temperatures. Since it grows poorly at temperatures below 30°C, it is important to rapidly cool cooked products.

5) *Staphylococcus aureus*: is commonly found in the environment and on skin particularly in the nasal areas or in the pus of infected sores. Once introduced into an ideal growth medium such as meat, *S. aureus* is capable of producing a toxin that is not destroyed by cooking. This means that cooking the infected food may destroy the organism but the toxin will still be present and able to cause a foodborne illness. The organism can grow at high salt levels but will not grow at refrigeration temperatures. Hence salted meat products that have been temperature-abused are the usual sources of this type of foodborne disease.

6) *Listeria monocytogenes*: is widely found in the environment. It has been isolated from water, silage, sewage, and the feces of man and animals. *Listeriosis*, the disease caused by this organism, is particularly serious because the fatality rate is extremely high. *L. monocytogenes* has two characteristics that make it a difficult hazard to control. First, the organism grows well at refrigerated temperatures (4°C).

   Secondly, there is some evidence that the organism may survive the minimum times and temperatures used in some cooked, cured meats. For these reasons, the best methods to prevent this organism from becoming a problem are to ensure that proper sanitation is carried out and that no risk of cross-contamination between raw and cooked products exists.

7) *Clostridium botulinum*: like *Clostridium perfringens*, it can only grow when no oxygen is present. Therefore the meat products that are most likely to be infected include large pieces of meat or cooked vacuum packed products. However some sausage products (liver and bloodwurst sausage) that have been stored too long with insufficient cooling have also caused botulism. The organism does not grow at refrigeration temperature and will not grow at an a_w (moisture level) below 0.93, as in salted or dried products. Large raw hams (bone-in hams particularly) have caused botulism if the pickling temperature has been too high and the pickling time has been too short. Nitrates are effective at controlling this organism but must be used at proper levels. However, other growth inhibiting factors (pH, salt concentration, water levels, and good sanitation) must also be controlled.

APPENDIX D

Parasite Hazards in Meat

Most meat animal species have one or more species of parasites that can infect their muscles. People become infected by consuming improperly cooked or untreated meat from an infected animal. The encysted parasite is released by the digestive process and then infects it's new host.

One of the more serious of this type of parasite for humans is Trichinella spiralis. In severe cases, death is possible. It is most commonly caused by eating under-cooked pork.

To control this organism (and most other parasites), the following methods are effective:

1) Cooking to a minimum internal temperature of 63°C.

OR

2) Freezing at a specific temperature and for minimum times depending on the size of the cuts:
   a) Products with a maximum thickness of 25cm for minimum 10 days at -25°C or lower.
   b) Products with a thickness between 25cm and 50cm for minimum 20 days at -25°C or lower.

APPENDIX E

Chemical Hazards in Meat

There are several potential chemical hazards that can be present in meat products. While not as common as illnesses caused by microbial hazards, chemical contamination can still be serious and have caused several outbreaks in food products. The following describes some chemical hazards that are commonly found in meat products:

1) Soaps or cleaners - All cleaners used in a meat plant must be food grade approved. Non food-grade cleaners may contain chemicals that can cause illness even in small amounts. Small amounts of food-grade cleaners in a food should cause no ill effects to the consumer. However, if high levels contaminate a food because of improperly rinsed equipment or accidental spillage, these chemicals can cause serious illness in those who consume it.

2) Allergens - Many people are severely allergic to a broad range of chemicals. Items known to be allergens include antibiotics, spices, flavourings, preservatives, wheat products, nuts, and certain fruits. The list of potential allergens is extremely long. To minimize the risk to the consumer, your labels must list all the ingredients used to make your products. This will allow consumers to avoid those products to which they are allergic.

3) Preservatives - At higher levels several of the preservatives used in the production of meat products can produce illness. For this reason, allowable usage levels are stringently controlled. Extreme care must be taken when measuring or weighing these preservatives to ensure they are within the usage levels or limits as set out in the *Canada Food and Drug Act.*

4) Antibiotics, Hormones - These potentially allergenic chemicals are better controlled at the farm level. However, as a meat plant manager, you should take steps to minimize their presence in the livestock you receive. Animals from farms with a poor record in this area should not be slaughtered in your plant.

APPENDIX F

Physical Hazards in Meat

Physical hazards refer to those items that, if consumed, can cause physical discomfort, injury or illness. These include pieces of metal, glass, nuts, bolts, wire, plastic, etc. Careful analysis of your operation and a little common sense should reduce these risks to a minimum. Observe there is no glass in the operation. Where there is any grinding mashing or stuffing steps, installation of a downstream metal detector is effective. Ensure that your machinery and equipment is properly designed, operated and maintained.

APPENDIX G

Approved Processes for the Production of Fermented Meat Products

Note: As science develops alternate methods of processing fermented meat products may available. New approved methods will be published first in Chapter 4 of the *Meat Hygiene Manual of Procedures* available at the Canadian Food Inspection Agency website.

Fermented Meat Products

INTRODUCTION

Preservation of meat products by fermentation has been used for hundreds of years. Similarly to other processes used in the preparation of ready-to-eat meat products, the manufacturing process for fermented meat products achieves a reduction of micro-organisms of concern to human health by creating an environment unsuitable for their survival. Fermentation also imparts a particular flavour to meat products.

Unlike cooked meat products which generally rely on cooking to act as a thermal "kill step", the manufacture of fermented meat products relies on a complex and precise combinations of time, temperature, nitrites, salt concentration, pH and a_w factors.

pH: pH is the negative logarithm of the hydrogen ion or proton concentration. The pH measures acidity or alkalinity on a scale of 0 to 14 with 7 as the neutral point. The lower the pH the higher the acidity.

a_w: The water activity (a_w) of a food is the ratio of the water vapour pressure of the food to that of pure water at the same temperature. It is measured at a scale of 0.00 to 1.00 with 0.00 indicating total dryness and 1.00 pure water.

1) Food borne pathogens of special concern:

All foodborne pathogens that have been linked to the consumption of a ready-to-eat meat product can affect fermented meat product. However, a number of organisms are considered to be of particular importance and establishments that manufacture dry or semi-dry fermented meat products must have corresponding controls in place to address each of these hazards. In addition, when a_w or pH is a critical factor in the manufacture of product, each production lot must be tested for these factors (refer to section (d) 7.)

Organism	Refer to
Trichinella spiralis	Part (d) 4) of this section
Enterotoxic Staphylococcus aureus	Part (d) 5) of this section
Verotoxinogenic E. coli (e.g., E. coli O157:H7) and Salmonella in fermented sausages	Part (d) 6) of this section and Annex K of this chapter

To be assessed as complete, an operator's HACCP plan for the manufacture of dry or semi-dry fermented meat products must have Critical Control Points in place which address these specific organisms in accordance to the requirements set out in this section. Other foodborne pathogens and hazards such as Salmonella and Listeria monocytogenes must also be analyzed and addressed in an

appropriate manner. Facility and equipment requirements for the manufacture of fermented meat products are outlined in part (c) of this section must also be met.

