DEVELOPMENT OF A HAZARD ANALYSIS CRITICAL CONTROL POINT (HACCP) MANUAL FOR CHICKEN SAUSAGES, CHICKEN MEATBALLS, CHICKEN HAM, COOKED HAM, STREAKY AND BACK BACON

by

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DECLARATION

This work described in this thesis carried out by me at the Cargills Quality Foods (Pvt.) Ltd, Colombo 15, under the supervision of Mrs. Nirupa Edirisinghe and Mrs. Indira Wickramasinghe. A report on this has not been submitted to any other university for another degree.

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MY PARENTS AND TEACHERS

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ABSTRACT

The Cargills Quality Foods (Pvt.) Ltd, being a confineable food company, where safe products are provided, among consumers, the HACCP system should be applied by the company. After application of this approach and by eliminating hazards such as biological, chemical and physical, consumers would receive a free safe food product. Hazard Analysis Critical Control Point (HACCP) is a systematic approach to the identification and assessment of the hazards and risks associated with a food operation in defining the means to their control.

HACCP manual was developed to establish such an effective system through identifying critical control points, deals with the manufacturing processes of meat based products. This approach is enriched by seven principles as analysis of potential hazards, determination of critical control points, establishment of monitoring procedures, verification procedures and establishment of record keeping and documentation.

After identification of all potential hazards from each and every raw material, ingredient and process step from receiving upto product distribution, the following critical control points were discovered. They are weighing of restricted ingredient (Nitrite: E 250), cooking in chamber, vacuum packaging and storage processes. Out of those steps, raw materials were covered under Supplier Quality Assurance (SQA). After chamber operation there was no any stage of addition of raw materials to processed products. That was the main element of controlling potential hazards associated with raw materials. Process steps were covered under Good Manufacturing Practices (GMPs).

Critical Limits of chicken sausages and chicken meatballs manufacturing processes were nitrite as 125mg per Kg of meat (maximum limit), cooking in chamber at 68°C for 23 second, vacuum packaging where there must not be any leaked product to leave and storage in blast freezer at –18°C for 3hrs. Critical limits of chicken ham and cooked ham manufacturing were nitrite as 125mg per Kg of meat (maximum limit), cooking in chamber at 64°C for 115 second. In vacuum packaging there must not be any leaked product to leave and storage in chiller at 10°C or below. Critical limits of streaky and back bacon manufacturing were nitrite as 125mg per Kg of meat (maximum limit), drying in chamber at 50°C for 30min and storage in blast freezer at –18°C for 3hrs.

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ABBREVIATION

HACCP	Hazard Analysis Critical Control Points
CCPs	Critical Control Points
CPs	Control Points
CLs	Critical Limits
GMPs	Good Manufacturing Practices
SQA	Supplier Quality Assurance
SOPs	Standard Operation Procedures
USDA	United State Department of Agriculture
FSIS	Food Safety Inspection Service
SLS	Sri Lanka Standards
NASA	National Aeronautics and Space Administration
US	United State
FDA	Food and Drug Administration
NAS	National Academy of Science
NACMCF	National Adversary Committee on Microbiological Criteria for Food
FAO	Food and Agriculture Organization
PCBs	Polychlorinated biphenyls
BHA	butylated hydroxyanisole
BHT	butylated hydroxytoluene
MDM	Mechanically Deboned Meat
MSM	Mechanically Separated Meat

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CHAPTER 01

1.1 INTRODUCTION

Nowadays consumers are well aware of their rights to buy safe and quality products and also the external pressure on companies to produce such products, by parties like Government, relevant authorities, media, local and international consumers, is very high. Applying a HACCP system to the chicken sausages, chicken meatballs, chicken ham, cooked ham, back bacon and streaky bacon at the Cargills Quality Food (Pvt.) Ltd will increase a substantial market share to the company and it will also reduce the cost of further inspection and testing on the end products. Since the initial setting up of a HACCP system is cost effective and failures could be identified in early stages to take corrective actions and it will bring lots of benefits to the company.

Hazard Analysis Critical Control Points (HACCP) is a Systematic approach and Scientific method to the identification of all potential hazards and risks associated with a food operation and implementation of activity to control of their hazards.

The concept of the Hazard Analysis Critical Control Points (HACCP) system is directly related to the Pillsbury Company's projects in food production and research for the United States Space Program. The main problem, however, was to come as close to 100% assurance as possible that the food products being produced for space use would not be contaminated with pathogens (either bacterial or viral), toxins, chemical, or physical hazards that could cause an illness or injury that might result in an aborted or catastrophic mission.

After that, food manufacturer has turned to produce hazards free food product with increasing confidence of consumer. Hazards associated with food are microbiological, physical and chemical which are felt into unacceptable contaminant, are glass, metal, stones, bones, wood, plastic, pests, and intrinsic material as physical hazards and chemical hazards are as Cleaning chemicals, pesticides, allergens, toxic metals, nitrites, nitrates and N-nitroso compounds, polychlorinated biphenyls (PCBs), chlorophenols and chloroanisoles, growth and survival of microorganisms and their toxins as biological hazards that would make food unsafe.

Food products, especially meat and meat products are sensitive to microbial contamination by bacteria, viruses and parasites. Meat and meat products are provided an excellent environment for growths of bacteria in case of meat are richer in nutritional compounds. Bacterial contamination and growth is a problem because it may result in foodborne illness. Product safety could be improved by application of a process control system known as "Hazard Analysis Critical Control Point" (HACCP). HACCP is a food safety management

system, which is bared seven principles to eliminate, control or prevent of all hazards related in receiving of entire raw materials to leaving of processed product to the consumer's hand. This food safety management system is matured with principles of Identification of hazards and their analysis, Determination of Critical Control Points, Establishment of Critical Limits, Establishment of Monitoring Procedures, Establishment of Corrective Actions, Verification Procedures and finally all of data are documented is called record keeping.

The success of HACCP concept depends upon the behavior and commitment of higher management to all plant employees to food safety and is also dependent upon the design and performance of facilities and equipment. Prerequisite programs are most of parts of hazards associated with food product able to cover before implementation of HACCP system in to the plant, Supplier Quality Assurance (SQA), Good Manufacturing Practices (GMPs) and Standard Operational Procedures (SOPs). The likelihood of the occurrence of a hazard in finished product is definitely influenced by facility and equipment design, construction, and installation, which play a key role in any preventive strategy. Management must provide financial and philosophical support to HACCP team members and employees because it demonstrates an awareness of the benefits of the program.

1.2 OBJECTIVES

1. Identification of all potential hazards associated with the processed meat products, chicken sausages, chicken meatballs, chicken ham, cooked ham, back bacon and streaky bacon.
2. Establishment of Critical Control Points for identified hazards.
3. Development of HACCP plan for each product by using Critical Control Points

CHAPTER 02

LITERATURE REVIEW

2.1The Origin and Concept of HACCP

2.1.1 Introduction

Hazard Analysis Critical Control Points (HACCP): Systematic approach to the identification and assessment of the hazards and risks associated with a food operation and the defining of the means to their control

The concept and reduction to practice of the Hazard Analysis Critical Control Points (HACCP) system is directly related to the Pillsbury Company's projects in food production and research for the United States Space Program. The basics were developed by the Pillsbury Company with the cooperation and participation of the National Aeronautics and Space Administration (NASA), the Natick Laboratories of the US Armed Forces, and the US Air Force Space Laboratory Project Group. Space program effort to produce a food that could be used under zero gravity conditions by astronauts. No one knew how food, especially particulates might act in zero gravity, and the initial conservative approach to solving this problem was to produce bite-sized foods covered with a flexible edible coating to prevent crumbling and consequent atmospheric contamination.

The main problem, however, was to come as close to 100% assurance as possible that the food products being produced for space use would not be contaminated with pathogens (either bacterial or viral), toxins, chemical, or physical hazards that could cause an illness or injury that might result in an aborted or catastrophic mission (Pearson and Dutson, 1999).

2.1.2 Development of the HACCP concept

This raised two equations. First, 'What could we do using new techniques that would help us approach the 100% assurance level?' Second, since food companies 'for good reason' did not practice this type of destructive testing. How much in the way of hazards was the industry missing by minimal tests of the raw materials, and in-line and end products test?' The latter question brought into serious doubt in the prevailing systems of quality control that was being used in Pillsbury's plants and by the food industry as a whole. The studies showed that most quality assurance programs were based on what the current quality assurance manager

believed were a good program. There was no uniformity of approach or even understanding in the food industry as to what constituted an excellent program.

In the search for answers, the zero defects program utilized by NASA was examined and was found to be designed for hardware. The type of testing that were used for hardware, using for example x-ray and ultrasound, were nondestructive and therefore suitable for that purpose, but not for food testing. In looking for better system, it was decided to try a new approach to the problem. It was concluded after extensive evaluation that the only way to the succeed would be to develop a preventative system. This would require control over the raw materials, the process, the environment, personnel, storage and distribution beginning as early in the system as possible.

It was test certain that if this type of control could be established, along with appropriate record keeping that a product that could be said to be safe with a high degree of assurance should be able to be produced. For all practical purposes, if it was done correctly, it should not require any testing of the final packaged product other than for monitoring purposes.

It should also be noted that the type of record keeping required under NASA rules not only furnished a clue as to how to approach the new system, but also facilitated the experimentation with this approach, and it is still a basic part of the HACCP system, as it now exists. Pillsbury were required by NASA contract to keep records that allowed traceability of the raw materials, the plant where the food was produced, the names of people involved in the production and any other information that might contribute to the history of the product; in other words, a mechanism for tracing problems back to the source. This required that a familiarity with the raw materials had to be developed, which was not being done at that time, in the normal process of food product development. For instance, in development of the HACCP system the latitude and longitude where the salmon used in salmon loaf were caught was known, as well as the name of the ship. It was by using this approach that the Hazard Analysis Critical Control Points (HACCP) system was developed (Pearson and Dutson, 1999).

2.1.3 Food Industry and HACCP Concept

Although started in 1959 and used in the Pillsbury Company production plants for several years, the HACCP system was first formally presented to the general public in the 1971 National Conference of Food Protection.

Following this conference, Pillsbury was granted a contract by the Food and Drug Administration (FDA) to conduct classes for FDA personnel on the HACCP system. The first comprehensive document on HACCP was published by the Pillsbury Company in 1973 and was used for training FDA inspectors in HACCP principles. A special session was also held with FDA personnel involved in acidified and low acid canned food regulations. This group developed the necessary information for promulgation of the acidified and low acid canned food regulation (FDA, 1973), which resulted in a successful HACCP system.

During the 1970's and early 1980's a number of companies requested and were given information and help in establishing their own HACCP programs. It was not until 1985 that the HACCP system was seriously considered for broad application nationally in the food industry. In that year, the HACCP system was recommended by the National Academy of Science NAS, 1985) in a publication entitled an evaluation of the role of microbiological criteria for food and food ingredients. The NAS committee concluded that a preventative system was essential for control of microbiological hazards and their conclusion was that end testing was not adequate to prevent food borne diseases (Pearson and Dutson, 1999).

2.1.4 Benefits of Implementing HACCP

To the company

- Production of safer food - lower business risk
- Improved/maintained reputation
- Compliance with legislation
- Staff have clearer ideas of food safety requirements and practices
- Demonstrates company commitment to food safety
- Better staff organization/use of time
- Long term reduction in wastage (in the short term wastage costs may go up due to corrective actions, requiring disposal of food as a result of failure to control CCPs properly)
- Less likely to receive customer complaints
- Possible increase in market access

To Customers

- Less risk of illness
- Improved quality of life

- Greater confidence in food
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To Government

- Facilitating food safety inspections/more efficient food control
- Improved public health/reduced health care costs
- Facilitates international trade

2.1.5 Drawbacks of Implementing HACCP

If HACCP is not properly applied, then it may not result in an effective control system. This may be due to improperly trained or untrained personnel not following the principles correctly; it may be that the outcome of the HACCP study is not implemented within the workplace; or it may be that the implemented system fails through lack of maintenance, eg: if a company implement a system and stops there, paying little or no need to changes that occur in the operation, then new hazard may be missed. The effectiveness may also be lost if the company carries out the hazard analysis and then tries to make its finding fit with existing controls.

If HACCP is carried out by only one person, rather than a multy-disciplinary team, or where it is done at the corporate level with little or no input from the processing facility. Some critics may say that HACCP is too narrow in that it focuses only on food safety; others say that it should only be used for microbiological safety. HACCP was designed for food safety and, safety should always come first, but the HACCP techniques are flexible and can be applied to other areas such as product quality, work practices and to products outsides the food industry (Mortimore and Wallace, 1998).

2.2The Stages of HACCP Concept

There is four stages could be considered when any company is ready to look at how to carry out the HACCP concept. There is logic sequence of HACCP study and plan development.

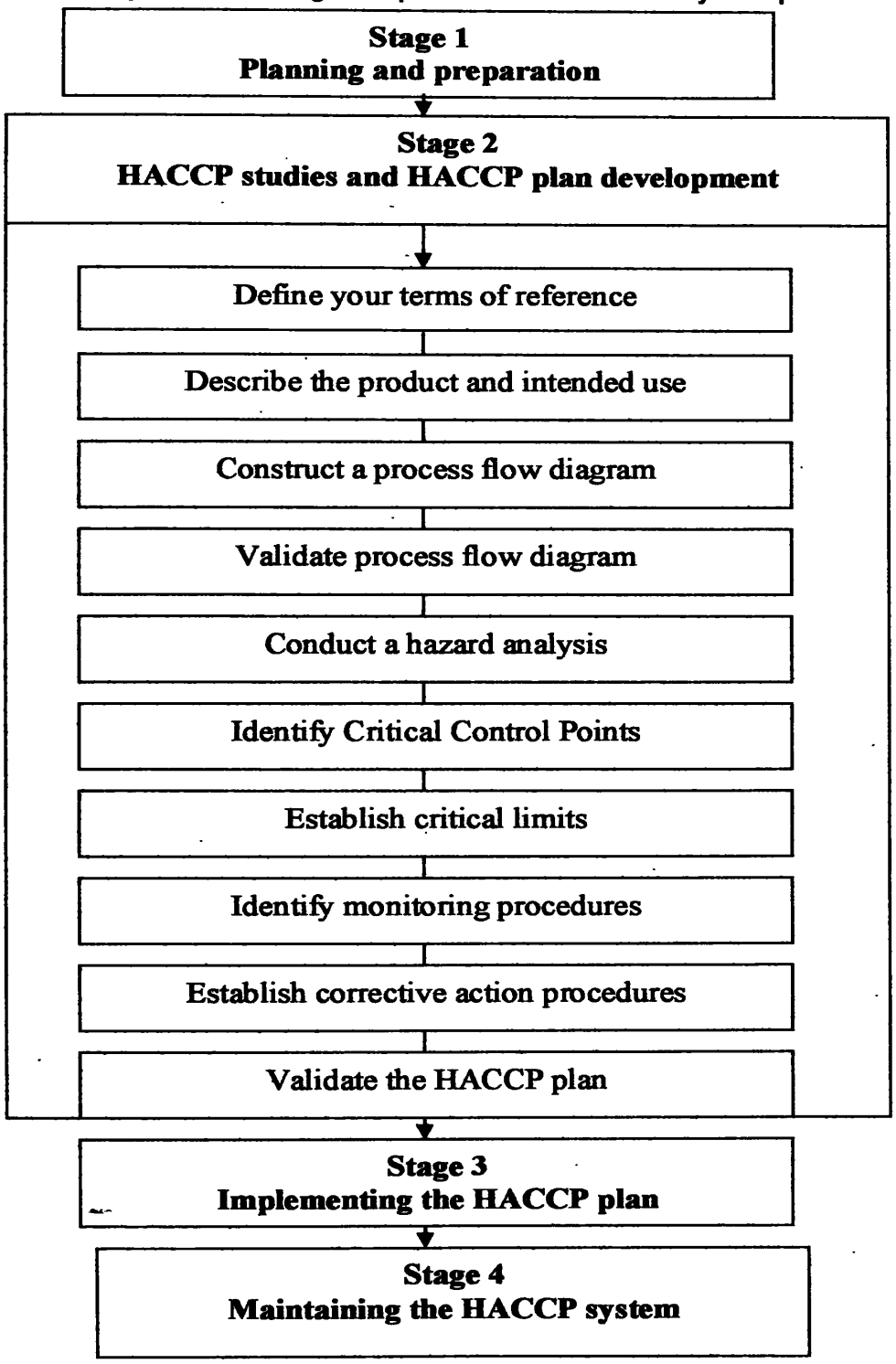


Figure: 2.1 The Stages of HACCP Concept

2.2.1The HACCP Team

Selection of HACCP team is the most important phase when developing and implementing HACCP concept for any food processing factory. HACCP is not carried out by one person alone but is the result of a multidisciplinary team effort. The HACCP team that consists of individuals who have specific knowledge or expertise on the operation's products and processes. It is not mandatory at this stage of development that team members have HACCP training. They should have specific or esoteric knowledge of the plant operations with responsibilities in different areas. The team may include personnel from maintenance, refrigeration, engineering, sanitation, quality assurance, laboratory, production or management. It is also recommended that outside experts in the areas of food microbiology, and microbial pathogens as well as chemical and physical hazards be included in the team or closely associated with the development and implementation of the HACCP concept (Mortimore and Wallace, 1998).