2) Requirements for Shelf Stable fermented meat products:

Many different types of manufacturing processes exist for making fermented meat products. Not all of these processes allow the finished product to be stored at ambient temperature.

In order to be considered "shelf-stable" and not require refrigeration, a fermented meat product must meet one of the following sets of specific requirements. Fermented products that do not meet these requirements must be labelled with a refrigeration statement.

a) The pH of the finished product is of 4.6 or less, regardless to its final aw.

b) The a_w of the finished product is 0.85 or less, regardless of its final pH.

   The pH is 5.3 or lower at the end of the fermentation period;

   Note: degree-hours requirements must be met (refer to part (d) 5) of this section);

c) + the product contains not less than 100 ppm nitrite or nitrate with salt as calculated at the moment of formulation; **and**

   + the end product has an a_w of 0.90 or lower.

Note: **for all fermented meat products which is treated as shelf-stable:** To minimize the danger of outgrowth of Clostridium botulinum spores and development of the botulin toxin in shelf-stable fermented product, nitrite/nitrate shall be added at a minimum level of 100ppm along with a minimum of 2.5% of salt. The level of nitrate-nitrite should not interfere with the process of fermentation.

Operators who manufacture a fermented meat product which is sold as shelf-stable must have specific controls in place. Refer to part (d) 7) of this section.

Please note that, with the exception of meat products made by a retort process, non-fermented meat products must have a finished product a_w of 0.85 or less in order for the product to be considered shelf-stable. If the process cannot achieve this a_w of 0.85 or less, then the product must be labelled with a refrigeration statement.

Operators of registered establishments who wish to market a meat product without a refrigeration declaration and which does not meet the criteria set out above, must submit a request for the acceptance of their proposal to the Chief, Program Development and Evaluation, Foodborne Pathogen Unit, Laboratory Services Division. The submission must be accompanied by detailed recipe, formulation and processing information for the product. Submissions will be evaluated and a letter of assessment indicating if the product can be considered shelf stable will be sent to the operator. This letter of assessment must be made available to the inspector when requested.

Manufacture of Dry and Semi-Dry Fermented Sausages

Dry or semi-dry fermented sausages are prepared by mixing ground meat with various combinations of spices, flavourings, salt, sugar, additives and bacterial cultures. The mixtures, in bulk or after stuffing, are allowed to ferment at different temperatures for varying periods of time. Following fermentation, the product may be smoked and/or dried under controlled conditions of temperature and relative humidity.

1) Types of sausages made with a fermentation process

There are many ways to classify or define the various types of sausages that are manufactured using a fermentation process. We have retained the following definitions:

(i) Dry Sausages: Dry Sausages are made with chopped or ground meat products that, as a result of bacterial action, or chemical acidification, reach a pH of 5.3 or less at the end of the fermentation period. Subsequently they are dried in a drying room to reduce their a_w to 0.90 or less.

(ii) Semi-Dry Sausages: Semi-Dry Sausages are made with chopped or ground meat products that, as a result of bacterial action, or chemical acidification, reach a pH of 5.3 or lower. Their a_w is reduced during the process but only to values above 0.90. This means they have to be kept refrigerated. In general, the semi-dry sausages are not subsequently dried in a drying room but are packaged soon after the fermentation/heating process is completed. They are generally smoked during the fermentation cycle.

2) Importance of ingredients and raw materials

Because of the complex nature of the fermentation process, it is critical that ingredients be especially well controlled and that the microbiological load of the meat used be as low as possible. The use of mechanically separated meat or finely textured meat in the fabrication of fermented meat products is strongly discouraged for this reason.

3) Fermentation and chemical acidification

(i) Fermentation

The fermentation process involves the growth of lactic acid bacteria in order to acidify the product. Providing raw materials are of excellent microbiological quality, during fermentation the combined effect of curing salts, curing aids and temperature encourages the gradual replacement of the contaminating flora including pathogens (such as Salmonella, Campylobacter and Staphylococci) by lactobacilli, pediococci and micrococci.

While it was once necessary to rely on environmental conditions for natural fermentation to occur, or to inoculate new batches with a portion of raw mixture from a previous batch (commonly referred to as "back slopping"), these methods were not always successful and represented significant risks. Commercial starter cultures are most often used today as they offer a degree of consistency and safety not found in other methods.

Contamination by pathogenic organisms at the outset of the process may have a critical effect on finished product. Bacterial competition, pH and a_w values are important factors in the control of the development or die-off of pathogenic organisms.

Lactobacilli and pediococci are primarily responsible for converting sugars into lactic acid thereby lowering the pH of the meat product. Where nitrate salts are used for curing in slow cured sausages, micrococci present convert nitrate salts to nitrite salts.

Lactobacilli with or without micrococci are components of starter cultures available for use in slow fermentation (25°C) whereas pediococci with or without micrococci are used in starter cultures for rapid fermentation at higher temperatures (25°C to 37°C). Pediococci do not occur in fresh meat products in numbers large enough to be a significant factor in traditional slow fermentation and therefore are only important in meat product fermentation if they are added in starter cultures.

When fermented cured sausages are subjected to an extended drying period, lactobacilli act to significantly reduce the number of undesirable microorganisms including pathogens.

The predominant type of fermenting organism combined with the formulation and process schedule will give a product its characteristic flavour.

(ii) Chemical Acidification

Chemical acidification may be used to help lowering the pH. Citric acid or glucono delta lactone are commonly used for this purpose.

4) Drying

Most fermented products are also subject to a drying process which reduces the amount of available water (aw) and thus further limits the survival or growth of pathogenic bacteria and spoilage organisms. This drying takes place during the fermentation process itself or as a separate activity after fermentation has been completed. Heat can also be used during drying.

The physical characteristics of the meat and fat particles (such as particle size, product temperature, etc.) are important in achieving a reduced a_w. The meat particles must be of such size that would efficiently allow release of moisture and the cut edges must be without fat smearing. Sharp and efficient grinding or chopping equipment and mixers are necessary.

(i) Water activity (a_w) measurement

The growth and metabolism of microorganisms demands the presence of water in available form. The most useful measurement of the availability of water in meat products is water activity (a_w). The a_w may be reduced by adding solutes (salt, sugar) or removing moisture.

Approximate minimum levels of a_w (if considered alone) for **growth** of:

molds ..... 0.61 to 0.96

yeasts..... 0.62 to 0.90

bacteria..... 0.86 to 0.97

Clostridium botulinum..... 0.95 to 0.97

Clostridium perfringens..... 0.95

Enterobacteriaceae ..... 0.94 to 0.97

Pseudomonas fluorescens..... 0.97

Salmonella 0.92-0.95

Trichinella spiralis will survive at an a_w of 0.93 but is destroyed at an a_w of 0.85 or less.