2.2.2 The Product Description

Plants are required to have a HACCP plan for each product they make. With each HACCP plan, a complete description of the product and the raw ingredients that go into the product are required. Some of the product description information that should be listed for each product includes:

- Product's common name
- How the product will be used
- Type of packaging material
- Length of product's shelf-life, and at what temperature
- Where product will be sold
- Product's labeling instructions
- Any special instructions for the product

2.2.3 Principles of HACCP Concept

The HACCP system consists of seven principles, which outline how to establish, implement and maintain a HACCP plan for the operation. The HACCP principles have international acceptance and details of this approach have been publish by the codex Alimentarius Commission (1993, 1997) and the National Advisory Committee on microbiological criteria for foods (NACMCF, 1993, 1997)

Principle 1: Hazard Analysis

Principle 2: Determine the Critical Control Points (CCPs)

Principle 3: Establish Critical Limits for control measures associated with each identified CCP

Principle 4: Establish a system to monitor control of the CCP, monitoring requirements for management of the CCP within its critical limits.

Principle 5: Establish the corrective actions to be taken when monitoring indicates that a particular CCP is not under control.

Principle 6: Establish procedures for verification to confirm that the HACCP system is working correctly.

Principle 7: Establish documentation concerning all procedures and records appropriate to these principles and their application (Mortimore and Wallace, 1998)

2.2.3.1 Principle 1: Hazard Analysis

Hazard analysis is "the process of collecting and evaluating information on hazards associated with the food under consideration to decide which are significant and must be addressed in the HACCP plan"

The hazard analysis for a specific food consists of a systematic evaluation of all raw materials, ingredients, and production steps; identification of hazards that are likely to occur; and consideration of control or preventive measures for the hazards.

The most rapidly evolving part of the HACCP system is the hazard analysis procedure. Hazard analysis is both the most of difficult and the most important part of the HACCP system. A poorly done or incomplete hazard analysis will cripple application of the remaining HACCP principles. Worse, it will compromise the safety of the food process.

In the USDA meat and poultry HACCP regulation, a hazard analysis is " the identification of any ha hazardous biological, chemical, or physical properties in raw materials and processing steps and an assessment of their likely occurrence and potential to cause food to be unsafe for consumption"

The basic three-step procedure for the HACCP team to use in conducting the hazard analysis on as specific food product and its process is;

- Prepare a list of steps in the process. This commonly includes listing raw materials and ingredients, process steps, and packing
- Identify potential or likely hazards at each step, biological, chemical, physical or combination of these.
- Describe the control measure(s) (Corlett Jr, 1998)

2.2.3.1.1 Hazards and their significance

2.2.3.1.1.1 Hazard

A biological, chemical or physical property, or condition of, food with the potential to cause an adverse health effect (Codex 1997)

A hazard is referred to as any factor that may be present in the product, which can cause harm to the consumer either through injury or illness. The basis of HACCP system is hazards may be biological, chemical or physical (Mortimore and Wallace, 1998).

2.2.3.1.1.1.1 Physical Hazards

These are the most common type of hazard to occur in foods in case of possible presence of foreign material. However, the risk of consumer injury is quite low for most type of foreign materials, as few items are sharp and could cause injury; items that are hard and could cause dental damage and items capable of blocking the airways and causing choking. The main food safety hazards are as glass, metal, stones, wood, plastic, pests, and intrinsic material eg: bones in meat products (Mortimore and Wallace, 1998).

2.2.3.1.1.1.2 Chemical Hazards

Chemical contamination of food stuffs can happen and any stage of their production, from growing of the raw materials. The effect of chemical contamination on the consumer can be long term (chronic), such as for accumulated chemicals (eg: Mercury) which can buildup in the body for many years, or it can be short term (acute), such as the effect of allergenic foods eg: Cleaning chemicals, pesticides, allergens, toxic metals, nitrites, nitrates and N-nitroso compounds, polychlorinated biphenyls (PCBs), chlorophenols and chloroanisoles (Mortimore and Wallace, 1998).

2.2.3.1.1.1.3 Biological Hazards

Biological hazards usually present the greatest and broadest danger to consumers. When a pathogenic microorganism grows in a food product, it can cause illness in many hundreds or thousands of consumers. Some of these illnesses can be quite serious, even fatal.

During the process or from the raw materials biological hazards will be risk at one or more times. These hazards can be either macro biological or microbiological. Macro biological issues, such as the presence of flies or insects, while unpleasant if found, rarely pose a risk themselves to product safety in its true sense. They may be the an indirect risk by harboring pathogenic microorganisms and introducing these to the product.

It is usual to consider macro biological issues as foreign material or physical contaminants, rather than biological hazards. Pathogenic or disease-causing microorganisms exert their effect either directly or indirectly on humans. Direct effects result from an infection or invasion of body tissues and are caused by the organism itself eg: bacteria, viruses and parasites/protozoa. Indirect effects are caused by the formation of toxins (or poisons) that are usually pre-formed in the food by bacteria and moulds. Eg: Pathogenic Gram-negative bacteria *Salmonella, Shigella, E. coli, Camphylobacter jejuni, Vibrio parahuemolyticus, Vibrio vulnificus* and *Yersina enterocolitica* and Pathogenic Gram-positive bacteria *Clostridium botulinum, Clostridium perfringens, Bacillus cereus, Staphylococcus aureus* and *Listeria monocytogenes* (Mortimore and Wallace, 1998).

Table 2.1 Factors contributing to microbiological food poisoning

Number of outbreaks in which factors recorded (%)		
Contributing Factors	***Salmonella***	***Staphylococcus aureus***
Preparation too far in advance	240 (42)	80 (48)
Storage at ambient temperature	172 (30)	75 (45)
Inadequate cooling	125 (22)	12 (7)
Inadequate reheating	76 (13)	5 (3)
Contaminated processed food	100 (19)	27 (16)
Undercooking	139 (25)	2 (1)
Contaminated canned food	2 (<1)	42 (25)
Inadequate thawing	61 (11)	
Cross contamination	84 (15)	2 (1)
Row food consumed	84 (15)	1 (<1)
Improper warm holding	15 (3)	
Infected food handlers	13 (2)	50 (30)
Use of leftovers	25 (4)	11 (7)
Extra large quantities prepared	29 (5)	2 (1)
Total	566	166

Source: (Mortimore and Wallace, 1998, HACCP a practical approach).

Table 2.2 Guide to potential microbiological, chemical, and physical hazards

Hazard or Complaint-Related Spoilage			
Material and Ingredients	**Microbiological**	**Chemical**	**Physical**
Food chemicals (ingredients, flavors, antioxidants, salt)	Not usually	Toxin if in high concern or contaminated with toxic chemicals	Metal (wire), glass, foreign objects
Food preservatives (benzoates, sorbates)	Not usually	Toxin if in high concern or contaminated with toxic chemicals	Metal (wire), glass, foreign objects
Packaging	Spoilage flora; leakage and recontamination with harmful microbes	Toxic chemicals from; ink, paint, packaging films, adhesives, lubricants, etc	Misc.
Product related	Any hazardous microorganism from process system, environment (dust, air, floor, drains, etc) and ingredients	Chemicals from environment or ingredients	May sources; ingredients, system, environment, people
Row meat and poultry	*Salmonella* sp:*Listeria monocytogenus, Escherchia coli* (pathogenic type; 0157:H7), *Staphylococcus aureus*, other bacteria and viral pathogens, parasites	Pesticides, antibodies, hormones, heavy metals, cleaning chemicals, natural chemicals	Metal, glass, bone, foreign objects
Water	Bacteria and viral pathogens, protozoa and parasites	Environmental chemical, heavy metals, nitrites, etc	Not usually

Source: (Corleff, Jr, 1998, HACCP User's manual).

2.2.3.1.2 Definition of Control Measures

Any factor or activity, which can be used to prevent, eliminate or reduce to an acceptable level, a food safety hazard.
When evaluating control measures it is necessary to consider what the company already has in place and what new measures may need to be put in place. More than one control measure may be required to control a hazard, which occurs at different stages of the process. Similarly, more than one hazard might be effectively controlled by one control measure, e.g. two microbiological pathogens by a heat process (Mortimore and Wallace, 1998).

2.2.3.1.2.1 Relationship of HACCP plan and prerequisite programs

If the prerequisite systems have been well designed and are in working order before we commence the HACCP process, then there may be fewer hazards to contend with in the operation than would otherwise potentially be present. Basically, the prerequisite programs reduce the day-to-day likelihood of the hazard occurring (Mortimore and Wallace, 1998).

2.2.3.1.2.1.1 Good Manufacturing Practices (GMPs)

Good Manufacturing Practice manages cross contamination, which is the risk of product safety occurring during the process from the internal factory environment. Cross contamination could arise from a wide range of sources and the inherent risks in a particular processing area must be understood. Layout, building, equipment, people, cleaning, chemicals, raw materials, storage, products and packaging, which are some of the main sources of potential cross contamination (Mortimore and Wallace, 1998).

2.2.3.1.2.1.2 Supplier Quality Assurance (SQA)

When we are going to make a safe product initial focus alongside HACCP development is raw material safety. Most of hazards are associated with raw materials. If in the company or by consumer cannot control the hazards, particularly important to know that the supplier is controlling hazards. There are a number of different elements to an effective SQA program, including having agreed specifications, auditing suppliers and certificates of analysis. Supplier approval will depend on having confidence in the supplier's operation; that the supplier is competent at managing the hazards prevent. It is therefore vital to developed

good customer/supplier relationship-partners in the management of safe raw materials and products (Mortimore and Wallace, 1998).

2.2.3.2 Principle 2: Determine the Critical Control Points (CCPs)

A Critical Control Point (CCP) was defined in the 1997 NACMCF HACCP system as "a step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level."

CCPs must be carefully developed and documented. They must be used only for purposes of product safety or where use must be justified by the critical nature of the CCP. CCPs should not be confused with control points (CPs) that don't control safety. For comparison, a CP is defined as " any step at which biological, chemical or physical factors can be controlled"

Critical Control Points (CCPs) may be located at any point in the food production and manufacturing system for a food product where hazards need to be prevented, eliminated or reduced to acceptable levels. For example, a CCP could be a specific heat process, based on a scientifically based time and temperature to destroy a specific microbiological pathogen in a specific food. Likewise, refrigeration required preventing hazardous microorganisms from multiplying, or the adjustment of a food to a ph necessary to prevent growth and toxin formation is also CCPs. Other examples of CCPs may include, but are not limited to: cooking, chilling, specific sanitation procedures, product formulation control, prevention of cross-contamination, and certain aspects of employee and environmental hygiene. CCPs may also include measures intended to prevent chemical hazards, such as washing; or measures intended to prevent physical hazards, such as metal detector on the packaging line.

Examination of the hazard analysis results will generally categorize each step into one of the three following classes:

- Steps and their control measures that are CCPs
- Steps and their control measures those are critical for product safety but fall under the Sop's. These must be labeled Sop's and require monitoring, corrective action, verification and record0keeping within the SSOP program
- Steps that don't require CCPs because hazards are taken care of at a later step, or there are no food safety hazards

The purpose of the decision tree is to identify CCP's and to separate them from no safety related controls. It should be applied systematically to the hazard analysis previously conducted on a food product. However, the decision tree is not a substitute for expert knowledge (Corlett Jr, 1998).

2.2.3.3 Principle 3: Establish Critical Limits

A critical limit is defined as " the maximum or minimum value to which a physical, biological or chemical parameters must be controlled at a critical control point to prevent, eliminate or reduce to an acceptable level the occurrence of the identified food safety hazards"
Critical limit must be based on authoritative technical information demonstrating the effectiveness of the critical limit(s) in preventing, eliminating or reducing a hazard to an acceptable level. Persons who provide this expertise for canned food process-determination, and may also be qualified to experimentally determine critical limit parameters for other controlled processes, are called process authorities. Authoritative critical limit information is becoming available for some foods such as meat and poultry products under USDA jurisdiction.
When critical limit information is not available, the HACCP team must obtain it from an authoritative source such as regulatory agencies, universities, groups such as trade associations, international Meat and Poultry HACCP Alliance, technical laboratories and consultants (Corlett Jr, 1998).

2.2.3.4 Principle 4: Establish Monitoring Procedures

The monitoring of a CCP involves the scheduled testing or observation of a CCP and its limits; monitoring results must be documented. If for example the temperature for certain process steps should not exceed 40oc.A chart recorder may be installed. Microbial counts generally are not satisfactory at this point since too much time is required for results. Physical and chemical parameters such as time, temperature, ph and water activity can be tested and results obtained immediately.
Sampling and microbiological testing is usually not adequate by themselves to ensure food safety. Microbiological testing is seldom effective for monitoring CCPs and cannot be used as means of process control because of the lengthiness of analytical procedures and the inability to provide results in real time. In addition detection of pathogenic microorganisms can be difficult if contamination of the product at the CCPs at a low level or is unevenly distributed in the food sample, necessitating large and numerous samples. (FAO, 1998)

Monitoring of HACCP systems must be much more intensive than in non-safety system such as the quality system. Failure of a CCP leads to illness, injury or death to the persons using the product. There is two types of monitoring procedures which are continuous monitoring, eg: records and charts to continuously record temperature and time of a cooking step, and non-continuous monitoring, eg: visual inspection of any CCP where this type of monitoring is effective such as cleaning of equipment, sanitation, employee food handling, employee hygiene and dress, damage inspection, or gross evidence of rodent or insect inspection.
The three basic requirements for developing monitoring procedures for the HACCP plan are;

- Defining the monitoring procedure
- Determining the frequency for monitoring
- Determining who will do the monitoring (Corlett Jr, 1998).

2.2.3.5 Principle 5: Establish Corrective Actions

Corrective actions must be taken if monitoring indicates that any of the critical limits for a CCP are out of control. Corrective action is defined as " any action to be taken when the results of monitoring at the CCP indicate a loss of control" (Codex 1997)
The HACCP system is designed to control or to prevent all identified hazards by the application of the CCP and critical limits. However, various types of failures and deviations may be expected to occur. Corrective action is required to prevent a health hazard and to bring the food system back into the safe control.
Corrective actions should include three elements;

- Determine and correct the cause of non-compliance
- Determine the disposition of non-compliant product
- Record the corrective actions that have been taken

Qualified persons who understand the process, the product and the HACCP plan should take corrective actions.
The development of corrective action procedure language in the HACCP plan may be based on the following actions:

- Reject incoming raw materials or ingredients (before receipt)
- Store the line (for critical limits on the production line)
- Place product on hold
- Insure that held product is properly identified and stored
- Determine the cause of the deviation
- Correct the cause of the deviation
- Make safe disposition of held product

- Designate and assign qualified persons to be responsible for these actions
- Keep records and document with proper initials/signatures, time and date
- Have records approved and dated

Held qualified persons must always evaluate product who are knowledgeable in the investigation and safe handling of product deviations.

- Release (when no hazard was found to exist)
- Rework/recondition (when this may be safely done)
- Use as a by product (such as approved addition to animal feed)
- Destroy (Corlett Jr, 1998).

2.2.3.6 Principle 6: Establish Verification Procedures

Verification is defined as "establish procedures for verification that the HACCP system is working correctly"

The elements of verification that need to be entered into the HACCP plan at each CCP consists primarily of;

1. The frequency of the verification inspections and audits and who will do the audits. Audits may be conducted internally by line supervisors and the HACCP team, and externally by the quality assurance department or independent audits.
2. The person(s) selected should have successfully completed a course of instruction on HACCP, or be a responsible official of the company.
3. Procedures that verify that a CCP and its critical limits are under control and monitoring equipment are calibrated and operating correctly. Specific items verified may include:

- Compliance to critical limits from review of monitoring records
- Effectiveness of sampling conducted at CCP
- Accuracy of temperature and timing devices
- Whether the critical limits correspond to plant records
- Whether the critical limits are adequate for the hazard
- Whether control actions are adequate
- Whether records were kept, initialed and dated
- Whether records were approved and dated

4. Sampling and testing to verify the safety of CCPs and limits. Testing may be physical, biological or chemical.
5. Any other specific verification procedures or tests that should be listed in the HACCP plan to verify the specific CCP and its associated critical limits (Corlett Jr, 1998).

2.2.3.7 Principle 7: Establish Record Keeping and Documentation Procedures

The HACCP plan must be well documented and at the food establishment and must be made available to official inspectors upon request. Forms for recording and documenting the system may be developed or standard forms may be used with necessary modification. Typically these may be forms that are completed on a regular basis and filed away. The forms should provide documentation for all ingredients, processing steps, packaging, storage and distribution (Corlett Jr, 1998).

2.3 Processed meat and food safety issues

Meat and meat products are defined as raw meat and processed meat product which is the meat ,mixed with salt ,spices like seasoning agents.Processed meat could be classified as mainly three types, such as Sausages, Cured meat, Ham and Bacon, and Miscellanes products eg: Meatball.

When manufacturing of meat and meat products could cause contaminates with any type of hazards,glass, metal, stones, bones, wood, plastic, pests, and intrinsic material as physical hazards and chemical hazards are as Cleaning chemicals, pesticides, allergens, toxic metals, nitrites, nitrates and N-nitroso compounds, polychlorinated biphenyls (PCBs), chlorophenols and chloroanisoles, growth and survival of microorganisms, *Escherchia coli, Staplylococcus aureus, Salmoneelae*,etc and their toxins as biological hazards that would make food unsafe.

The chemical hazard which is present in the processed meat product is NO_3^- level.The food processing company should have a responsibility to control above hazards in to the acceptable level in order to give a good safety to their products (Mortimore and Wallace, 1998).

2.3.1 Raw Materials and Restricted Ingredients

2.3.1.1 Spices

Spices and herbs have been used for thousands of centuries by many cultures to enhance the flavor and aroma of foods. The growth of both Gram-positive and Gram-negative foodborne bacteria, yeast. and mold can be inhibited by garlic, onion, cinnamon, cloves, thyme, sage, and other spices. Effects of the presence of these spices / herbs can be seen in food products such as meat products. The fat, protein, water, and salt contents of food influence microbial resistance. Spices and herbs may be contaminated because of conditions in which they were grown and harvested. Spores of both *Clostridium perfringens*

and *Bacillus cereus* have been found to be present in spices and herbs. Contaminated spices cause foodborne illness and spoilage. Fewer microorganisms are present in spices with higher antimicrobial activity example as cloves. Spices and herbs harbor microbial contaminants. Spices and herbs may serve as substrates for microbial growth and toxin production. Amounts of spices and herbs added to foods are generally too low to prevent spoilage by microorganisms (Snyder, 1997).

Table 2.3 Inhibitory Effects of Spices and Herbs

Spice/ Herb	**Microorganisms**
Garlic	*Salmonella typhymurium, Escherichia coli, Staphylococcus aureus, Bacillus cereus, Bacillus subtilis,* mycotoxigenic *Aspergillus, Candida albicans*
Cinnamon	Mycotoxigenic *Aspergillus, Aspergillus parasiticus*
Cloves	Mycotoxigenic *Aspergillus*

Source: (Snyder, Hospitality Institute of Technology and Management;St. Paul, Minnesota, 1997).

2.3.1.2 Antioxidants

Substances used to preserve food by retarding deterioration, rancidity, or discoloration due to oxidation. The most commonly used antioxidant formulations contain combination of BHA (butylated hydroxyanisole), and BHT (butylated hydroxytoluene), and prophy gallate. Antioxidants are effective at low concentration, that is, 0.02 percent or less (Igoe and Hui, 1997).

2.3.1.3 Preservatives

Antimicrobial agents used to preserve food by preventing growth of microorganisms and subsequent spoilage, including fungicides, mold and rope inhibitors. The preservatives most widely used are the benzoates, sorbates and the propionates, which are organic acids or their salts. Acidulants are used as preservatives because the they increase the acidity of foods, which can reduce growth of bacteria. Acidulants used include acitic acids,adipic acid, citric acid, fumaric acid, lactic acid, and phosphoric acid(Igoe and Hui, 1997).

2.3.1.4 Nitrites and Nitrates

Nitrite is the salt of the nitrous acid and Nitrates is the salt of nitric acid. These are used in meat curing to develop and stabilize the pink color associated with cured meat. Nitrite also plays a role to affect flavor and function as an antioxidant. Nitrites convert to nitric oxide, which reacts with the myoglobin pigments (purple-red) to form nitro-somyoglobin (dark red). Nitrosomyoglobin plus heating to 130°F to 140°F results in the formation of the stable pigment nitrosohemochrome, resulting in the cured meat color. It has bacteriostatic properties as an inhibitor of especially *Clostridium botulinum.* (Igoe and Hui, 1997)

Addition of nitrite and nitrate to food is closely governed by legislation as high levels of nitrites, nitrates and *N*-nitroso compounds in food can produce a variety of toxic effects. Specific examples include infantile methaemoglobinaemia and carcinogenic effects. The HACCP team must ensure that nitrite and nitrate being added to products do not exceed the legal, safe levels and must give appropriate consideration to the risk of contamination from other sources and ingredients, giving an increased overall level
(Mortimore and Wallace, 1998).

2.3.2 Basic operations during process

2.3.2.1 Refrigeration

Refrigeration is the most commonly used method for carcasses immediately after slaughter, during transport and storage and for packed meat (cuts and ground meat). At refrigeration temperature (4°C) the shelf life of properly packed retail meat is 72h, after which some discoloration can be expected to appear, while the shelf life of ground meat is for only one day (Fellows, 1998).

Temperature, airflow and humidity will play a vital role in the efficient management of chilling rooms. In modern practices, carcasses chilling rooms are normally operated in the temperature range of –2°C to –4°C (28°F -25°F) with relative humidity of 88-92%, shrinkage loss from the carcass is in the range of 1-2% (Davies , 1998).

2.3.2.2 Freezing

Freezing is an effective method of storing cuts of large carcasses, whole small carcasses, retail cuts in fresh stage for extended periods and meat products such as sausages, meatballs. Consumer prefers to see the appearance of the product. Frozen meat will not give the appearance of fresh meat due to the ice crystal formation on the meat surface. Meat freeze between –1.5°C and –7°C. The recommended temperature for frozen meat is –18°C (0°F). Blast freezes temperature lies between –30°C and –40°C. In freezing temperature, microorganisms are subjected to stress that is some cells may express no detrimental effects, some are killed, and some may undergo sub lethal or metabolic injury.Freezing can be used to destroy *Trichinella spiralis* and protozoa also are destroyed at temperatures below –5°C (Davies , 1998).

2.3.2.3 Vacuum Packaging

The complete removal of oxygen from a pack of meat ensures longer preservation against microbial deterioration than packaging in oxygen but the color of the meat becomes darker and purplish. On opening the package, oxygen becomes available at the surface and the meat color reverts to the desirable red color (Paine and Paine, 1992).

2.3.2.4 Cooking

A variety of batch and continuous cooking methods are used for perishable cooked ready-to-eat meat and meat products. These methods include cooking in vats of water or oil or cooking in ovens for a specific time. The product may be cooked in plastic bags, cans, casings, molds and pans or exposed with no protective covering. The method of cooking influences the rate of heat penetration and the variability of the thermal process. The cooking process must be controlled to achieve the food safety goals.

- To prevent excessive microbial multiplication during heating, before lethal temperatures are reached, pathogens can multiply during very slow heating in the range of 10°C to 52°C (50°F to 126°F) when lethal temperatures are reached then the vegetative cells would be destroyed.
- Dehydration during the initial phase of heating especially at the product's surface, which is not sealed in a container or plastic film. The reduction in water activity at the surface of the product can result in increased heat resistance and survival of pathogens (eg: *Salmonellae*)

- To heat the product to the required minimum internal temperature throughout the product. This may also require holding the product at a minimum internal temperature for a specific time. This is the simplest approach to assuring microbiological safety (Pearson and Dutson, 1998).

2.3.2.5 Cooling/Showering with water

Cooling is important because initially it is a contamination of the cooking process and also important because multiplication from germinated surviving spores must be controlled. Below 20°C (68°F) mesophilic spore forming pathogens multiply slowly. The pathogenic mesophilic spore formers, which are likely to occur in cooked meat and poultry products, do not multiply below 10°C (50°F). Products which are to be vacuumed packed must be chilled before packaging to avoid loose film. Imperfect seals can result in the uptake of water into the products; therefore, the cooling water must be controlled (eg: potable, chlorinated) to minimize the risk of microbial contamination (Pearson and Dutson, 1998).

2.3.2.6 Smoking

Smoking and cooking, which are generally carried out together, are also involved in development of color. This true for the development of cured meat color, which is stabilized by heating. The brown color developed on the surface of many-processed meat products are also enhanced by smoking. The chemical components most found in wood smoke include phenols, organic acids, alcohols, carbonyls, hydrocarbons, and some gaseous components such as carbon dioxide, carbon monoxide, oxygen, nitrogen, and nitrous oxide.
By almost components especially phenol acts as an antioxidants, contributes to color and flavor of smoked products, have a bacteriostatic effect that contribute to preservation (Pearson and Gillett, 1997).

2.3.2.7 Multy-Needle Stitch Pumping

This is one of curing methods used in meat industry. Formulated pickle solution is injected into the muscle by using multiple needles. There are several models of machines for injecting the cure into bellies, loins, and hams. Most injection equipment contains a serious of offset needles. Pickle is pumped until the desired weight is obtained. Since these included additives, growth and multiplication of pathogenic microbes are slowed. If

If there is over limited quantity of pickle injected into the muscle, it may be health risk for consumption (Pearson and Gillett, 1997)

2.3.3 Pathogens associated with processed meat

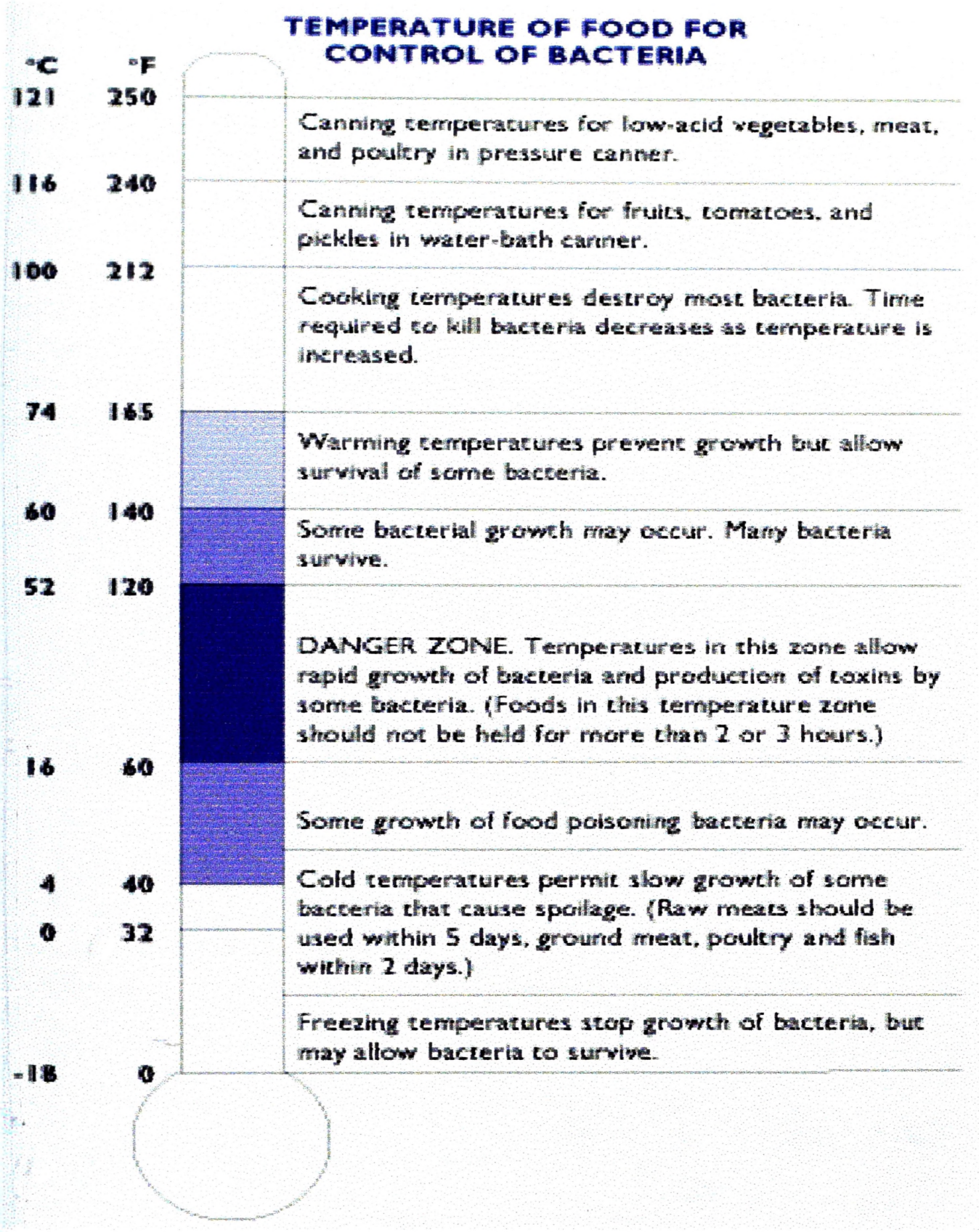


Figure: 2.2 Temperatures, affecting for bacteria

2.3.3.1 *Salmonellae*

The main reservoir for Salmonellae is the intestinal tract of animals. Meat and poultry products are thus prime offenders. As many as half of healthy poultry and one quarter of healthy cattle have been showed to harbor this organism. Poor food handling practices can also introduce the organism.

Salmonellae can thrive in many foods because of their simple nutritional requirements and ability to grow under both aerobic and anaerobic conditions. Furthermore, they can exist over a diverse range of ph and temperature. Most strains are heat sensitive, although some strains isolated from meat exhibits heat resistance. Drying or freezing does not kill all of them. Some stains can grow slowly at moderate refrigeration temperatures eg: over 45°F.

The organism is found in many foods because of cross contamination. Improperly cleaned countertops, cutting boards, and cutting utensils used for uncooked meat and poultry may serve to inoculate other foods. Salmonellae quickly reached hazardous levels during the growing period (Jones, 1998).

Table 2.4 *Salmonella's* growth of various temperatures

Temperature Range	**Category**
65°C	Organism growth
46°C -65°C	No growth
36°C	Fastest growth occurs
5°C -46°C	Growth
Below 5°C	Little or no growth of most species, but most species are not killed by freezing temperature

Source: (Jones, 1998, Food Safety).

Table 2.5 D values of *salmonella typhinurium*

Temperature	D value (minutes)
62.8°C	0.11
71.7°C	0.003

Source: (Shapton and Shapton, 1991, Safe Processing of Food).

2.3.3.2 *Staphylococcus aureus*

Non-motile, Gram positive, Spherical or avoid in shape, aerobic and facultative anaerobic bacteria is a major cause of food borne disease in many parts of the world. Ubiquitous is in man's environment. The primary habitat is on the skin, and in the nose and throat of man and animals. A large proportion of healthy people carry *Staphylococcus aureus*. Nasal carries form 40-44% of the population. Hand carriers vary from 14 to 40%. *Staphylococcus aureus* can also establish itself on food processing equipment and are not removed during CIP treatment of equipment (Jones, 1998).

In human the main source of *Staphylococcus aureus* is the nasal cavity. From this source the organism finds its way to the skin and in to wounds either directly or indirectly. The most common skin sources are the arms, hands and the face. In addition to the skin and the nasal cavities *Staphylococcus aureus* may be found in the eye, throat and the intestinal tract. From the sources the organism finds its way in to air and dust, in to clothing and in other places from which it may contaminate foods. (Jay, 1992)

Approximately 60% of the strains of *Staphylococcus aureus* produce toxin and illness is cause by ingesting food which already contains *Staphylococcus aureus* in the food. The population of *Staphylococcus aureus* needs to have reached a level of $5*10^6$ per gram before sufficient toxin is produced. However, since the toxin is heat stable, and growth may have occurred before any heat processing stage, the food may not contain any living Parameters for development *Staphylococcus aureus* cells. Ingestion of 1ng per g is thought to be sufficient to cause illness. (Jones, 1998)

Table 2.6 Parameters for development of *Staphylococcus aureus*

	Minimum	Optimum	Maximum
Temperature (°C)	11	37	48
P^h	4	6-7	9.8-10
a_w	0.86	0.98	0.99

Source: (Shapton and Shapton, 1991, Safe processing of Food).

Table 2.7 Parameters for toxin production of *Staphylococcus aureus*

	Minimum	Optimum	Maximum
Temperature (°C)	10	40-45	48
pH	4	7-8	9.6
a_w	0.85	0.98	0.99

Source: (Shapton and Shapton, 1991, Safe processing of Food).

2.3.3.3 *Eschechia coli*

Eschechia coli is a common resident of the intestinal tract of warm-blooded animals. For many years, the organism was thought to be harmless but was used as a marker organism to provide evidence of the non-sanitary handling of food and equipment. Some strains of *Eschechia coli* cause enteric diseases, diarrhea and gastrointestinal illness due to poor sanitary conditions. Some strains can survive long periods of frozen storage but are very sensitive to thermal inactivation. Sanitary food handling is essential to minimize infection by this organism, as the human gut is the only source for certain strains. The animal's gut may be the source of meat contamination. Even under the slaughter conditions, animal carcasses may regularly be contaminated with *Eschechia coli* from the animal's bowel.

Codes of GMP that have been set down for food industry are useful in preventing contamination by this microorganism, since some strains can grow at refrigerator temperatures and some may have picked up antibiotic resistance. Adequate cooking is the other way to avoid this infection. As with all raw meat products, it is crucial to avoid cross contamination from cutting boards and equipment (Jones, 1998).

Table 2.8 Limiting conditions for *Eschechia coli* growth

Minimum aw	0.93-0.95
Minimum ph	3.6-4.7
Maximum ph	9.5
Maximum % salt	7.5-8
Minimum temperature	0.6-3oC
Maximum temperature	45oC
Oxygen requirement	Facultative anaerobic

Source: (Corlett, jr, 1998, HACCP User's manual).

CHAPTER 03

METHOD AND METHODOLOGY

3.1 Identification of the task of HACCP study and Scope of the Company

Most consumers preferred processed meat products, at Cargills Quality Foods (Pvt.) Ltd were identified by getting crossed of documented data. Those products were subjected to apply HACCP concept and also Scope of the Company was recognized.

3.2 Identification of HACCP Team

HACCP team members were selected of multy-disciplinary personnel in the company. They had specific knowledge or expertise on the operation's products and processes.

3.3 Product description and intended use

Each and every selected meat products and intended use were described under product specification, packaging materials, restricted ingredients and others with their food safety category.