The above levels are based on the absence of other inhibitory effects such as nitrite, competitive growth, sub-optimum temperatures, etc., which may be present in meat products. In normal conditions, enterotoxin formation by Staphylococcus aureus has not been observed at a_w below 0.92.

Facility and Equipment Requirements

The following controls shall be in place during the processing:

- Temperature in the fermentation, drying and smoking chambers shall be uniform and controlled to prevent any fluctuation that could impact on the safety of the final product.
- Fermentation, drying and smoking chambers shall be equipped with a shatter resistant indicating thermometer, (or equivalent), with graduations of 1°C or less. If mercury thermometers are used,

their mercury columns shall be free from separations. All thermometers shall be located such that they can be easily read.

- Indicating thermometers shall be checked for accuracy against a standard thermometer (validated) at least annually and records shall be kept.
- Fermentation and smoking chambers shall be equipped with a recording thermometer for determining degree/hours calculations in a reliable manner. Recording thermometers are also preferable in drying and aging rooms but, in these rooms, it may be sufficient to read and record the temperatures 2 times a day.
- Drying and aging rooms shall be equipped with humidity recorders in order to prevent uncontrolled fluctuations of the relative humidity. The only alternative to an automatic humidity recorder in these rooms would be for the company to manually monitor and record ambient humidity twice a day (morning and afternoon) every day with a properly calibrated portable humidity recorder.
- The recording thermometer shall be adjusted to agree with the indicating thermometer.
- The recording charts shall contain the following information:
  - Date and time started - date and time concluded
  - Identification of recorder (if more than one used)
  - Batch number
  - Processing time
  - Reading of the temperature of the indicating thermometer and the relative humidity at a specific time within the processing period
  - Name of product and batch size
  - Record of unusual occurrences (process deviation)
  - Signature or "initials" of operator or responsible person designated by him

pH measurement devices: For routine monitoring, accurate measurement electronic pH metres (± 0.05 units) should be employed. It is most important that the manufacturer's instructions for use, maintenance and calibration of the instrument as well as recommended sample preparation and testing be followed.

aw measurement devices: When the a_w of product is a critical limit set out in the manufacturing process or HACCP plan for a meat product, accurate measurement devices shall be employed. It is most important that the manufacturer's instructions for use, maintenance and calibration of the instrument as well as recommended sample preparation and testing be followed.

Operator Controls on Ingredients and the Manufacturing Process

1) Ingredients and raw materials

The operator must have physical and microbiological specifications for **ALL** ingredients that may represent a hazard when used in the preparation of a fermented meat product. To ensure that the initial bacterial load is acceptable, microbiological specifications will be maintained for meat, starter culture and, where back slopping is used, the raw batter used for new batches. Records of microbiological tests performed to ensure compliance to determine specifications shall be available to the inspector on request.

2) Inoculum used to begin the fermentation process

(i) If commercial starter cultures are used, they shall have been listed in annex G of this chapter. There must be microbiological specifications for the cultures. Commercial cultures shall be stored according to the culture manufacturer's directions.

In order for a new commercial starter culture to be added to the list, details of commercial starter cultures for use in registered establishments must be submitted for review by the inspector.

(ii) "Back Slopping" is the process of using Inoculum from a previous batch to initiate the fermentation process of a new batch. Because of the risk of transmitting pathogens from the Inoculum to the new batch, strict controls are required when using this technique.

Inoculum used for back slopping shall be carefully handled and stored to avoid any contamination. The storage temperature for that Inoculum shall be maintained at 4°C or less and a pH of 5.3 or less. Samples for microbiological analysis shall be taken to ensure that the process is in line with the specifications. The frequency of that sampling is to be adjusted according to compliance to specifications. Each batch of Inoculum which will have a pH >5.3 shall be analyzed to detect at least *Staphylococcus aureus*. Only on satisfactory results, will this Inoculum be allowed to be used for back slopping.

(iii) "Natural fermentation", is a process which relies on the fermentation process self-initiating without help of neither commercial starter culture nor Inoculum from a previous batch. Because of the high potential for process failure, this process is not considered acceptable.

3) Chemical acidification

If product is chemically acidified by addition of citric acid, glucono delta lactone or another chemical agent approved for this purpose, controls shall be in place and records kept to ensure that pH of 5.3 or lower is achieved by the conclusion of the process.

4) Controls to ensure the destruction of viable Trichinella spiralis

Refer to Appendix A.

5) Controls to address hazards related to enterotoxic *Staphylococcus aureus*

Certain strains of the bacteria *Staphylococcus aureus* are capable of producing a highly heat stable toxin that causes illness in humans. Above a critical temperature of 15.6°C, *Staphylococcus aureus* multiplication and toxin production can take place. Once a pH of 5.3 is reached, *Staphylococcus aureus* multiplication and toxin production are stopped. Processors are required to control this hazard by verifying that their product attains a pH of 5.3 within predefined degree/hours limits.

As part of their control, processors shall verify the pH of each lot and record the time that it took from the moment of formulation until the pH of the sausage achieved a pH of 5.3 or less. This normally is done when each batch of product leaves the "green room".

When a process has not met degree/hours limits, the lot shall be dealt with in accordance with part (iv) of this section.

(i) Degrees/Hours Defined

A process can be judged acceptable as long as the product consistently reaches a pH of 5.3 using:

1) Fewer than 665 degree/hours when the highest fermentation temperature is less than 33°C.

2) Fewer than 555 degree/hours when the highest fermentation temperature is between 33° and 37°C.

3) Fewer than 500 degree/hours when the highest fermentation temperature is greater than 37°C.

Degree/Hours are the product of time as measured in hours at a particular temperature multiplied by the "degrees" measured in excess of 15.6°C (the critical temperature at which staphylococcal growth effectively begins). Degree/Hours are calculated for each temperature used in the process. The limitation of the number of degree/hours indicated in points 1), 2) and 3) above depends upon the highest temperature in the fermentation process prior to the time that a pH of 5.3 or less is attained.

Manufacturers are encouraged to measure temperatures at the surface of the product. Where this is not possible, manufacturers should utilize fermentation room temperatures. The table and examples are based on fermentation room temperatures. Temperature and humidity should be uniform throughout the fermentation room.

(ii) Fermentation done at a constant temperature (Constant Temperature Process)

When fermentation is done at a constant temperature, operators can either use the following table or the calculation method (see examples below) for determining degree-hours limits and maximum time for fermentation at a given room temperature.