3.4 Construction of process flow diagrams

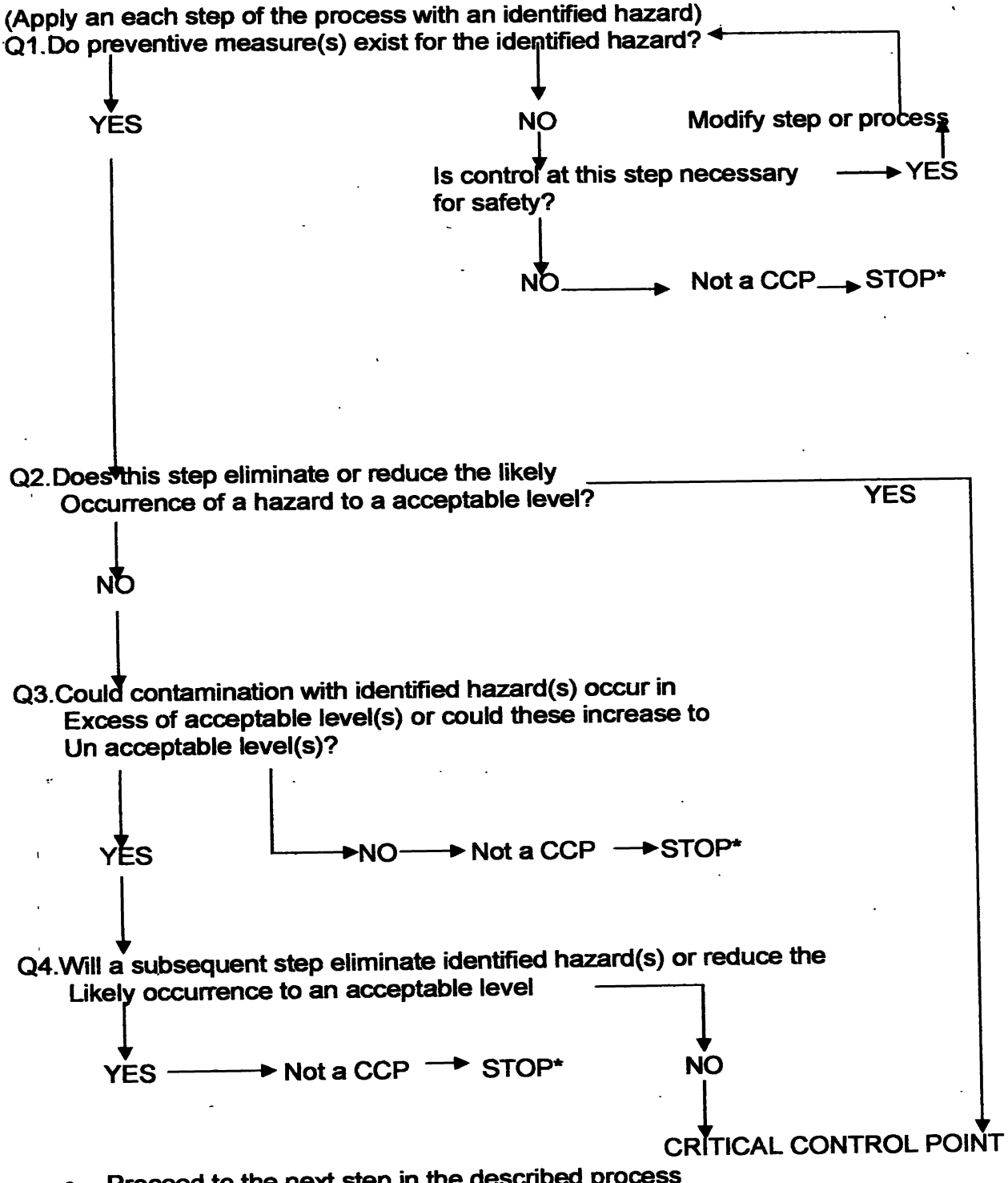
Process flow diagrams were drawn including all steps of processing line with relevant parameters.

3.5 Identification of hazards and hazard analysis

Under this step, all potential hazards, biological, chemical and physical of each and every raw material, ingredients, process steps were individually identified. Then identified potential hazards were seriously covered by control measures, which were Supplier Quality Assurance and Good Manufacturing Practices. Finally analyzed hazards of each step were listed.

3.6 Determination of Critical Control Points

Critical Control Points were determined by application of the Decision Tree (Codex 1997) (Mortimore and Wallace, 1998).



- Proceed to the next step in the described process

Figure 3.1: Decision Tree (Codex 1997)

3.7 Preparation of the HACCP Control Chart

3.7.1 Establishment of Critical Limits

Information from various sources, scientific publications, research data, regulatory requirements and guidelines of SLS and experts were taken to establish critical limits for identified CCPs. Critical limits were chemical limits, physical limits, procedurals limits and microbiological limits. Target levels which are the limits, however, there is time to be got action and reduce the rise of a deviation, also were established.

3.7.2 Identification of Monitoring Procedures

Continuous basis was better than batch basis for monitoring procedures were established for identified CCPs. How to monitor, who is the responsible person(s) and frequency of monitoring were included in this column.

3.7.3 Establishment of Corrective Action Procedures

Corrective Action Procedures were established for each CCP when deviations of critical limits are takenplace.

3.7.4 Establishment of Verification Procedures

Verification procedure(s) and responsible person(s) of the verification column at each CCP were established.

3.7.5 Documentation and Records

Necessary all of records of HACCP plan were named in a column of HACCP control chart.

CHAPTER 04

RESULTS AND DISCUSSION

4.1. RESULTS

4.1.1 Scope of the HACCP study

All hazards, biological, physical and chemical were identified and developed HACCP manual for selected processed meat products.

4.1.2 Scope of the company

Being a market oriented company the scope included: production of value added meat based food products such as sausages, meatballs, ham, bacon for the catering and retail outlets in market.

The basic quality mission is to meet the quality requirements of consumers throughout products and service. The success of activities depends on having the proper aims and adequate resources at the right time and place and on the proper use of all such resources and facilities.

4.1.3 HACCP team members

The Executive Director
Production Manager
Production Executives
Production Supervisors
Marketing Manager
Quality Assurance Manager
Quality Assurance Executives
Maintenance Staff

4.1.4 Chicken Sausages

4.1.4.1 Product Description and Intended use

4.1.4.1.1 Ingredients

4.1.4.1.1.1 Restricted Ingredients

Nitrite (E 250)
Mono Sodium Glutamate (MSG)

4.1.4.1.1.2 Other Ingredients

Spices

Iodized Salt

Sugar (Glucose)

Flavor Enhancer (E 621)

Permitted coloring (E 161)

Refined palm oil

Soya protein

Rusk powder

Full cream milk powder

4.1.4.1.2 Packing Materials

Low Density Polyethylene (LDP)

4.1.4.1.3 Product Specification.

4.1.4.1.3.1 Microbiology

TPC (cfu/g)	: $1x10^5$
E. coli (1g)	:Absent
S. aureus (1g)	: Absent
Salmonellae (25g)	:Absent

4.1.4.1.3.2 Chemistry

NaCl content	: 2.5% by mass (max.)
Total meat content	: 60% by mass (min.)
Nitrite content	: 125ppm (max.)
Fat content	: 10% by mass (max.)

4.1.4.1.4 Pack size

150g, 250g and 1kg as vacuum pack

4.1.4.1.5 Shelf life

6 month from the date of manufacture
Storage and distribute at freeze condition

4.1.4.1.6 Intended Use

General public consumer instructions are as follows:

Keep Freeze temperature until ready to use

Defrost fully, and then fry or toss in a curry, pre-cooked, no need to boil

4.1.4.2 Process Flow Diagram-Chicken Sausages

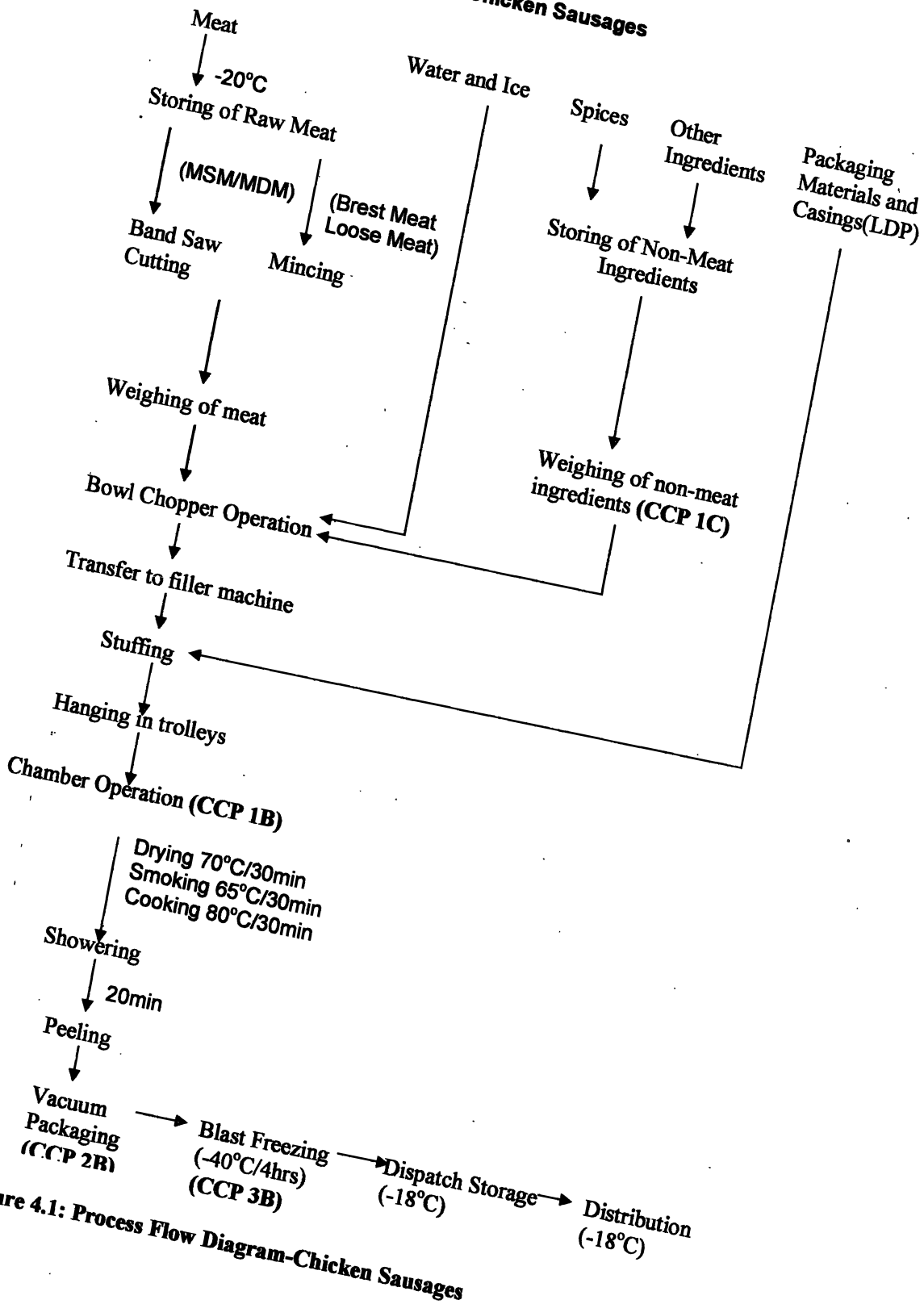


Figure 4.1: Process Flow Diagram-Chicken Sausages

Table 4.1: Hazard Analysis Chart-Chicken Sausages

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
1 1a	Receiving of Raw Materials Meat Frozen MDM/MSM Frozen Chicken Breast Frozen Loose Meat	B-presence of pathogenic organisms; *Salmonellae, Yersinia enterocolitica, C. botulinum, L. monocytogenes*	Supplier Quality Assurance certificate In-house laboratory testing Effective cooking step at 11
		P-presence of bone fragments	Supplier Quality Assurance certificate Effective chopping step at 7
		C-contaminated with drugs, antibiotics, growth promoters and pesticide residues	Supplier Quality Assurance certificate
1b	Water and Ice	B-presence of pathogenic organisms; bacteria, parasites and protozoa	CMC (Colombo Municipal Council) water used In-house laboratory testing for Chlorine, pH, Alkalinity, Microbes Effective cooking at step 11
		P-inert matter contamination	CMC water used In-house laboratory testing for turbidity
		C-heavy metal contamination	CMC water used In-house laboratory testing for turbidity
1c	Spices	B-spores contamination of bacteria, yeast and moulds (*Salmonella typhymurium, Escherichia coli, Staphylococcus aureus, Bacillus cereus, Bacillus subtilis,* mycotoxigenic *Aspergillus, Candida albicans*)	Supplier Quality Assurance certificate In-house laboratory testing Effective cooking step at 11
		P-presence of metallic and non-metallic foreign matter	Supplier Quality Assurance certificate Visual inspection at point of receiving

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
		Insects, rodents and their excrete matter	
1d	Ingredients	B-spores contamination of bacteria, yeast and moulds	Supplier Quality Assurance certificate In-house laboratory testing Effective cooking step at 11
		P-presence of metallic and non-metallic foreign matter Insects, rodents and their excrete matter	Supplier Quality Assurance certificate Visual inspection at point of receiving
1e	Packaging Materials	B-presence of swab	Supplier Quality Assurance certificate In-house laboratory testing (Swab test consignment)
		P-presence of impurities	Supplier Quality Assurance certificate
2a	Storing of Raw Meat	B and C- growth of pathogenic organisms and enzymatic decomposition due to incorrect temperature and time combination	Correct setting of freezer temperature -20°C Observe good hygiene practices First In First Out approach Effective cooking at step 11
2b	Storing of Non-Meat Ingredients (Dry Store)	B-growth of yeast and moulds	Keep dry store well ventilated Observe good hygiene practices First In First Out approach
3	Band Saw Cutting	B-contamination through equipment and operators (*Salmonella typhymurium, Escherichia coli, Staphylococcus aureus,*)	Observe good hygiene practices Maintain low factory temperature 20°C
		P-metal fragments contamination	Check teeth of Band Saw regularly (metal detecting is recommended after vacuum packaging)
		C-oil and grease contamination due to careless handling	Observe good hygiene practices Use food grade oil and grease

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
4	Mincing	B-contamination through equipment and operators	Observe good hygiene practices Maintain low factory temperature 20°C
		C-oil and grease contamination due to careless handling	Observe good hygiene practices Use food grade oil and grease
5	Weighing of Raw Meat	B-contamination through equipment, aerosol and operators	Observe good hygiene practices
		P-inaccurate weighing of meat and inert matter contamination	Observe good hygiene practices Appoint the train and skill employees Timely calibration of weighing balance
6	Weighing of non-meat ingredients	C-excessive amount of Nitrite cause potential health risk	Properly weigh Nitrite at appropriate formulation using appropriately train and skill employees Supervision for spice room format No: WI P 0500
7	Bowl Chopper Operation	B-contamination through equipment, poor quality water, aerosol and operators	Observe good hygiene practices Use tested water at step 1b
		P-inaccurate chopping of meat and inert matter contamination	Observe good hygiene practices Appoint the train and skill employees
		C-oil and grease contamination due to careless handling	Observe good hygiene practices Use food grade oil and grease
8	Transferring to Filler Machine	B-contamination through equipment and operators	Observe good hygiene practices Covering of batter tub while transferring
9	Stuffing	B-contamination through equipment and operators	Observe good hygiene practices Avoid touching food with bare hands and soiled utensils Use tested water at step 1b Cover the hopper, Appoint the train and skill employees Fill the format No: WI P0600
		C-oil and grease contamination due to careless handling	Observe good hygiene practices Use food grade oil and grease
10	Hanging in trolleys	B-contamination through equipment and	Observe good hygiene practices

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
		operators	Avoid touching food with bare hands and soiled utensils
11	Chamber Operation	B-growth and survival of pathogenic organisms due to incorrect temperature and time combination	Strict adherence to scheduled temperature and time combination Fill the format No: WI P0700
12	Showering	B-contamination through equipment, poor quality water and operators due to presence of damaged casings	Observe good hygiene practices Use tested water at step 1b Setting of proper showering time 20min
		C-loss of binding properties	Setting of proper showering time 20min
13	Peeling	B-contamination through equipment, aerosol and operators	Observe good hygiene practices Avoid touching food with bare hands and soiled utensils Maintain low factory temperature 20°C Packaging of peeled sausages as soon as possible
14	Vacuum Packaging	B-growth of aerobic pathogenic organisms due to improper vacuum packed and contamination trough equipment and operators	Observe good hygiene practices Avoid touching food with bare hands and soiled utensils Maintain low factory temperature (20°C) Visual inspection of seals before startup and then regularly
		P-incorrect packing details	Random checking of packing details
15	Blast Freezing	B and C- growth of pathogenic organisms, abnormal chemical reaction due to incorrect time and temperature combination, over load leads to reduce	Strict adherence to scheduled temperature and time combination (-40°C, 4-5hrs) Maintain the cool room capacity

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
		temperature	Restrict open and entrance to the blast freezer
16	Dispatch Storage	B - growth of pathogenic organisms	Correct setting of freezer temperature -18°C Observe good hygiene practices First In First Out approach
17	Distribution	B - growth of pathogenic organisms	Correct setting of freezer temperature –20°C in distributing truck Observe good hygiene practices

Table 4.2: Process Step Decision Matrix-Chicken Sausage

No	Process Step	Decision Tree Codex 1997				CCP Y/N
		Q1	Q2	Q3	Q4	
1	Receiving of Raw Materials					
1a	Meat (Frozen MDM/MSM, Frozen Chicken Breast, Frozen Loose Meat)					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
	Chemical	Y	N	N		N
1b	Water and Ice					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
	Chemical	Y	N	Y	Y	N
1c	Spices					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
1d	Ingredients					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
1e	Packaging Materials					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	N		N
2a	Storing of Raw Meat					
	Biological	Y	N	Y	Y	N
2b	Storing of Non-Meat Ingredients					
	Biological	Y	N	N		N