Degrees-hours limit for the corresponding temperature	Fermentation Room Temperature (°C)	Maximum Allowed Hours to Achieve a pH of 5.3 (Based on Guideline)
665	20	150.0
665	22	103.4
665	24	78.9
665	26	63.8
665	28	53.6
665	30	46.2
665	32	40.5
555	33	31.8
555	34	30.1
555	35	28.6
555	36	27.2
555	37	25.9
555	38	22.3
500	40	20.4
400	42	18.9
500	44	17.6
500	46	16.4
500	48	15.4
500	50	14.5

EXAMPLES OF HOW TO USE THE CALCULATION METHOD FOR CONSTANT TEMPERATURE PROCESSES:

Process A: Fermentation room temperature is a constant 26°C. It takes 55 hours for the pH to reach 5.3.

Degrees above 15.6°C: 26 - 15.6 = **10.4**

Hours to reach pH of 5.3: **55**

Degree/Hours calculation: (10.4) x (55) = **572** degree/hours

The corresponding degree/hours limit (less than 33°C) is 665 degree/hours.

Conclusion: Process A meets the guideline because its degree/hours is less than the limit.

Process B: Fermentation Room temperature is a constant 35°C. It takes 40 hours for the pH to reach 5.3.

Degrees above 15.6°C: 35 - 15.6 = **19.4**

Hours to reach pH of 5.3: **40**

Degree/Hours calculation: (19.4) x (40) = **776** degree/hours

The corresponding degree/hours limit (between 33 and 37°C) is 555 degree/hours.

Conclusion: Process B does not meet the guideline because its degree/hours exceeds the limit ● hold the product and refer to part (iv) of this section.

(iii) Fermentation done at different temperatures (Variable Temperature Processes)

When the fermentation takes place at various temperatures, each step in the progression is analyzed for the number of degree/hours it contributes. The degree/hours limit for the entire fermentation process is based on the highest temperature reached during fermentation.

EXAMPLES OF HOW TO USE THE CALCULATION METHOD FOR VARIABLE TEMPERATURE PROCESSES:

Process C: It takes 35 hours for product to reach a pH of 5.3 or less. Fermentation room temperature is 24°C for the first 10 hours, 30°C for second 10 hours and 35°C for the final 15 hours.

Hours	Fermentation room temperature (°C)	Critical Temperature Adjustment	Degrees above 15.6°C	Degree/hours
10	24°	(24°-15.6°)	= 8.4°	84
10	30°	(30°-15.6°)	= 14.4°	144
15	35°	(35°-15.6°)	= 19.4°	291
pH=5.3			**Total:**	**519**

The highest temperature reached = 35°C

The corresponding degree/hour limit = 555 (between 33 and 37°C)

Conclusion: Process C meets the guideline because its degree/hours is less than the limit.

Process D: It takes 38 hours for product to reach a pH of 5.3 or less. Fermentation room temperature is 24°C for the first 10 hours, 30°C for second 10 hours and 37°C for the final 18 hours.

Hours	Fermentation room temperature (°C)	Critical Temperature Adjustment	Degrees above 15.6°C	Degree/hours
10	24°	(24°-15.6°)	= 8.4°	84
10	30°	(30°-15.6°)	= 14.4°	144
18	37°	(37°-15.6°)	= 21.4°	385.2
pH=5.3			**Total:**	**613.2**

The highest temperature reached = 37°C

The corresponding degree/hour limit = 555 (between 33 and 37°C)

Conclusion: Process D does not meet the guidelines because its degree/hours exceeds the limit ● hold the product and refer to part (iv) of this section.

(iv) Disposition of lots which have not met degree/hours limits:

The inspector in charge must be notified of each case where degree/hours limits have been exceeded. Such lots must be held and samples of product submitted for microbiological laboratory examination after the drying period has been completed. Analyses should be done, at least for *Staphylococcus aureus* and its enterotoxin, and for principal pathogens such as *E. coli O157:H7*, *Salmonella*, *Listeria monocytogenes*, etc.

- If the bacteriological evaluation proves that there are fewer than 10^4 *Staph. aureus* per gram, that neither enterotoxin nor other pathogens are detected, then the product may be sold provided it is labelled as requiring refrigerated storage.
- In the case of an *Staphylococcus aureus* level higher than 10^4 per gram but there is no enterotoxin present, or if other pathogens are present in very low numbers, the product may be used in the production of compatible cooked product but only if the heating process destroys **all** of the pathogens present.
- In the case where *Staphylococcus aureus* enterotoxin is detected in the product, irrespective of the level of viable *S. aureus* cells, the product shall be destroyed.

6) Controls to address hazards related to Verotoxinogenic *E. coli* (e.g., *E. coli O157:H7*) and to *Salmonella* in fermented sausages

Outbreaks of human illness associated with the consumption of fermented sausages which were found to contain Verotoxinogenic *E. coli and E. coli O157:H7* have been reported in the United States (1994), Australia (1995) and Canada (1998, 1999).

Following the 1994 US outbreak, work by the United States Department of Agriculture (USDA) and a task force composed of US industry and academia scientifically confirmed that some fermentation processes used by industry were effective (5 D reduction - A unit which expresses the lethality of a process. This is the time required to destroy 90% of the organisms present. Hence, a 5 D reduction would destroy 99.999% of the organisms or 10^5 organisms) against *E. coli O157:H7* but others were only partially effective (between 2 and 5 D reduction). The task force recommended five possible ways to minimize

the risk of E. coli O157:H7 in fermented sausages. At the same time, it has been established that Salmonella may also be found in the resulting product.

In order to suitably control these hazards and prevent incidents of food borne disease, registered establishments who manufacture fermented sausages are required to use one of the five following options for the control of Verotoxinogenic *E. coli and E. coli O157:H7* when they make this type of product.

To date, outbreaks of E. coli O157:H7 reported in association with dry/semi-dry fermented sausages have been linked to beef meat ingredients. The following establishments must therefore use one of the five options outlined in this section when manufacturing a dry or semi-dry fermented meat sausage product:

- establishments which use beef as an ingredient in a dry or semi-dry fermented meat sausage;
- establishment which store or handle uncooked beef on site; AND
- establishments who obtain raw meat from a supplying establishment which stores or handles uncooked beef on site.

Other establishments (for example establishments which only handle pork and who do not obtain meat ingredients from establishments which handle beef) are therefore not currently obliged to use one of the five options for the control of *E. coli O157:H7* in dry/semi-dry fermented sausages. However, they must validate through a microbiological testing program that their process will not result in presence of *E. coli O157:H7* or Salmonella in finished product. They are not required to use the testing protocol outlined under Option 3.

To ensure that all of the requirements corresponding to the selected option are met, and to suitably demonstrate this, operators of registered establishments who fabricate a dry/semi-dry fermented sausage are required to:

- compile a list of all the types of dry and semi-dry fermented sausages made at the establishment or which have a current label registration on file with the CFIA; AND
- complete a copy of Annex K "Option used for the control of *E. coli O157:H7* in dry and semi-dry fermented sausage" for each different product and attach all the required information.

This material will be screened by the Inspector-in-charge and forwarded to the area CFIA program office for verification.

If an establishment does not follow one of the other available options, they are automatically considered to be using Option 3, end product testing. If an establishment which has to do end product testing as per Option 3 refuses to do the required testing on the finished product, they are creating a situation whereby the CFIA inspector must take action to deal with a potential health hazard. In such a case, the CFIA inspector shall formally detain the affected product, take measures to prevent cross-contamination of other product and inform the establishment that, if they do not provide the necessary test results within 60 days, the affected product will be treated as inedible and condemned.

(i) Option 1: Include as part of the manufacture of the sausage, one of the following heat process which is recognized as controlling E. coli O157:H7. Under this option, it is not required to test for *E. coli O157:H7*. Time and temperature controls will be documented in the same manner as is required for other similar cooking processes (refer to Chapter 4, Sections 4.10.2 (2) and 4.10.3 (3)).

Minimum internal temperature maintained during the entire process		Minimum processing time in minutes after the minimum temperature has been reached
(°F)	(°C)	

[1] This table is identical to the roast beef cooking table with one exception: the minimum processing time for a minimum internal product temperature of 145°F/62.8°C is 4 minutes instead of "instantaneous". This difference is because the sausage product's smaller size results in a much quicker cooling and decreased cumulative lethality.

(ii) Option 2: Use a manufacturing process (combination of fermentation, heating, holding and/or drying) which has already been scientifically validated to achieve a 5 D reduction of *E. coli O157:H7*.

Manufacturing processes used to make fermented sausages are only considered effective against *E. coli O157:H7* if it is shown that they achieve a 5D reduction or more of *E. coli O157:H7.* The manufacturing process used must be evaluated in a scientific manner consistent with the challenge study recommendations (refer to "Option 5", part (iv)) of this section.

Under this option #2, it is not required to test each lot for *E. coli O157:H7* or *Salmonella*. The operator shall nevertheless conduct some degree of testing for these organisms as a verification procedure for their process.

The operator must maintain suitable records to demonstrate that all of the critical control points (CCP) for the process have been met (for e.g.: casing diameter, fermentation room (green room) thermographs, pH at the end of the fermentation step of the process, a_w, etc.)

The following processes have been scientifically validated as achieving a 5D or greater reduction of *E. coli O157:H7*.

Fermentation chamber temperature		pH at the end of fermentation process	Casing diameter	Subsequent process (dry, hold or cook)	Ref.
°F	°C				
70	21	>5.0	<55mm	HEAT (1hr @ 110°F and 6 hrs @ 125°F)	1
90	32	<4.6	<55mm	HOLD @ 90°F for >6 days	1
90	32	<4.6	<55mm	HEAT (1hr @ 110°F then 6 hrs @ 125°F)	1
90	32	<4.6	56 to 105mm	HEAT (1hr @100°, 1hr @110°F, 1hr @120°F, then 7hrs @ 125°F	1
90	32	>5.0	56 to 105mm	HEAT (1hr @100°, 1hr @110°F, 1hr @120°F, then 7hrs @ 125°F)	1
96	36	<5.0	<55mm	HEAT (128°F internal product temperature x 60 minutes) and DRY (at 55°F and 65% Relative Humidity to a Moisture Protein Ratio of <1.6:1)	2
110	43	<4.6	<55mm	HOLD @ 110°F for >4 days	1
110	43	<4.6	56 to 105mm	HOLD @ 110°F for >4 days	1
110	43	>5.0	56 to 105mm	HOLD @ 110°F for >7 days	1

[1] Nicholson, R., et al, *Dry fermented sausage and Eshcerichia coli O157:H7*. National Cattlemen's Beef Association, Research Report No. 11-316, Chicago, IL, 1996.

[2] Hinkens, J.C., et al, *Validation of Pepperoni Processes for Control of Escherichia coli O157:H7*, Journal of Food Protection, Vol. 59, No. 12, 1996, pp. 1260-1266.

(iii) Option 3: Where the manufacturing process does not correspond to one of the processes set out under options 2 or 4 of this section and has not been assessed in accordance to option 5 of this section, do **microbiological end-product testing of each production lot and hold the lots pending reception of results:**

(a) Definition of "lot": The definition of "lot" for purposes of sampling must be statistically sound and must correspond to product manufactured under the same conditions. A lot cannot exceed a single day's production.

(b) Sampling plan: For each lot, the operator shall take **30** samples of finished product and submit them for analysis. The sample plan must be representative of the lot.

(c) Sample size: Each sample shall consist of at least **25g** of product. Samples must be taken in accordance to standard microbiological techniques to avoid contamination of product and sampling of intact product packages is strongly recommended. It is unacceptable to take multiple samples from one intact package, as this is not considered statistically representative of the lot.

(d) Compositing of samples by the laboratory for analysis: It is acceptable to combine a **maximum of three (3) samples** into a composite for purposes of analysis when testing is done for *E. coli O157:H7* and *Salmonella*.

(e) Organisms to be tested: At a minimum, each composite sample shall be tested for the presence of *E. coli O157:H7* and *Salmonell*a.

(f) Laboratory requirements: **CAUTION!** - Since *E. coli O157:H7* are pathogenic to humans, the tests should be conducted by appropriately trained personnel.

(g) Method used: The method used to analyze the end product samples shall be one of the methods listed in Health Canada's Compendium of Analytical Methods, Volume 3, Laboratory Procedures for the Microbiological Analysis of Foods (ISBN 0-921317-17-4).

(h) Reporting of results: Results shall be reported in writing. Results shall be identified to the lot of product being tested and shall include individual results for each test performed, method used, minimum sensitivity of the test used, lot

(i) Release of product: Product will be held under the control of the operator until the written results of analysis have been received. In order to be released, all tests must be negative for the presence of *E. coli O157:H7* and *Salmonella* and any other pathogens tested.

(j) In case of a positive result for either *E. coli O157:H7* or *Salmonella* or another pathogen: the entire lot must be held and either submitted to a 5D reduction process or be destroyed. Possible cross-contamination of other lots shall also be assessed.

(k) Keeping of records: Records of test results shall be kept for a minimum of 24 months beyond the release date of the product.

(iv) Option 4: Implement a HACCP system at the establishment which includes testing of raw meat and batter, and use a manufacturing process (fermentation and holding, heating and/or drying) which has been scientifically validated as achieving at least 2 D reduction of *E. coli O157:H7*.

To be eligible to use this option, the operator must have implemented a HACCP system which is meeting CFIAs FSEP approach. Sampling of raw batter must be done in accordance to the requirements set out in parts (a) to (k) of this section.