No	Process Step	Decision Tree Codex 1997				CCP Y/N
		Q1	Q2	Q3	Q4	
3	Band Saw Cutting					
	Biological	Y	N	N		N
	Physical	Y	N	Y	Y	N
	Chemical	Y	N	N		N
4	Mincing					
	Biological	Y	N	N		N
	Chemical	Y	N	N		N
5	Weighing of Raw Meat					
	Biological	Y	N	N		N
	Physical	Y	N	N		N
6	Weighing of non-meat ingredients					
	Chemical	Y	Y			Yes-CCP1C
7	Bowl Chopper Operation					
	Biological	Y	N	N		N
	Physical	Y	N	N		N
	Chemical	Y	N	N		N
8	Transferring to Filler Machine					
	Biological	Y	N	N		N
9	Stuffing					
	Biological	Y	N	N		N
	Chemical	Y	N	N		N
10	Hanging in trolleys					
	Biological	Y	N	N		N
11	Chamber Operation					
	Biological	Y	Y			Yes-CCP1B
12	Showering					
	Biological	Y	N	N		N

No	Process Step	Decision Tree Codex 1997				CCP Y/N
		Q1	Q2	Q3	Q4	
	Chemical	Y	N	N		N
13	Peeling					
	Biological	Y	N	N		N
14	Vacuum Packaging					
	Biological	Y	Y			Yes-CCP2B
	Physical	Y	N	N		N
	Chemical	Y	N	N		N
15	Blast Freezing					
	Biological	Y	Y			Yes-CCP 3B
16	Dispatch Storage					
	Biological	Y	N	N		N
17	Distribution					
	Biological	Y	N	N		N

Table 4.3: HACCP Control Chart-Chicken Sausages

CCP No	Process Step	Critical Limits	Monitoring Procedure	Corrective Action	Documentation
CCP 1C	Weighing of Non-meat ingredients (restricted ingredient: E 250)	125ppm/1Kg of meat (max.) (SLS 1218:2001)	**How:** Formulation records checking **When:** Each batch **Who:** Formulation operator	**How:** 1.Place product on hold 2.Identify and eliminate cause of deviation. 3. Bring CCP under control after corrective action is taken. 4. Take action to prevent reoccurrence. **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Holding Log 2.Formulation Chart 3.Deviation/ Corrective Action Log 3.Weighing Scale device Calibration Chart 4.Verification Log
CCP 1B	Chamber Operation (Cooking)	Core temperature 68°C for 23sec (FSIS: Appendix A)	**How:** Check with Temperature and Time Monitoring Devices **When:** Each batch **Who:** Chamber operator	**How:** 1. Identify and eliminate cause of deviation. 2. Bring CCP under control after corrective action is taken. 3. Take action to prevent reoccurrence. 4. If not in proper manner, procedure for rework **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Temperature/Time Log 2.Cooking Chart 3.Deviation/ Corrective Action Log 3.Temperature Monitoring Device Calibration Chart 4.Verification Log

CCP No	Process Step	Critical Limits	Monitoring Procedure	Corrective Action	Documentation
CCP 2B	Vacuum Packaging	No any vacuum leaked product allowed	**How:** Visual Inspection **When:** Each and Every Product **Who:** Machine Operator	**How:** 1. Identify and eliminate cause of deviation. 2. Bring CCP under control after corrective action is taken. 3. Take action to prevent reoccurrence. 4. If not in proper manner, procedure for rework **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Temperature/Time Log 2.Packaging Chart 3.Deviation/ Corrective Action Log 3.Package Machine Calibration Chart 4.Verification Log
CCP 3B	Blast Freezing	Freeze to –18 °C for 3hrs (SLS 1161:1997)	**How:** Temperature and Time Monitoring Devices **When:** Three Times a Day **Who:** Storage Operator	**How:** 1. Identify and eliminate cause of deviation. 2. Bring CCP under control after corrective action is taken. 3. Take action to prevent reoccurrence. 4. If spoiled rejected from human consumption **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Temperature/Time Log 2.Blast Freezing Chart 3.Deviation/ Corrective Action Log 3.Temperature Monitoring Device Calibration Chart 4.Verification Log

Table 4.4: Verification Chart-Chicken Sausages

CCP No	Process Step	Verification Procedure
CCP 1C	Weighing of Non-meat ingredients ngredient: E 250)	1.Visual observation of monitoring activity by Production Manager or designee. 2. Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review formulating charts. 4.Weekly calibration and/or verification of weighing scale device by Production Manager or designee
CCP 1B	Chamber Operation (Cooking)	1.Visual observation of monitoring activity by Production Manager or designe. 2.Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review cooking charts. 4.Weekly calibration and/or verification of temperature monitoring device by Production Manager or designee.
CCP 2B	Vacuum Packaging	1. Visual observation of monitoring activity by Production Manager or designee. 2. Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review Packaging charts. 4.Weekly calibration and/or verification of Package Machine by Production Manager or designee
CCP 3B	Blast Freezing	1.Weekly internal product temperature –40°C in cooler by Production Manager or designee. 2. Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review chilling charts. 4.Weekly calibration and/or verification of temperature monitoring device by Production Manager or designee.

4.1.5 Chicken Meatballs

4.1.5.1. Product Description and Intended use

4.1.5.1.1 Ingredients

4.1.5.1.1.1 Restricted Ingredients

Nitrite (E 250)

Phosphate (E 450 b)

Anti-oxidant (E 300)

4.1.5.1.1.2 Others Ingredients

Spices

Iodized Salt

Flavor Enhancer (E 621)

Permitted coloring (E 161)

Rusk powder

4.1.5.1.2 Packing Materials

Low Density Polyethylene (LDP)

4.1.5.1.3 Product Specification.

4.1.5.1.3.1 Microbiology

TPC (cfu/g)	:$1x10^5$
E. coli (1g)	:Absent
S. aureus (1g)	: Absent
Salmonellae (25g)	:Absent

4.1.5.1.3.2 Chemistry

NaCl content	:5% by mass (max.)
Total meat content	:40% by mass (min.)
Nitrite content	:125ppm(max.)
Fat content	: 20% by mass (max.)

4.1.5.1.4 Pack Size

150g, 250g as vacuum pack

4.1.5.1.5 Self Life

6 month from the date of manufacture
Storage and distribute at freeze condition

4.1.5.1.6 Intended Use

General public consumer instructions are as follows:

Keep Freeze temperature until ready to use

Defrost fully, and then fry or toss in a curry, pre-cooked, no need to boil

4.1.5.2 Process Flow Diagram- Chicken Meatballs

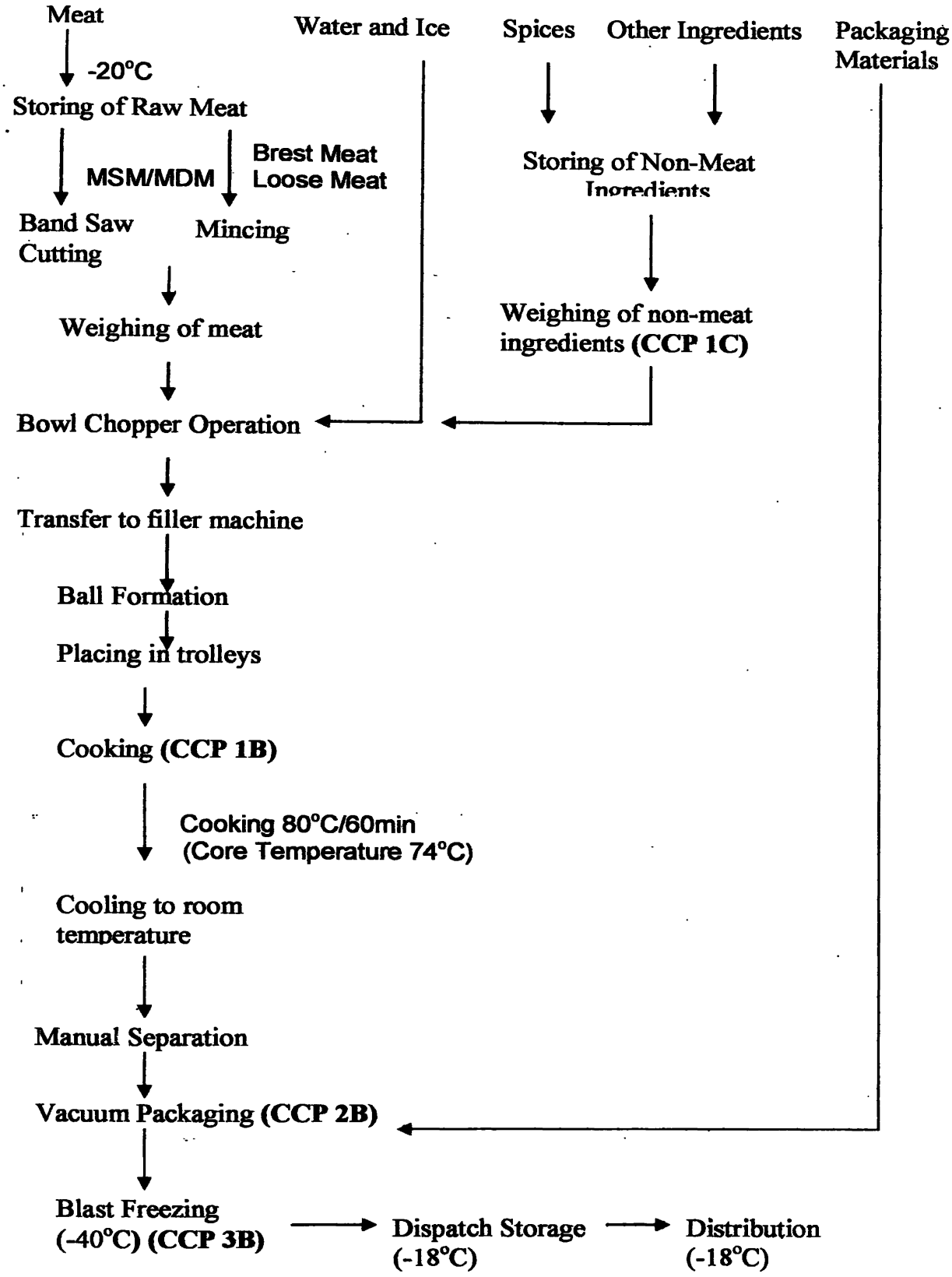


Figure 4.2:Process Flow Diagram- Chicken Meatballs

Table 4.5: Hazard Analysis Chart-Chicken Meatballs

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
1 1a	Receiving of Raw Materials Meat Frozen MDM/MSM Frozen Chicken Breast Frozen Loose Meat	B-presence of pathogenic organisms; *Salmonellae, Yersinia enterocolitica, C. botulinum, L. monocytogenes*	Supplier Quality Assurance certificate In-house laboratory testing Effective cooking step at 11
		P-presence of bone fragments	Supplier Quality Assurance certificate Effective chopping step at 7
		C-contaminated with drugs, antibiotics, growth promoters and pesticide residues	Supplier Quality Assurance certificate
1b	Water and Ice	B-presence of pathogenic organisms; bacteria, parasites and protozoa	CMC water used In-house laboratory testing for Chlorine, P, Alkalinity, Microbes Effective cooking at step 11
		P-inert matter contamination	CMC water used In-house laboratory testing for turbidity
		C-heavy metal contamination	CMC water used In-house laboratory testing for turbidity
1c	Spices	B-spores contamination of bacteria, yeast and moulds	Supplier Quality Assurance certificate In-house laboratory testing Effective cooking step at 11
		P-presence of metallic and non-metallic foreign matter Insects, rodents and their excrete matter	Supplier Quality Assurance certificate Visual inspection at point of receiving
1d	Ingredients	B-spores contamination of bacteria, yeast and moulds	Supplier Quality Assurance certificate In-house laboratory testing Effective cooking step at 11

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
		P-presence of metallic and non-metallic foreign matter Insects, rodents and their excrete matter	Supplier Quality Assurance certificate Visual inspection at point of receiving
1e	Packaging Materials	B-presence of swab	Supplier Quality Assurance certificate In-house laboratory testing (swab test consignment)
		P-presence of impurities	Supplier Quality Assurance certificate
2a	Storing of Raw Meat	B and C- growth of pathogenic organisms and enzymatic decomposition due to incorrect temperature and time combination	Correct setting of freezer temperature -20°C Observe good hygiene practices First In First Out approach Effective cooking at step 11
2b	Storing of Non-Meat Ingredients (Dry Store)	B-growth of yeast and moulds (mycotoxigenic *Aspergillus, Candida albicans*)	Keep dry store well ventilated Observe good hygiene practices First In First Out approach
3	Band Saw Cutting	B-contamination through equipment and operators	Observe good hygiene practices Maintain low factory temperature 20°C
		P-metal fragments contamination	Check teeth of Band Saw regularly (metal detecting is recommended after vacuum packaging)
		C-oil and grease contamination due to careless handling	Observe good hygiene practices Use food grade oil and grease
4	Mincing	B-contamination through equipment and operators	Observe good hygiene practices Maintain low factory temperature 20°C
		C-oil and grease contamination due to careless handling	Observe good hygiene practices Use food grade oil and grease

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
5	Weighing of Raw Meat	B-contamination through equipment, aerosol and operators	Observe good hygiene practices
		P-inaccurate weighing of meat and inert matter contamination	Observe good hygiene practices Appoint the train and skill employees Timely calibration of weighing balance
6	Weighing of non-meat ingredients	C-excessive amount of Nitrite cause potential health risk	Properly weigh Nitrite at appropriate formulation using appropriately train and skill employees Supervision for spice room format No: WI P 0500
7	Bowl Chopper Operation	B-contamination through equipment, poor quality water, aerosol and operators	Observe good hygiene practices Correct setting of temperature at chopping 0°C to -1.5°C Use tested water at step 1b
		P-inaccurate chopping of meat and inert matter contamination	Observe good hygiene practices Appoint the train and skill employees
		C-oil and grease contamination due to careless handling	Observe good hygiene practices Use food grade oil and grease
8	Transferring to Filler Machine	B-contamination through equipment and operators	Observe good hygiene practices Covering of batter tub while transferring
9	Ball Formation	B-contamination through equipment and operators	Observe good hygiene practices Avoid touching food with bare hands and soiled utensils Use tested water at step 1b Cover the hopper Appoint the train and skill employees Fill the format No: WI P0600
		C-oil and grease contamination due to careless handling	Observe good hygiene practices Use food grade oil and grease

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
10	Place in trolleys	B-contamination through equipment and operators	Observe good hygiene practices Avoid touching food with bare hands and soiled utensils
11	Chamber Operation	B-growth and survival of pathogenic organisms due to incorrect temperature and time combination	Strict adherence to scheduled temperature and time combination Fill the format No: WI P0700
12	Cooling to Room Temperature	B-contamination through equipment and operators	Observe good hygiene practices Avoid touching food with bare hands and soiled utensils Maintain low factory temperature 20°C
		C-loss of binding properties	Setting of proper showering time 20min
13	Manual Separation	B-contamination through equipment, aerosol and operators	Observe good hygiene practices Avoid touching food with bare hands and soiled utensils Maintain low factory temperature 20°C Packaging of cooled meatballs as soon as possible
14	Vacuum Packaging	B-growth of aerobic pathogenic organisms due to improper vacuum packed and contamination trough equipment and operators	Observe good hygiene practices Avoid touching food with bare hands and soiled utensils Maintain low factory temperature (20°C) Visual inspection of seals before startup and then regularly
		P-incorrect packing details	Random checking of packing details
		C-improper vacuum packing leads to some abnormal chemical reactions	Separate personnel for vacuum checking Fill the format No: WI P0800

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
15	Blast Freezing	B and C- growth of pathogenic organisms, abnormal chemical reaction due to incorrect time and temperature combination, over load leads to reduce temperature	Strict adherence to scheduled temperature and time combination (-40°C, 4-5hrs) Maintain the cool room capacity Restrict open and entrance to the blast freezer
16	Dispatch Storage	B - growth of pathogenic organisms	Correct setting of freezer temperature -20°C Observe good hygiene practices First In First Out approach
17	Distribution	B - growth of pathogenic organisms	Correct setting of freezer temperature -20°C in distributing truck Observe good hygiene practices

Table 4.6:Process Steps Decision Matrix-Chicken Meatballs

No	Process Step	Decision Tree Codex 1997				CCP Y/N
		Q1	Q2	Q3	Q4	
1	Receiving of Raw Materials					
1a	Meat(Frozen MDM/MSM, Frozen Chicken Breast, Frozen Loose Meat)					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
	Chemical	Y	N	N		N
1b	Water and Ice					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
	Chemical	Y	N	Y	Y	N
1c	Spices					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
1d	Ingredients					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
1e	Packaging Materials					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	N		N
2a	Storing of Raw Meat					
	Biological	Y	N	Y	Y	N
2b	Storing of Non-Meat Ingredients					
	Biological	Y	N	N		N
3	Band Saw Cutting					
	Biological	Y	N	N		N
	Physical	Y	N	Y	Y	N
	Chemical	Y	N	N		N
4	Mincing					
	Biological	Y	N	N		N

No	Process Step	Decision Tree Codex 1997				CCP Y/N
		Q1	Q2	Q3	Q4	
	Chemical	Y	N	N		N
5	Weighing of Raw Meat					
	Biological	Y	N	N		N
	Physical	Y	N	N		N
6	Weighing of non-meat ingredients					
	Chemical	Y	Y			Yes CCP 1C
7	Bowl Chopper Operation					
	Biological	Y	N	N		N
	Physical	Y	N	N		N
	Chemical	Y	N	N		N
8	Transferring to Filler Machine					
	Biological	Y	N	N		N
9	Ball Formation					
	Biological	Y	N	N		N
	Chemical	Y	N	N		N
10	Placing in trolleys					
	Biological	Y	N	N		N
11	Chamber Operation					
	Biological	Y	Y			Yes CCP 2B
12	Cooling to Room Temperature					
	Biological	Y	N	N		N
	Chemical	Y	N	N		N
13	Manual Separation					
	Biological	Y	N	N		N
14	Vacuum Packaging					
	Biological	Y	Y			Yes CCP 3B

No	Process Step	Decision Tree Codex 1997				CCP Y/N
		Q1	Q2	Q3	Q4	
	Physical	Y	N	N		N
	Chemical	Y	N	N		N
15	Blast Freezing					
	Biological	Y	Y			Yes CCP 4B
16	Dispatch Storage					
	Biological	Y	N	N		N
17	Distribution					
	Biological	Y	N	N		N

Table 4.7: HACCP Control Chart-Chicken Meatballs

CCP No	Process Step	Critical Limits	Monitoring Procedure	Corrective Action	Documentation
CCP 1C	Weighing of Non-meat ingredients (restricted ingredient: E 250)	125ppm/1Kg of meat (max.) (SLS 886:2001)	**How:** Formulation records checking **When:** Each batch **Who:** Formulation operator	**How:** 1.Place product on hold 2.Identify and eliminate cause of deviation. 3. Bring CCP under control after corrective action is taken. 4. Take action to prevent reoccurrence. **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Holding Log 2.Formulation Chart 3.Deviation/ Corrective Action Log 3.Weighing Scale device Calibration Chart 4.Verification Log
CCP 1B	Cooking	Core temperature 68°C for 23sec(FSIS: Appendix A)	**How:** Temperature and Time Monitoring Devices **When:** Each batch **Who:** Chamber operator	**How:** 1. Identify and eliminate cause of deviation. 2. Bring CCP under control after corrective action is taken. 3. Take action to prevent reoccurrence. 4. If not in proper manner, procedure for rework **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Temperature/Time Log 2.Cooking Chart 3.Deviation/ Corrective Action Log 3.Temperature Monitoring Device Calibration Chart 4.Verification Log

CCP No	Process Step	Critical Limits	Monitoring Procedure	Corrective Action	Documentation
CCP 2B	Vacuum Packaging	No any vacuum leaked product allowed	**How:** Visual Inspection **When:** Each and Every Product **Who:** Machine Operator	**How:** 1. Identify and eliminate cause of deviation. 2. Bring CCP under control after corrective action is taken. 3. Take action to prevent reoccurrence. 4. If not in proper manner, procedure for rework **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Temperature/Time Log 2.Packaging Chart 3.Deviation/ Corrective Action Log 3.Package Machine Calibration Chart 4.Verification Log
CCP 3B	Blast Freezing	Freeze to –18 for 3rs (SLS 1161:1997)	**How:** Temperature and Time Monitoring Devices **When:** Three Times a Day **Who:** Storage Operator	**How:** 1. Identify and eliminate cause of deviation. 2. Bring CCP under control after corrective action is taken. 3. Take action to prevent reoccurrence. 4. If spoiled rejected from human consumption **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Temperature/Time Log 2.Blast Freezing Chart 3.Deviation/ Corrective Action Log 3.Temperature Monitoring Device Calibration Chart 4.Verification Log

Table 4.8: Verification Chart-Chicken Meatballs

CCP No	Process Step	Verification Procedure
CCP 1C	Weighing of Non-meat ingredients (restricted ingredient: E 250)	1.Visual observation of monitoring activity by Production Manager or designee. 2. Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review formulating charts. 4.Weekly calibration and/or verification of weighing scale device by Production Manager or designee
CCP 1B	Cooking	1.Visual observation of monitoring activity by Production Manager or designe. 2.Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review cooking charts. 4.Weekly calibration and/or verification of temperature monitoring device by Production Manager or designee.
CCP 2B	Vacuum Packaging	1. Visual observation of monitoring activity by Production Manager or designee. 2. Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review Packaging charts. 4.Weekly calibration and/or verification of Package Machine by Production Manager or designee
CCP 3B	Blast Freezing	1.Weekly internal product temperature in cooler by Production Manager or designee. 2. Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review chilling charts. 4.Weekly calibration and/or verification of temperature monitoring device by Production Manager or designee.

4.1.6 Cooked Ham

4.1.6.1 Product Description and Intended use

4.1.6.1.1 Ingredients

4.1.6.1.1.1 Restricted Ingredients

Nitrite (E 250)

Phosphate (E 450 b)

Anti-oxidant (E 300)

4.1.6.1.1.2 Others Ingredients

Iodized Salt

Sugar (Glucose)

Flavor Enhancer (E 621)

4.1.6.1.2. Packing Materials

Low Density Polyethylene (LDP)

4.1.6.1.3 Product Specification.

4.1.6.1.3.1 Microbiology

TPC (cfu/g)	: $1x10^5$
E. coli (1g)	:Absent
S. aureus (1g)	:100
Salmonellae (25g)	:Absent

4.1.6.1.3.2 Chemistry

NaCl content	:5% by mass (max.)
Total fat content	:10% by mass (max.)
Nitrite content	: 125ppm(max.)
Moisture content	: 75% by mass (max.)

4.1.6.1.4 Pack size

150g, 250g as vacuum pack and 5-5.5kg of Polyethylene Bags

4.1.6.1.5 Shelf life

3 month from the date of manufacture
Storage and distribute at chill condition (0°C-5°C)

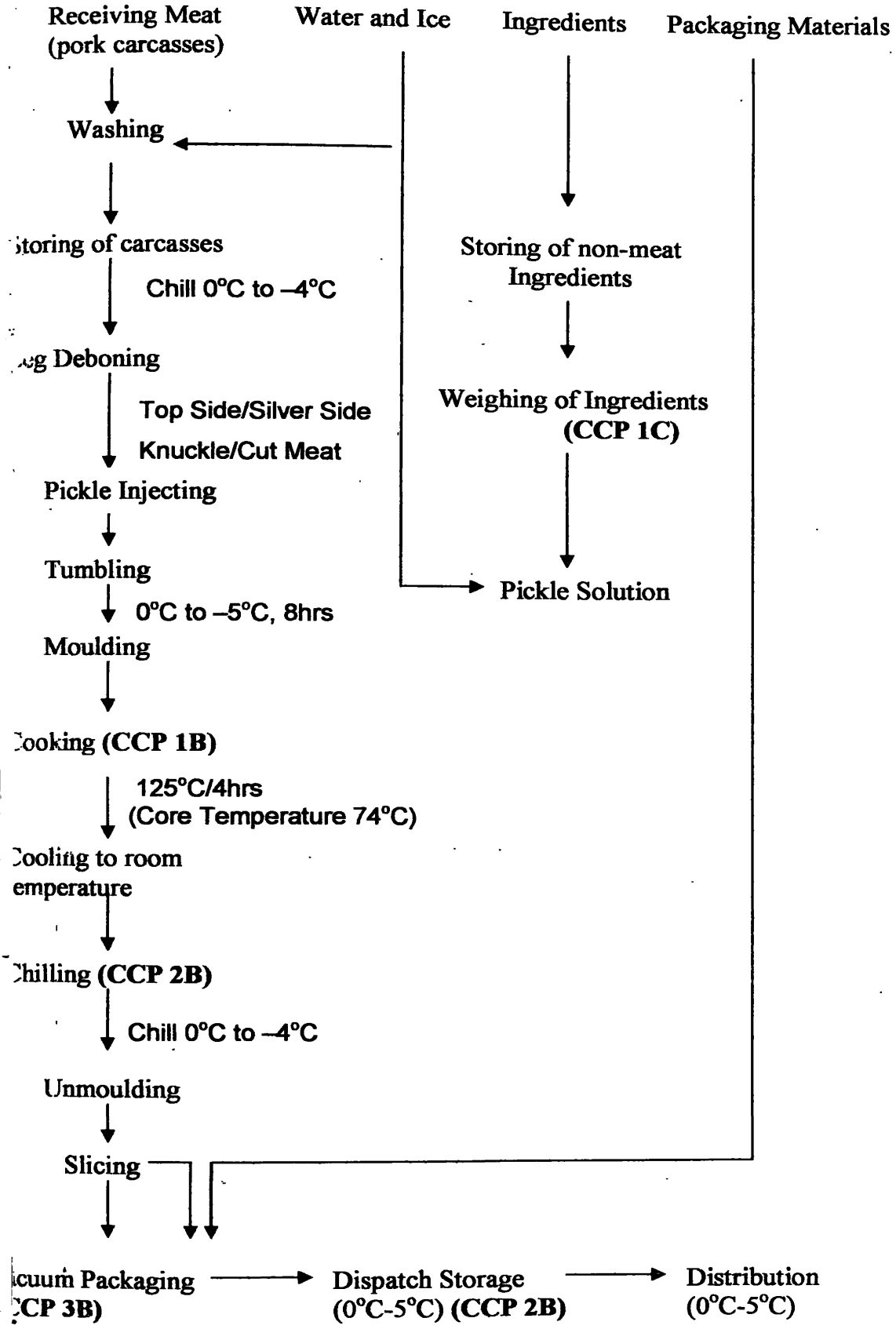
4.1.6.1.6 Intended Use

General public consumer instructions are as follows:

Keep chill temperature (0°C-5°C) until ready to use

Then serve in a salad or sandwich, pre-cooked, no need to boil

6.2. Process Flow Diagram-Cooked Ham



igure 4.3: Process Flow Diagram – Cooked Ham

Table 4.9: Hazard Analysis Chart-Cooked Ham

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
1 1a	Receiving of Raw Materials Meat (Pork Carcasses)	B-presence of pathogenic organisms; *Salmonellae, Yersinia enterocolitica, C. botulinum, L. monocytogenes, Trichinelis* and *Toxoplasma gondii*	Supplier Quality Assurance certificate In-house laboratory testing Effective cooking step at 11
		P-presence of Bristles	Supplier Quality Assurance certificate
		C-contaminated with drugs, antibiotics, growth promoters and pesticide residues	Supplier Quality Assurance certificate
1b	Ingredients Sodium Nitrite, Diphosphate, Ascorbic Acid, Mono Sodium Glutamate, Iodized Salt and Sugar (Glucose)	B-spores contamination of bacteria, yeast and moulds	Supplier Quality Assurance certificate In-house laboratory testing Effective cooking step at 11
		P-presence of metallic and non-metallic foreign matter Insects, rodents and their excrete matter	Supplier Quality Assurance certificate Visual inspection at point of receiving
1c	Packaging Materials	B-spores contamination of bacteria, yeast and moulds	Supplier Quality Assurance certificate In-house laboratory testing (Swab test consignment)
		P-presence of impurities	Supplier Quality Assurance certificate

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
1d	Water and Ice	B-presence of pathogenic organisms; bacteria, parasites and protozoa	CMC water used In-house laboratory testing for Chlorine, PH, Alkalinity, Microbes Effective cooking at step 11
		P-inert matter contamination	CMC water used In-house laboratory testing for turbidity
		C-heavy metal contamination	CMC water used In-house laboratory testing for turbidity
2	Washing	B-presence of pathogenic organisms due to poor quality water used	Tested water used at step 1d
		P-inert matter contamination due to poor quality water used	Tested water used at step 1d
		C-heavy metal contamination due to poor quality water used	Tested water used at step 1d
3a	Storing of Pork carcasses	B-growth of pathogenic organisms and enzymatic decomposition due to temperature abused	Correct setting of chilling temperature (0°c to – 5°c) and time Observe good storage practices First In First Out approach Effective cooking at step 11
3b	Storing of non-meat ingredients	B-growth of yeast and moulds	Keep dry store well ventilated Observe good storage practices First In First Out approach
4	Weighing of non-meat ingredients	C-excessive amount of Nitrite cause potential health risk	Properly weigh Nitrite at appropriate formulation using appropriately train and skill employees Supervision for spice room format No: WI P 0500
5	Pickle Solution Sodium Nitrite, Diphosphate, Ascorbic Acid,	B-contamination through equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C)
		P-inert matter contamination	Visual inspection Random checking of pickle ingredients

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
	Mono Sodium Glutamate, Iodized Salt, Sugar (Glucose) and Water	C-hazard due to incorrect pickle concentration due to careless handling	Appointed skill and train employees
6	Leg Deboning (Top Side, Silver Side, Knuckle and Loose Meat)	B-contamination through equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C)
		P-presence of bone particles and metal fragments	Visual inspection for bone fragments Metal detection later in process(metal detecting is recommended after vacuum packaging)
7	Pickle Injecting	B-contamination through equipment and operators	Observe good hygiene practices Maintain low factory temperature (2°C)
		C-uneven pickle injecting	Strict adherence to scheduled pressure and speed Appointed train and skill employees
8	Tumbling	B-contamination through equipment and operators	Correct setting of temperature and time (0°C to –5°C, 8hrs) Observe good hygiene practices Maintain low factory temperature (20°C)
		C-contaminated with oil and grease	Apply food grade oil and grease
9	Moulding	B-contamination through equipment, polythene, poor quality water and operators	Observe good hygiene practices Maintain low factory temperature (20°C) Swab testing for polythene Tested water used at step 1d
10	Cooking	B-growth of pathogenic bacteria and Parasites due to incorrect temperature and time combination	Strict adherence to scheduled temperature and time combination At the end of the operation core temperature

No.	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
			74°C should be checked Fill the format No: WI P 07
11	Cooling	B-cross contamination though equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C)
12	Chilling	B-growth of pathogenic organisms due to incorrect temperature and time	Correct temperature and time combination (0°C to –4 C, 4-5hrs) Restrict the open and entrance to chiller room First In First Out approach Fill the format No: WI P 02
13	Unmoulding	B- contamination though equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C) Avoid touching food with bare hands and soiled utensils
		P-duot and other inert matter contamination	Visual inspection
14	Slicing/as Blocks	B- contamination though equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C) Avoid touching food with bare hands and soiled utensils After slicing as soon as possible vacuum pack
		P- inert matter contamination	Visual inspection
15	Vacuum Packaging	B-growth of aerobic pathogenic organisms due to improper vacuum packed and contamination trough equipment and operators	Observe good hygiene practices Avoid touching food with bare hands and soiled utensils Maintain low factory temperature (20°C) Visual inspection of seals before startup and then regularly

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
		P-incorrect packing details	Random checking of packing details
		C-improper vacuum packing leads to some abnormal chemical reactions	Separate personnel for vacuum checking Fill the format No: WI P 08
16	Dispatch Storage	B - growth of pathogenic organisms	Correct setting of Chiller temperature 0°C–5°C Observe good hygiene practices First In First Out approach
17	Distribution	B - growth of pathogenic organisms	Correct setting of Chiller temperature 0°C–5°C in distributing truck Observe good hygiene practices First In First Out approach

Table 4.10: Process Steps Decision Matrix-Cooked Ham

No	Process Step	Decision Tree Codex 1997				CCP Y/N
		Q1	Q2	Q3	Q4	
1	Receiving of Raw Materials					
1a	Meat (Pork Carcasses)					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	N		N
	Chemical	Y	N	N		N
1b	Water and Ice					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
	Chemical	Y	N	Y	Y	N
1c	Ingredients					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
1d	Packaging Materials					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	N		N
2	Washing					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
	Chemical	Y	N	Y	Y	N
3a	Storing of Pork Carcasses					
	Biological	Y	N	Y	Y	N
	Chemical	Y	N	Y	Y	N
3b	Storing of Non-Meat Ingredients					
	Biological	Y	N	N		N

No	Process Step	Decision Tree Codex 1997				CCP Y/N
		Q1	Q2	Q3	Q4	
4	Weighing of non-meat ingredients					
	Chemical	Y	Y			Yes CCP 1C
5	Pickle Solution					
	Biological	Y	N	N		N
	Physical	Y	N	N		N
6	Debonning					
	Biological	Y	N	N		N
	Physical	Y	N	Y	Y	N
7	Pickle Injecting					
	Biological	Y	N	N		N
	Chemical	Y	N	N		N
8	Tumbling					
	Biological	Y	N	N		N
	Chemical	Y	N	N		N
9	Molding					
	Biological	Y	N	N		N
10	Cooking					
	Biological	Y	Y			Yes CCP1B
11	Cooling					
	Biological	Y	N	N		N
12	Chilling					
	Biological	Y	Y			Yes CCP2B
13	Unmoulding					
	Biological	Y	N	N		N

No	Process Step	Decision Tree Codex 1997				CCP Y/N
		Q1	Q2	Q3	Q4	
	Physical	Y	N	N		N
14	Slicing/as Blocks					
	Biological	Y	N	N		N
	Physical	Y	N	N		N
15	Vacuum Packaging					
	Biological	Y	Y			Yes CCP3B
	Physical	Y	N	N		N
	Chemical	Y	N	N		N
16	Dispatch Storage					
	Biological	Y	Y			Yes CCP2B
17	Distribution					
	Biological	Y	N	N		N

Table 4.11: HACCP Control Chart-Cooked Ham

CCP No	Process Step	Critical Limits	Monitoring Procedure	Corrective Action	Documentation
CCP 1C	Weighing of Non-meat ingredients (restricted ingredient: E 250)	125ppm/1Kg of meat (max.) (SLS 1146:)	**How:** Formulation records checking **When:** Each batch **Who:** Formulation operator	**How:** 1.Place product on hold 2.Identify and eliminate cause of deviation. 3. Bring CCP under control after corrective action is taken. 4. Take action to prevent reoccurrence. **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Holding Log 2.Formulation Chart 3.Deviation/ Corrective Action Log 3.Weighing Scale device Calibration Chart 4.Verification Log
CCP 1B	Cooking	Core temperature 64°C for 115sec (FSIS: Appendix A)	**How:** Temperature and Time Monitoring Devices **When:** Each batch **Who:** Chamber operator	**How:** 1. Identify and eliminate cause of deviation. 2. Bring CCP under control after corrective action is taken. 3. Take action to prevent reoccurrence. 4. If not in proper manner, procedure for rework **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Temperature/Time Log 2.Cooking Chart 3.Deviation/ Corrective Action Log 3.Temperature Monitoring Device Calibration Chart 4.Verification Log

CCP No	Process Step	Critical Limits	Monitoring Procedure	Corrective Action	Documentation
CCP 2B	Chilling Storage	Storage at 10°C or lower (FSIS: Appendix B)	**How:** Temperature and Time Monitoring Devices **When:** Three Times a Day **Who:** Storage Operator	**How:** 1. Identify and eliminate cause of deviation. 2. Bring CCP under control after corrective action is taken. 3. Take action to prevent reoccurrence. 4. If spoiled rejected from human consumption **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Temperature/Time Log 2. Dispatch Storage Chart 3.Deviation/ Corrective Action Log 3.Temperature Monitoring Device Calibration Chart 4.Verification Log
CCP 3B	Vacuum Packaging	No any vacuum leaked product allowed	**How:** Visual Inspection **When:** Each and Every Product **Who:** Machine Operator	**How:** 1. Identify and eliminate cause of deviation. 2. Bring CCP under control after corrective action is taken. 3. Take action to prevent reoccurrence. 4. If not in proper manner, procedure for rework **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Temperature/Time Log 2.Packaging Chart 3.Deviation/ Corrective Action Log 3.Package Machine Calibration Chart 4.Verification Log

Table 4.12: Verification Chart-Cooked Ham

CCP No	Process Step	Verification Procedure
CCP 1C	Weighing of Non-meat ingredients (restricted ingredient: E 250)	1.Visual observation of monitoring activity by Production Manager or designee. 2. Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review formulating charts. 4.Weekly calibration and/or verification of weighing scale device by Production Manager or designee
CCP 1B	Cooking	1.Visual observation of monitoring activity by Production Manager or designe. 2.Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review cooking charts. 4.Weekly calibration and/or verification of temperature monitoring device by Production Manager or designee.
CCP 2B	Chilling Storage	1.Weekly internal product temperature in Dispatch Storage by Production Manager or designee. 2. Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review Dispatch Storage charts. 4.Weekly calibration and/or verification of temperature monitoring device by Production Manager or designee.
CCP 3B	Vacuum Packaging	1. Visual observation of monitoring activity by Production Manager or designee. 2. Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review Packaging charts. 4.Weekly calibration and/or verification of Package Machine by Production Manager or designee

Chicken Ham.