Manufacturing processes used to make fermented sausages are considered partially effective against *E. coli O157:H7* if it is shown that they achieve 2D to 5D reduction of *E. coli O157:H7*. The manufacturing process used must be evaluated in a scientific manner consistent with the challenge study recommendations (refer to "Option 5", part (iv) of this section). A number of manufacturing processes have been scientifically demonstrated as achieving a 2D to 5D reduction, refer to part (l) of this section.

(a) Definition of "lot": The definition of "lot" for purposes of sampling must be statistically sound and must correspond to like production practices. Provided that effective controls for tracing product are in place and all corresponding dry fermented sausage manufacturing processes have been validated as achieving at least a 2D reduction of *E. coli O157:H7*, it would be acceptable to conduct one single series of sampling on batter which is used in different sausages. A lot cannot exceed one days production of raw batter.

(b) Sampling plan: For each lot, the operator shall take 15 samples of raw batter and submit them for analysis. The sample plan must be representative of the lot.

(c) Sample size: Each sample shall consist of at least **25g** of product. Samples must be taken in accordance to standard microbiological techniques to avoid contamination of product. It is unacceptable to take multiple samples from one site, as this is not considered statistically representative of the lot.

(d) Compositing of samples by the laboratory for analysis: It is acceptable to combine a **maximum of three (3) samples** into a composite for purposes of analysis when testing is done for *E. coli O157:H7* and *Salmonella*.

(e) Organisms to be tested: At a minimum, each composite sample shall be tested for the presence of *E. coli O157:H7* and *Salmonella*.

(f) Laboratory requirements: **CAUTION!** - Since *E. coli O157:H7* are pathogenic to humans, the tests should be conducted by appropriately trained personnel.

(g) Method used: The method used to analyze the end product samples shall be one of the methods listed in Health Canada's *Compendium of Analytical Methods, Volume 3, Laboratory Procedures for the Microbiological Analysis of Foods* (ISBN 0-921317-17-4).

(h) Reporting of results: Results shall be reported in writing. Results shall be identified to the lot of product being tested and shall include individual results for each test performed, method used, minimum sensitivity of the test used, lot for which these results apply.

(i) Release of product: Product will be held under the control of the operator until the written results of analysis have been received. In order to be released, all tests must be negative for the presence of *E. coli O157:H7* and *Salmonella*.

(j) In case of a positive result for either *E. coli O157:H7* or *Salmonella*: the entire lot must be held and either submitted to a 5D reduction process or be destroyed.

(k) Keeping of records: Records of test results shall be kept for a minimum of 24 months beyond the release date of the product.

(l) Methods which have been scientifically documented as achieving a minimum 2D reduction in *E. coli O157:H7*.

Fermentation chamber temperature		pH at the end of fermentation	Casing diameter	Subsequent process (dry, hold or cook)	Ref
°F	°C				
70	21	>5.0	56 to 105 mm	HEAT (1hr @ 110°F and 6 hrs @ 125°F)	1
90	32	<4.6	56 to 105 mm	HOLD @ 90°F for 7 days then dry	1
90	32	>5.0	56 to 105 mm	HOLD @ 90°F for 7 days then dry	1
110	43	>5.0	<55 mm	HOLD @ 110°F for 7 days then dry	1
110	43	>5.0	56 to 105 mm	HEAT (1hr @ 110°F and 6 hrs @ 125°F)	1

[1] *Nicholson, R., et al, Dry fermented sausage and Eshcerichia coli O157:H7*. National Cattlemen's Beef Association, Research Report No. 11-316, Chicago, IL, 1996.

(v) Option 5: Use an alternative manufacturing process which is scientifically validated against *E. coli O157:H7*.

(a) Establishments which elect to use this option may choose to demonstrate that:

- their method achieves a 5D reduction of *E. coli O157:H7*, in which case they will be able to manufacture product according to the requirements of Option 2 (e.g., not be required to test each lot of product for *E. coli O157:H7* and Salmonella); or alternatively

- their method achieves a 2D reduction of *E. coli O157:H7*, in which case they will be able to manufacture product according to the requirements of Option 4 (e.g., HACCP system and testing of raw batter)

(b) The manufacturer shall make a request for the evaluation of the alternative manufacturing process to the inspector. To allow the process to be evaluated, manufacturers shall use the challenge protocol developed by the USDA for such purposes and which is listed under part (d) below. Because of the complex nature of the protocol, it is strongly recommended that the services of an experienced food technology centre be retained.

(c) Upon completion of a successful evaluation, the operator shall be provided in writing, with a letter stating that the there is no objection the process has been evaluated for its ability to control *E. coli O157:H7* and that it does not object to the manufacturer using the process. Until such confirmation is received, the operator will have to manufacture product in accordance to one of the other 4 options outlined in this section.

(d) Challenge protocol for the evaluation of a fermented sausage manufacturing process ability to control *E. coli O157:H7*.

1. Biosafety requirements: CAUTION! - This protocol is a laboratory-based validation procedure that employs cultures that are pathogenic to humans. THE VALIDATION SHOULD NOT BE CONDUCTED WITHIN AN ACTUAL FOOD MANUFACTURING FACILITY. Work should be conducted in a Biosafety level II facility by appropriately trained personnel. Following use, autoclave all inoculated product and sanitize processing equipment. Follow appropriate procedures for the disposal of waste.

2. Types and numbers of strains of *E. coli O157:H7* to use as an Inoculum: at least five (5) strains of *E. coli O157:H7* should be used including representatives of strains associated with human illness and strains isolated from meat and poultry products. One isolate from an outbreak associated with a dry fermented sausage product must be included.

3. Methods of production, enumeration and standardization of Inoculum: Individual cultures of each strain should be prepared by inoculating an appropriate growth media, such as Tryptic Soy or Trypticase Soy broth, supplemented with 1% glucose and incubating for 18 to 24 hours at 37°C to obtain stationary phase cells. The additional glucose is added to ensure that the Inoculum is pre-adapted for acid tolerance. Cultures should be grown the day prior to product inoculation with a minimum holding period prior to actual use. Each strain should be centrifuged, washed and re-suspended in 0.1% peptone broth. Dilutions of each strain should be made to yield approximately equal numbers of each of the five strains. The five strains should be thoroughly mixed prior to being used as an Inoculum. After the mixed working Inoculum is prepared, the viable count of the mixture should be determined by direct surface plating on MacConkey sorbitol agar (MSA). Each of the individual strains in the Inoculum should contribute about 20 percent of the total Inoculum.

4. Size of Inoculum to be used: the final concentration of *E. coli O157:H7* in the meat mixture should be no less than 2.0 x 107 CFU/g of meat mixture. The actual Inoculum level in the meat mixture should be confirmed by sampling the inoculated meat mixture immediately after the inoculation using the above media. At this concentration, product can be serially diluted and direct plated without the need for enrichment to recover low levels of Inoculum. The initial Inoculum level was chosen to allow direct enumeration of at lest a 5 log reduction in the level of the Inoculum between the initial count in the meat mixture and the finished product.

5. Method of inoculation to be used: the Inoculum must be added to the meat and mixed prior to the addition of the other ingredients or a starter culture to the meat mixture. The use of a non-inhibitory, food grade, green dye added to the Inoculum may aid in determining the uniform distribution of Inoculum. The following procedure is recommended:
   i. Add Inoculum to meats while grinding or chopping the meats to the desired consistency
   ii. Mix in cure (if used), salt and spices.
   iii. Blend in starter culture (if used) near end of mixing cycle.
   iv. Stuff batter into casings.
6. Stuffing product into casings: Inoculated product should be stuffed into casing as usual to approximate normal production procedures. A shorter length may be used as long as the length is approximately twice the diameter of the stuffed casing.
7. Sample size, sampling time, sampling location and number of samples to test: Select two sausage sticks at the end of the drying period (finished product). From each stick selected, cut multiple cross-sectional slices from multiple locations on each stick to a final analytical sample weight of 25g per stick.
8. Methods of microbial analysis: Blend each of the two 25g samples (one per stick) in separate 225ml portions of buffered peptone water. Serially dilute the homogenates in buffered peptone water and surface plat 0.1ml portions from the dilutions onto MSA plates in duplicate. Count colonies by serological and biochemical methods as necessary. Report count per gram of finished product. Report initial Inoculum level.
9. Number of replicates: a minimum of three replicates of the study should be performed. Three separate formulation batches can, however, be processed concurrently following stuffing.

Therefore, total number of samples for microbiological analysis =

Time zero (0)	=	2
After fermentation	=	0
During drying	=	0
End drying	=	2
		4
Number of replicates	x	3
Total samples		12

10. Measurement of process parameters used to determine when a product is finished at each stage of production (process control criteria): Duplicate uninoculated samples of the product which are collected after stuffing and at each production stage should be assayed for moisture, fat, protein, salt content, pH, a_w, and titratable acidity.

Therefore, total number of samples for additional analysis =

Time zero (0)	=	2
After fermentation	=	2
During drying	=	2
End drying	=	2
Number of replicates	x	3
Total samples		24

7) Controls for the aw and pH of product

a_w and pH values are critical for processes used to ensure the control of pathogens in all semi-dry and dry fermented meat products as well as to ensure shelf-stability of certain of these products. a_w and pH values may vary greatly between individual production lots. Consequently, if a_w or pH value is a identified as a critical factor in the manufacture of dry fermented meat products, each production lot must be tested for a_w and/or pH in order to verify that the critical limits are met.

With the exception of products with a pH of 4.6 or less, fermented dry sausages and fermented meat products sold as shelf-stable must have an a_w value of 0.90 or less before release. Even though a_w measurement is mandatory only for shelf stable products, it is strongly recommended that plant management determine the norm for a_w values achieved for each product type they manufacture and for each production line (room). Once this has been established, frequent regular checks should be made.

INSPECTIONAL CONTROL

The inspector should regularly review plant management's controls and testing activities, and the results obtained. The inspector should verify if all applicable controls are in place. Plant managements' determination of pH and a_w values should be verified, periodically, by observing the operator doing actual a_w and pH measurements and by observing the operators calibration activities for a_w and pH measuring equipment. Any discrepancy should be checked by repeating the sampling and testing procedures. Any product found in non-compliance shall be held pending further evaluation.

When a company is submitting a sample for laboratory examination due to product not meeting pH and a_w requirements, the inspector should take a paired sample and submit it to departmental laboratory for bacteriological evaluation. In order to minimize disruption to scheduled monitoring programs, the inspector shall consult with his regional office before the submission of those samples.

Summary of the Control Points Applicable to Dry/Semi-Dry Fermented Meat Products

- Meat Quality
- Microbial specification for ingredients/Regular testing
- Acidification
- Commercial starter cultures/back sloping
- Time/temperature control (degree/hours)
- Indicating thermometer
- Thermometer, verifications
- Recording thermometer, correlation
- Recording charts (temperature - relative humidity)
- Relative humidity control
- Relative humidity recorder in greenrooms and smokehouses (recommended in drying rooms)
- pH monitoring
- Process deviation/ planned corrective action
- a_w monitoring
- Nitrate/Nitrite salt levels
- Trichinosis control
- Controls for E. coli O157:H7 and Salmonella in dry and semi-dry fermented sausage and completion of the checklist in Annex K of this chapter for each different type of such product made at the establishment.

Pasteurization

Food products that are pasteurized prior to or immediately after packaging under modified atmosphere (vacuum packaging, gas flushing) in hermetically sealed containers such as flexible pouches/ plastic trays/bowls/cups and require refrigeration throughout their shelf-life, shall be prepared under strict rules. The most important groups of products processed in this way are "cooked and assembled" and "sous vide" products.

The requirements applicable to the preparation of this type of product are provided in the "CANADIAN CODE OF RECOMMENDED MANUFACTURING PRACTICES FOR PASTEURIZED/MODIFIED ATMOSPHERE PACKAGED/REFRIGERATED FOOD"

- March, 1990, produced by the Agrifood Safety Division of the Canadian Food Inspection Agency.

N.B. This code is not intended for the preparation of pasteurized products to which preservatives are added. It is intended only for foods that rely only on refrigeration to ensure their quality and safety.

Handling of Meat Products Which Have Fallen on the Floor

The handling of ready-to-eat meat products is very critical because these meats will be eaten by consumers without further cooking, or any other antibacterial treatment. Exposure of the product to any contamination, from the time it is cooked until the time it is sold, must be as minimal as practically possible. Any known contamination imparted to a ready-to-eat meat product in a registered establishment must be dealt drastically and without compromise. The following general procedure should be followed when dealing with ready-to-eat meat products which have fallen on the floor:

1. In the case of ready-to-eat meats covered by skin:
    - wash skin covered surfaces thoroughly with potable water;
    - trim all other surfaces completely;
    - fully re-cook the product before allowing it to be sold or reworked.
2. In the case of ready-to-eat meats in casings:
    - if casing is intact and ends sealed - wash and dry;
    - if casing is not intact - wash the casing covered surfaces thoroughly with potable water, remove casing, trim exposed surfaces and fully re-cook before
3. In the case of ready-to-eat meats not covered by skin or a casing:
    - trim all the surfaces completely;
    - fully re-cook the product or use it for rework in a meat product that will be fully cooked.

A suitable work surface, different from other meat handling surfaces should be used for the above procedure and be sanitized after each use.

If the management decides not to follow the above procedures, product is to be treated as condemned.

Rework

This is defined as the inclusion of a prepared meat product into another meat product. It is the responsibility of plant management to ensure that all the ingredients and components of the rework material are allowed into the meat product to which they are added. A special attention shall be paid to the list of ingredients of the resulting meat product; all ingredients added either directly or by the means of a rework product shall be accurately declared.