1 Product Description and Intended use

.1.1 Ingredients

.1.1.1 Restricted Ingredients

e (E 250)

phate (E 450 b)

xidant (E 300)

1.1.2 Others Ingredients

d Salt

r (Glucose)

Enhancer (E 621)

1.2 Packing Materials

)ensity Polyethylene (LDP)

1.3 Product Specification

1.3.1 Microbiology

cfu/g)	: $1x10^5$
i (1g)	:Absent
reus (1g)	:100
onellae (25g)	:Absent

1.3.2 Chemistry

content	:5% by mass (max.)
fat content	:10% by mass (max.)
content	: 125ppm(max.)
ure content	: 75% by mass (max.)

1.4 Pack size

250g and whole block as vacuum packs

1.5 Shelf life

ith from the date of manufacture

ge and distribute at chill condition

1.6 Intended Use

ral public consumer instructions are as follows:

chill temperature until ready to use

st fully, and then serve in a salad or sandwich, pre-cooked, no need to boil.

4.1.7.2 Process Flow Diagram – Chicken Ham

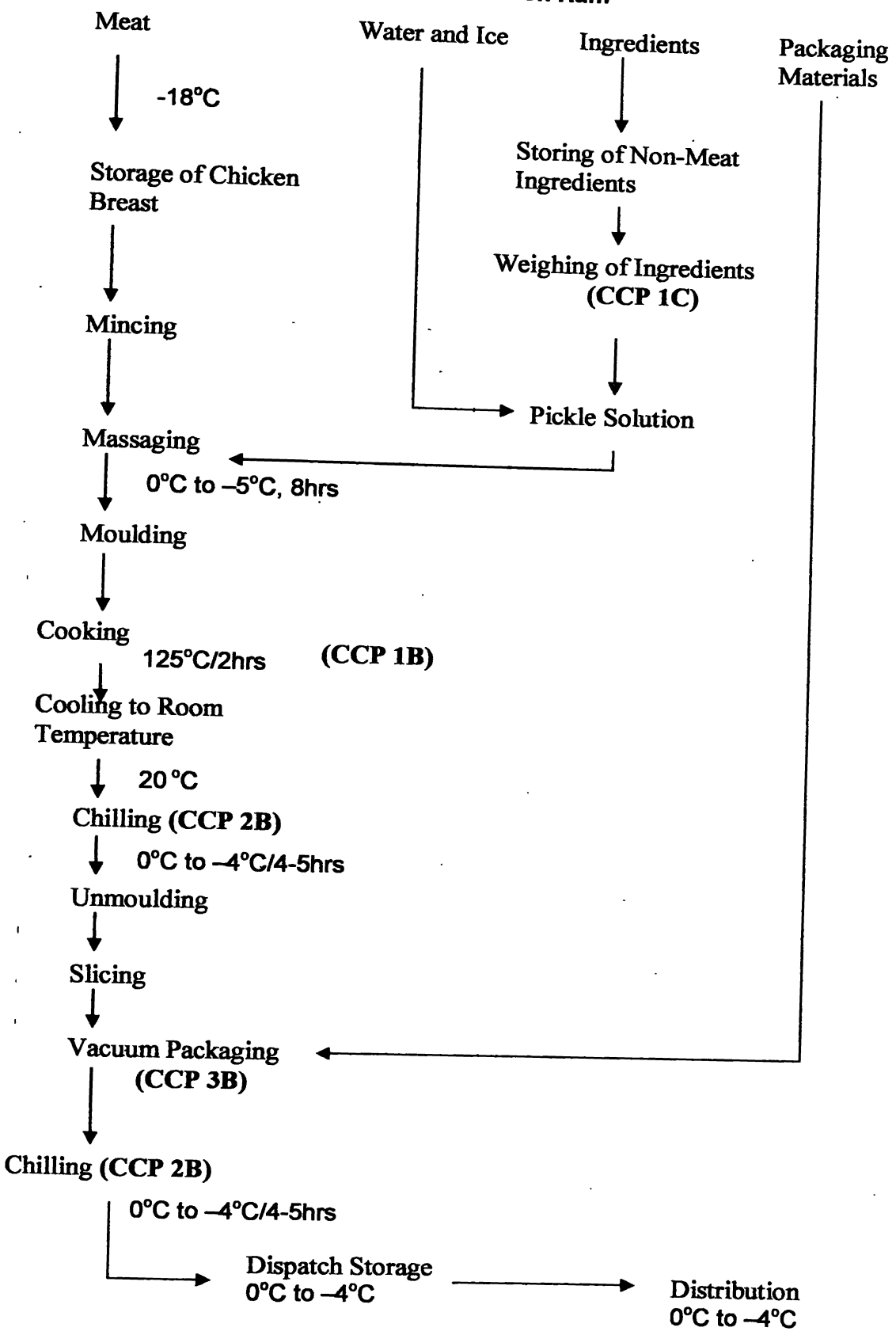


Figure 4.4: Process Flow Diagram – Chicken Ham

Table 4.13: Hazard Analysis Chart-Chicken Ham

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
1 1a	Receiving of Raw Materials Meat (Frozen Chicken Breast)	B-presence of pathogenic organisms; *Salmonellae, Yersinia enterocolitica, C. botulinum, L. monocytogenes,*	Supplier Quality Assurance certificate In-house laboratory testing Effective cooking step at 11
		P-presence of bone fragments	Supplier Quality Assurance certificate
		C-contaminated with drugs, antibiotics, growth promoters and pesticide residues	Supplier Quality Assurance certificate
1b	Ingredients	B-spores contamination of bacteria, yeast and moulds	Supplier Quality Assurance certificate In-house laboratory testing Effective cooking step at 11
		P-presence of metallic and non-metallic foreign matter Insects, rodents and their excrete matter	Supplier Quality Assurance certificate Visual inspection at point of receiving
1c	Packaging Materials	B-presence of swab	Supplier Quality Assurance certificate In-house laboratory testing (Swab test consignment)
		P-presence of impurities	Supplier Quality Assurance certificate
1d	Water and Ice	B-presence of pathogenic organisms; bacteria, parasites and protozoa	CMC water used In-house laboratory testing for Chlorine, PH, Alkalinity, Microbes Effective cooking at step 11

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
		P-inert matter contamination	CMC water used In-house laboratory testing for turbidity
		C-heavy metal contamination	CMC water used In-house laboratory testing for turbidity
2a	Storing of Meat (Chicken Breast)	B-growth of pathogenic organisms and enzymatic decomposition due to temperature abused	Correct setting of Freeze temperature–20°c) Observe good storage practices First In First Out approach Effective cooking at step 11
2b	Storing of Non-Meat Ingredients	B-growth of yeast and moulds	Keep dry store well ventilated Observe good storage practices First In First Out approach
3	Weighing of non-meat ingredients	C-excessive amount of Nitrite cause potential health risk	Properly weigh Nitrite at appropriate formulation using appropriately train and skill employees Supervision for spice room format No: WI P 0500
4	Pickle Solution	B-contamination through equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C)
		P-inert matter contamination	Visual inspection Random checking of pickle ingredients
		C-hazard due to incorrect pickle concentration due to careless handling	Appointed skill and train employees
5	Mincing	B-contamination through equipment and operators	Observe good hygiene practices Maintain low factory temperature 20°C
		C-oil and grease contamination due to careless handling	Observe good hygiene practices Use food grade oil and grease
6	Massaging	B-contamination through equipment and operators	Correct setting of temperature and time (0°C to –5°C, 8hrs) Observe good hygiene practices Maintain low factory temperature (20°C)

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
		C-contaminated with oil and grease	Apply food grade oil and grease
7	Moulding	B-contamination through equipment, polythene, poor quality water and operators	Observe good hygiene practices Maintain low factory temperature (20°C) Swab testing for polythene Tested water used at step 1d
8	Cooking	B-growth of pathogenic bacteria due to incorrect temperature and time combination	Strict adherence to scheduled temperature and time combination At the end of the operation core temperature 74°C should be checked Fill the format No: WI P 07
9	Cooling	B-cross contamination though equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C)
10	Chilling	B-growth of pathogenic organisms due to incorrect temperature and time	Correct temperature and time combination(0°C to –4°Co, 4-5hrs) Restrict the open and entrance to chill room First In First Out approach Fill the format No: WI P 02
11	Unmoulding	B- contamination though equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C) Avoid touching food with bare hands and soiled utensils
		P-duot and other inert matter contamination	Visual inspection
12	Slicing	B- contamination though equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C) Avoid touching food with bare hands and soiled utensils After slicing as soon as possible vacuum pack
		P- inert matter contamination	Visual inspection
13	Vacuum Packaging	B-growth of aerobic pathogenic organisms due to improper vacuum packed and contamination trough equipment and	Observe good hygiene practices Avoid touching food with bare hands and soiled utensils Maintain low factory temperature (20°C)

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
		operators	Visual inspection of seals before startup and then regularly
		P-incorrect packing details	Random checking of packing details
		C-improper vacuum packing leads to some abnormal chemical reactions	Separate personnel for vacuum checking Fill the format No: WI P 08
14	Chilling	B and C- growth of pathogenic organisms, abnormal chemical reaction due to incorrect time and temperature combination, over load leads to reduce Temperature	Strict adherence to scheduled temperature and time combination (-4°C, 4-5hrs) Maintain the cool room capacity Restrict open and entrance to the chiller room Fill the format No: WI CL02
15	Dispatch Storage	B - growth of pathogenic organisms	Correct setting of Chiller temperature 0°C to -4°C Observe good hygiene practices First In First Out approach
16	Distribution	B - growth of pathogenic organisms	Correct setting of Chiller temperature 0°C to -4°C in Distributing truck Observe good hygiene practices

Table 4.14: Process Steps Decision Matrix-Chicken Ham

No	Process Step	Decision Tree Codex 1997				CCP Y/N
		Q1	Q2	Q3	Q4	
1	Receiving of Raw Materials					
1a	Meat (Chicken Breast)					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	N		N
	Chemical	Y	N	N		N
1b	Water and Ice					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
	Chemical	Y	N	Y	Y	N
1c	Ingredients					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
1d	Packaging Materials					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	N		N
2a	Storing of Raw Meat					
	Biological	Y	N	Y	Y	N
	Chemical	Y	N	Y	Y	N
2b	Storing of Non-Meat Ingredients					
	Biological	Y	N	N		N
3	Weighing of non-meat ingredients					
	Chemical	Y	Y			Yes CCP 1C
4	Pickle Solution					
	Biological	Y	N	N		N
	Physical	Y	N	N		N
5	Mincing					

No	Process Step	Decision Tree Codex 1997				CCP Y/N
		Q1	Q2	Q3	Q4	
	Biological	Y	N	N		N
	Chemical	Y	N	N		N
6	Massaging					
	Biological	Y	N	N		N
	Chemical	Y	N	N		N
7	Moulding					
	Biological	Y	N	N		N
8	Cooking					
	Biological	Y	Y			Yes CCP 1B
9	Cooling					
	Biological	Y	N	N		N
10	Chilling					
	Biological	Y	Y			Yes CCP 2B
11	Unmoulding					
	Biological	Y	N	N		N
	Physical	Y	N	N		N
12	Slicing/as Blocks					
	Biological	Y	N	N		N
	Physical	Y	N	N		N
13	Vacuum Packaging					
	Biological	Y	Y			Yes CCP 3B
	Physical	Y	N	N		N
	Chemical	Y	N	N		N

No	Process Step	Decision Tree Codex 1997				CCP Y/N
		Q1	Q2	Q3	Q4	
14	Chilling					
	Biological	Y	Y			Yes CCP 2B
15	Dispatch Storage					
	Biological	Y	N	N		N
16	Distribution					
	Biological	Y	N	N		N

Table 4.15: HACCP Control Chart-Chicken Ham

CCP No	Process Step	Critical Limits	Monitoring Procedure	Corrective Action	Documentation
CCP 1C	Weighing of Non-meat ingredients (restricted ingredient: E 250)	125ppm/1Kg of meat (max.) (SLS 11462001)	**How:** Formulation records checking **When:** Each batch **Who:** Formulation operator	**How:** 1.Place product on hold 2.Identify and eliminate cause of deviation. 3. Bring CCP under control after corrective action is taken. 4. Take action to prevent reoccurrence. **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Holding Log 2.Formulation Chart 3.Deviation/ Corrective Action Log 3.Weighing Scale device Calibration Chart 4.Verification Log
CCP 1B	Cooking	Core temperature 64°C for 115sec (FSIS: Appendix A)	**How:** Temperature and Time Monitoring Devices **When:** Each batch **Who:** Chamber operator	**How:** 1. Identify and eliminate cause of deviation. 2. Bring CCP under control after corrective action is taken. 3. Take action to prevent reoccurrence. 4. If not in proper manner, procedure for rework **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Temperature/Time Log 2.Cooking Chart 3.Deviation/ Corrective Action Log 3.Temperature Monitoring Device Calibration Chart 4.Verification Log

CCP No	Process Step	Critical Limits	Monitoring Procedure	Corrective Action	Documentation
CCP 2B	Chilling	Temperature 10°C or below (FSIS: Appendix B)	**How:** Temperature and Time Monitoring Devices **When:** Three Times a Day **Who:** Storage Operator	**How:** 1. Identify and eliminate cause of deviation. 2. Bring CCP under control after corrective action is taken. 3. Take action to prevent reoccurrence. 4. If spoiled rejected from human consumption **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Temperature/Time Log 2.Chilling Chart 3.Deviation/ Corrective Action Log 3.Temperature Monitoring Device Calibration Chart 4.Verification Log
CCP 3B	Vacuum Packaging	No any vacuum leaked product allowed	**How:** Visual Inspection **When:** Each and Every Product **Who:** Machine Operator	**How:** 1. Identify and eliminate cause of deviation. 2. Bring CCP under control after corrective action is taken. 3. Take action to prevent reoccurrence. 4. If not in proper manner, procedure for rework **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Temperature/Time Log 2.Packaging Chart 3.Deviation/ Corrective Action Log 3.Package Machine Calibration Chart 4.Verification Log

Table 4.16:Verification Chat-Chicken Ham

CCP No	Process Step	Verification Procedure
CCP 1C	Weighing of Non-meat ingredients (restricted ingredient: E 250)	1.Visual observation of monitoring activity by Production Manager or designee. 2. Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review formulating charts. 4.Weekly calibration and/or verification of weighing scale device by Production Manager or designee
CCP 1B	Cooking	1.Visual observation of monitoring activity by Production Manager or designe. 2.Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review cooking charts. 4.Weekly calibration and/or verification of temperature monitoring device by Production Manager or designee.
CCP 2B	Chilling	1.Weekly internal product temperature in Chiller by Production Manager or designee. 2. Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review chilling charts. 4.Weekly calibration and/or verification of temperature monitoring device by Production Manager or designee.
CCP 3B	Vacuum Packaging	1. Visual observation of monitoring activity by Production Manager or designee. 2. Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review Packaging charts. 4.Weekly calibration and/or verification of Package Machine by Production Manager or designee

4.1.8 Streaky and Back Bacon.

4.1.8.1 Product Description and Intended use

4.1.8.1.1 Ingredients

4.1.8.1.1.1 Restricted Ingredients

Nitrite (E 250)

Phosphate (E 450 b)

Anti-oxidant (E 300)

4.1.8.1.1.2 Others Ingredients

Iodized Salt

Sugar (Glucose)

Flavor Enhancer (E 621)

4.1.8.1.2 Packing Materials

Low Density Polyethylene (LDP)

Cardboard boxes

4.1.8.1.3 Product Specification

4.1.8.1.3.1 Microbiology

TPC (cfu/g) : $1x10^5$

E. coli (1g) :Absent

S. aureus (1g) :100

Salmonellae (25g) :Absent

4.1.8.1.3.2 Chemistry

NaCl content :05% by mass (max.)