Curing aids

It should be noted that the presence of some curing aids may be found in significant amounts in the final product if their presence in the rework was not taken into consideration. In that respect, the level of nitrite/nitrate salts and of phosphates must be recalculated if the amount of rework material added to the formulation is in excess of 10% (see 4.10.3(11)).

Meat products in edible artificial casings

Sausages in artificial edible casings (e.g. collagen) are allowed as rework material in the preparation of sausages wrapped in artificial edible casings or natural casings, to a limit of 3% in weight of the new meat product. The artificial edible casing does not have to be declared on the label of the product.

Meat products in natural casings

Sausages in natural casings are only allowed as rework material in the preparation of equivalent meat products (i.e. also wrapped in natural casing), to a limit of 3% in weight of the new meat product. When meat products in natural casings are reworked special attention must be paid to the animal species from which the casings were derived in order to verify that labelling requirements are met.

Packaging

Packaging operations shall be conducted in a sanitary manner. Contact surfaces such as tables, knives, equipment, aprons, etc., shall be kept in a suitably sanitary condition at all times during operations. Adequate separation, to prevent product contamination, shall be maintained between packaging

materials brought into the room for use and exposed product (e.g. separate tables). Only enough packaging materials for one shift are to be moved into the packaging room. Packaging materials shall not be stored in the packaging room past the end of the shift. If packaging materials need to be returned to the dry storage area, they must be clean and properly protected. Employees must exercise care when conducting operations to ensure that product is maintained in a satisfactory condition and is not exposed to contamination risks.

Packaging operations for incompatible types of product (e.g.: ready-to-eat/non ready-to-eat meats) are segregated physically, or when such separation is not possible, segregated operationally; suitably documented operational controls shall be established, maintained and implemented.

Room temperature in the packaging area must be 10°C or less.

All packaging materials coming into contact with meat products must be approved (e.g. insert liners, plastic trays, pads, films, waxed cartons, plastic liners, etc.).

Storage of Palletized Meat Products

Rooms used for the storage of palletized meat products should be provided with suitable shelving when pallets are stored in superposition.

Where storage rooms are not provided with suitable shelving and pallets are stacked the following provisions apply:

(i) The stacking of palletized meat products must not result in the contamination of the boxes (separators or other acceptable means may be used where necessary to prevent such contamination to occur).

(ii) The product should be stored in such a way that boxes at the bottom of the row and their contents are not seriously damaged as a result of the weight that they will support. In the case of hermetically sealed containers the operator is responsible for ensuring that the conditions under which the canned meat products are stored are in keeping with the can manufacturer's specifications. The operator is responsible for providing those specifications to the inspector upon request.

N.B.: The operator must ensure that pallets are in good repair and clean before use. In some cases, where problems are encountered, the use will require restriction or change to appropriate alternate equipment.

APPENDIX H

Minimum Internal Temperature/Time Combinations for Cooked Meat

Minimum Internal Temperature		Minimum Cooking Time (Minutes)
°F	°C	
144.5	62.5	5
143.6	62.0	6
142.7	61.5	8
140.9	60.5	10
140.0	60.0	12
139.1	59.5	15
138.2	59.0	19
137.3	58.0	24

Source: Manual of Procedures, Meat Hygiene Division, Food Production and Inspection Branch, Agriculture and Agri-Foods Canada

APPENDIX I

Blank and Example HACCP Forms and Worksheets

Process Flow Diagram	***Date:***
Product Name or Type:	
Plant Section or Process:	

Hazards Listing

Date:

Product Name or Type:

List all hazards in the process. Consider ingredients, processing, product flow, product handling and the ways to control those hazards.

HAZARDS	CONTROLLED AT

HACCP System:

Product Name or Type:

Plant Section or Process:

CCP	Monitoring Step	Monitoring Frequency	Critical Limits	Action on Deviations	Responsibility

HACCP System:	**Tasty Meats Ltd**
Product Name or Type:	**Yum-Yum Sweet Ham**
Plant Section or Process:	**Receiving and Slaughter**

CCP	Monitoring Step	Monitoring Frequency	Critical Limits	Action on Deviations	Responsibility
1) Sanitation of Receiving, Holding and Stunning Areas	Inspect the receiving, holding and stunning areas.	Prior to receiving any hogs and on-going thereafter.	No large accumulation of manure.	Move hogs to clean free pen. Hose wash then broom brush dirty pens. Stop trucks unloading if barn is full.	Receiver
2) "Suspects" Identification	All "suspects" identified by veterinarian are ear tagged. "Suspects" are slaughtered and dressed at end of day.	All "suspects" identified at beginning and end of dressing.	Number of "suspects" in barn coincides with number of "suspects" at end of dressing.	If all suspects cannot be identified at end of dressing, foreman to review procedures with receiver and other slaughter and processing personnel.	Receiver
3) Stunning Methods	All hogs are properly stunned.	Foreman to observe methods used by stunner every hour.	All hogs are incapacitated before sticking and bleeding.	Foreman to review stunning methods with stunner.	Foreman
4) Sticking and Bleeding	All hogs are stunned before bleeding. Bleeding is performed in a sanitary manner.	Foremen to observe methods used by stunner every hour.	All hogs are stunned before sticking and bleeding. Sticking knife is sanitized after each use.	Foreman to review sticking and bleeding methods with stunner.	Foreman

HACCP System Item Check List

Date:

Product Name or Type:

Plant Section or Process:

Responsibility:

Monitoring Step	Time Checked	Lot or Batch Number	Comments	Action

HACCP System Item Check List

Date: **Jan. 1, 1996**

Product Name or Type: **Yum-Yum Sweet Ham**

Plant Section or Process: **Receiving and Slaughter**

Responsibility: **Joe Foreman**

Monitoring Step	Time Checked	Lot or Batch Number	Comments	Action
All hogs are properly stunned.	6:00 am	010196	OK	
	7:00 am		OK	
	8:00 am		OK	
	9:00 am		OK	
	10:00 am		Regular stunner went home sick. Relief stunner not properly stunning hogs before sticking.	Showed relief stunner how to stun hogs properly.
	11:00 am		OK	
	12:00 pm		OK	
	1:00 pm		OK	
	2:00 pm		OK	
	3:00 pm		End of Production	

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5. *Generic HACCP for Raw Beef,* Food Microbiology, Pages 449-488, 1993.
6. Good Manufacturing Practices - Fermented Dry and Semi-Dry Sausage, American Meat Institute, 1989.
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9. Microbial Control During Production of Ready-to-Eat Meat Products, American Meat Institute, 1988.
10. *Procedures to Implement the Hazard Analysis Critical Control Point System,* International Association of Milk, Food and Environmental Sanitarians, Inc. 1991.