Total meat content :40% by mass (max.)

Nitrite content : 125ppm(max.)

Protein content : 09% by mass (max.)

4.1.8.1.4 Pack size

Pack in polyethylene and cardboard boxes as 2kg

4.1.8.1.5 Shelf life

6 month from the date of manufacture

Storage and distribute at freeze condition (-18°C)

4.1.8.1.6 Intended Use

General public consumer instructions are as follows:

Keep freeze temperature (-18°C) until ready to use

Defrost fully, and then serve in a salad or sandwich, pre-cooked, no need to boil

4.1.8.2: Process Flow Diagram – Streaky and Back Bacon

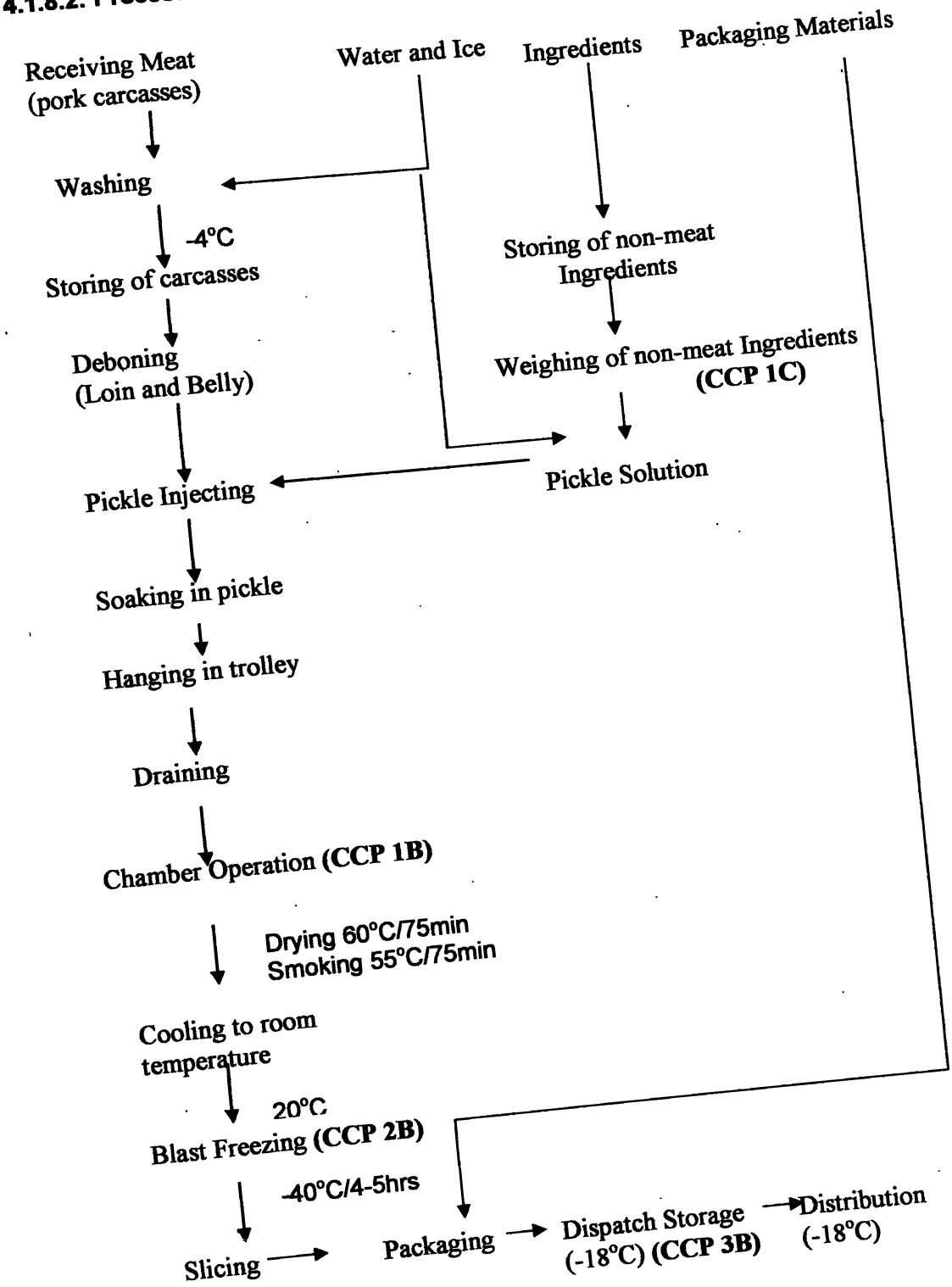


Figure 4.5: Process Flow Diagram – Streaky and Back Bacon

Table 4.17: Hazard Analysis Chart-Streaky and Back Bacon

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
1 1a	Receiving of Raw Materials Meat (Pork Carcasses)	B-presence of pathogenic organisms; *Salmonellae, Yersinia enterocolitica, C. botulinum, L. monocytogenes, Trichinelis* and *Toxoplasma gondii*	Supplier Quality Assurance certificate In-house laboratory testing Effective cooking step at 11
		P-presence of Bristles	Supplier Quality Assurance certificate
		C-contaminated with drugs, antibiotics, growth promoters and pesticide residues	Supplier Quality Assurance certificate
1b	Ingredients	B-spores contamination of bacteria, yeast and moulds	Supplier Quality Assurance certificate In-house laboratory testing Effective cooking step at 11
		P-presence of metallic and non-metallic foreign matter Insects, rodents and their excrete matter	Supplier Quality Assurance certificate Visual inspection at point of receiving
1c	Packaging Materials	B-presence of swab	Supplier Quality Assurance certificate In-house laboratory testing (swab test consignment)
		P-presence of impurities	Supplier Quality Assurance certificate
1d	Water and Ice	B-presence of pathogenic organisms; bacteria, parasites and protozoa	CMC water used In-house laboratory testing for Chlorine, PH, Alkalinity, Microbes Effective cooking at step 11
		P-inert matter contamination	Colombo Municipal Council (CMC) water used In-house laboratory testing for turbidity

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
		C-heavy metal contamination	CMC water used In-house laboratory testing for turbidity
2	Washing	B-presence of pathogenic organisms due to poor quality water used	Tested water used at step 1d
		P-inert matter contamination due to poor quality water used	Tested water used at step 1d
		C-heavy metal contamination due to poor quality water used	Tested water used at step 1d
3a	Storing of Meat (Pork carcasses)	B-growth of pathogenic organisms and enzymatic decomposition due to temperature abused	Correct setting of chilling temperature (0°c to –5°c) and time Observe good storage practices First In First Out approach Effective cooking at step 11
3b	Storing of non-meat ingredients	B-growth of yeast and moulds	Keep dry store well ventilated Observe good storage practices First In First Out approach
4	Weighing of non-meat ingredients	C-excessive amount of Nitrite cause potential health risk	Properly weigh Nitrite at appropriate formulation using appropriately train and skill employees Supervision for spice room format No: WI P 0500
5	Pickling	B-contamination through equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C)
		P-inert matter contamination	Visual inspection Random checking of pickle ingredients
		C-hazard due to incorrect pickle concentration due to careless handling	Appointed skill and train employees
6	Deboning	B-contamination through equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C)
		P-presence of bone particles and metal fragments	Visual inspection for bone fragments Metal detection later in process(metal detecting is recommended after vacuum packaging)

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
7	Pickle Injecting	B-contamination through equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C)
		C-uneven pickle injecting	Strict adherence to scheduled pressure and speed Appointed train and skill employees
8	Socking in pickle solution	B-contamination through equipment and operators	Maintain low factory temperature (20°C) and time (8hrs) Observe good hygiene practices As soon as cover the tub
		C-contaminated with oil and grease	Apply food grade oil and grease
9	Hanging by hooks in trollies	B-contamination through equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C) Avoid touching food with bare hands and soiled utensils
10	Draining	B-contamination through equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C) Avoid touching food with bare hands and soiled utensils
11	Chamber Operation	B-growth of pathogenic bacteria due to incorrect temperature and time combination	Strict adherence to scheduled temperature and time combination Fill the format No: WI P 07
12	Cooling	B-cross contamination though equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C) Avoid touching food with bare hands and soiled utensils
13	Blast Freezing	B-growth of pathogenic organisms due to incorrect temperature and time	Correct temperature and time combination (-40°C, 4-5hrs) Restrict the open and entrance to Blast Freezer room First In First Out approach Fill the format No: WI P 02
14	Slicing	B- contamination though equipment and operators	Observe good hygiene practices Maintain low factory temperature (20°C) Avoid touching food with bare hands and soiled utensils

No	Process Step	Potential Hazard and Possible Causes B-biological C-chemical P-physical	Control Measures
			After slicing as soon as possible vacuum pack
		P- inert matter contamination	Visual inspection
15	Packaging	B-growth of pathogenic organisms due to correct packed and contamination trough equipment and operators	Observe good hygiene practices Avoid touching food with bare hands and soiled utensils Maintain low factory temperature (20°C) Visual inspection of seals before startup and then regularly
		P-incorrect packing details	Random checking of packing details
		C-improper packing leads to some abnormal chemical reactions	Separate personnel for vacuum checking Fill the format No: WI P 08
16	Dispatch Storage	B - growth of pathogenic organisms	Correct setting of freezer temperature –18°C Observe good hygiene practices First In First Out approach
17	Distribution	B - growth of pathogenic organisms	Correct setting of freezer temperature -18°C in Distributing truck Observe good hygiene practices

Table 4.18: Process Steps Decision Matrix-Streaky and Back Bacon

No	Process Step	Decision Tree Codex 1997				CCP Y/N
		Q1	Q2	Q3	Q4	
1	Receiving of Raw Materials					
1a	Meat(Pork Carcasses)					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	N		N
	Chemical	Y	N	N		N
1b	Water and Ice					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
	Chemical	Y	N	Y	Y	N
1c	Ingredients					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
1d	Packaging Materials					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
2	Washing					
	Biological	Y	N	Y	Y	N
	Physical	Y	N	Y	Y	N
	Chemical	Y	N	Y	Y	N
3a	Storing of Raw Meat					
	Biological	Y	N	Y	Y	N
3b	Storing of Non-Meat Ingredients					
	Biological	Y	N	Y	Y	N
4	Weighing of non-meat ingredients					
	Chemical	Y	N	N		N
5	Pickle Solution					
		Y	Y			Yes CCP1C

No	Process Step	Decision Tree Codex 1997				CCP Y/N
		Q1	Q2	Q3	Q4	
	Biological	Y	N	N		N
	Physical	Y	N	N		N
6	Deboning					
	Biological	Y	N	N		N
	Physical	Y	N	Y	Y	N
7	Pickle Injecting					
	Biological	Y	N	N		N
	Chemical	Y	N	N		N
8	Soaking in pickle solution					
	Biological	Y	N	N		N
9	Hanging by hooks in trolleys					
	Biological	Y	N	N		N
10	Draining					
	Biological	Y	N	N		N
11	Chamber Operation (Cooking)					
	Biological	Y	Y			Yes CCP1B
12	Cooling					
	Biological	Y	N	N		N
13	Blast Freezing					
	Biological	Y	Y			Yes CCP2B
14	Slicing					
	Biological	Y	N	N		N
	Physical	Y	N	N		N
15	Packaging					
	Biological	Y	N	Y	Y	N

No	Process Step	Decision Tree Codex 1997				CCP Y/N
		Q1	Q2	Q3	Q4	
	Physical	Y	N	N		N
	Chemical	Y	N	N		N
16	Dispatch Storage					
	Biological	Y	Y			Yes CCP3B
17	Distribution					
	Biological	Y	N	N		N
	Biological	Y	N	N		N

Table 4.19: HACCP Control Chart- Streaky and Back Bacon

CCP No	Process Step	Critical Limits	Monitoring Procedure	Corrective Action	Documentation
CCP 1C	Weighing of Non-meat ingredients (restricted ingredient: E 250)	125ppm/1Kg of meat (max.) (SLS 342:2001)	**How:** Formulation records checking **When:** Each batch **Who:** Formulation operator	**How:** 1.Place product on hold 2.Identify and eliminate cause of deviation. 3. Bring CCP under control after corrective action is taken. 4. Take action to prevent reoccurrence. **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Holding Log 2.Formulation Chart 3.Deviation/ Corrective Action Log 3.Weighing Scale device Calibration Chart 4.Verification Log
CCP 1B	Drying	Core temperature 50°C for 30min (FSIS: Appendix A)	**How:** Temperature and Time Monitoring Devices **When:** Each batch **Who:** Chamber operator	**How:** 1. Identify and eliminate cause of deviation. 2. Bring CCP under control after corrective action is taken. 3. Take action to prevent reoccurrence. 4. If not in proper manner, procedure for rework **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Temperature/Time Log 2.Cooking Chart 3.Deviation/ Corrective Action Log 3.Temperature Monitoring Device Calibration Chart 4.Verification Log

CCP No	Process Step	Critical Limits	Monitoring Procedure	Corrective Action	Documentation
CCP 2B	Blast Freezing	Freeze to −18°C for 3hrs (SLS 1161: 1997)	**How:** Temperature and Time Monitoring Devices **When:** Three Times a Day **Who:** Storage Operator	**How:** 1. Identify and eliminate cause of deviation. 2. Bring CCP under control after corrective action is taken. 3. Take action to prevent reoccurrence. 4. If spoiled rejected from human consumption **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Temperature/Time Log 2.Blast Freeze Chart 3.Deviation/ Corrective Action Log 3.Temperature Monitoring Device Calibration Chart 4.Verification Log
CCP 3B	Dispatch Storage	Freeze to −18°C for 3hrs (SLS 1161: 1997)	**How:** Temperature and Time Monitoring Devices **When:** Three Times a Day **Who:** Storage Operator	**How:** 1. Identify and eliminate cause of deviation. 2. Bring CCP under control after corrective action is taken. 3. Take action to prevent reoccurrence. 4. If spoiled rejected from human consumption **Who:** 1.Production Manager 2.QA department 3.Maintenance	1.Temperature/Time Log 2.Freezing Chart 3.Deviation/ Corrective Action Log 3.Temperature Monitoring Device Calibration Chart 4.Verification Log

Table 4.20: Verification Chart- Streaky and Back Bacon

CCP No	Process Step	Verification Procedure
CCP 1C	Weighing of Non-meat ingredients (restricted ingredient: E 250)	1.Visual observation of monitoring activity by Production Manager or designee. 2. Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review formulating charts. 4.Weekly calibration and/or verification of weighing scale device by Production Manager or designee
CCP 1B	Drying	1.Visual observation of monitoring activity by Production Manager or designe. 2.Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review cooking charts. 4.Weekly calibration and/or verification of temperature monitoring device by Production Manager or designee.
CCP 2B	Blast Freezing	1Weekly internal product temperature in Blast Freezer Storage by Production Manager or designee. 2. Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review Dispatch Storage charts. 4.Weekly calibration and/or verification of temperature monitoring device by Production Manager or designee.
CCP 3B	Dispatch Storage	1.Weekly internal product temperature in Dispatch Storage by Production Manager or designee. 2. Every days of manufacturing, Production Manager or designee will review records. 3.Production Manager or designee will review Dispatch Storage charts. 4.Weekly calibration and/or verification of temperature monitoring device by Production Manager or designee.

4.2 DISCUSSION

HACCP is a systematic approach that could be assured the product is safe from hazards like biological, chemical and physical. By application of HACCP system to Food Company, it could be obtained more benefits with increasing customer's confidence.

Being a rational company in Sri Lanka, Cargills Quality Foods (Pvt.) Ltd markets 80-100 different varieties of processed meat products to the market. Among those products especially Chicken Sausages, Chicken Meatballs, Chicken Ham, Cooked Ham, Back Bacon, and Streaky Bacon receive a higher demand at the market. Almost customer preferable those products, which were subjected to apply HACCP concept to achieve hazards free or safe product.

In those products, from receiving to distribution of product, all hazards were identified as mentioned in tables under results. Receiving of fresh meat ingredients, Chicken as Chicken Breast Meat, Mechanically Deboned Meat (MDM), Mechanically Separated Meat (MSM), Loose Meat and Pork Carcasses could be contaminated with all potential hazards. Non-meat ingredients, Spices (Pepper, Nutmeg, Mace, Garlic, Cumin, etc), restricted ingredients (Sodium Nitrites), other ingredients, Water and Ice and Packaging Materials are covered under Supplier Quality Assurance (SQA) programs. Spices, which are added before cooking process, therefore potential hazards could be controlled by using, treated spices (eg: *Salmonellae* in Pepper).

At principle 2: Identification of Critical Control Points, all of CCPs which are established throughout receiving to distribution of the product by using Decision Tree. Out of CCPs, other process steps were covered under Good Manufacturing Practices (GMPs).

Accordance of Decision Tree, Identified CCPs of products are mentioned as follows:

1.Weighing of non-meat ingredient (restricted ingredient-Nitrite)
2.Cooking in Chamber and Drying (Bacon)
3.Vacuum Packaging
4.Storage (Chiller and Blast Freezer)

4.2.1 Weighing of non-meat ingredient (restricted ingredient-Nitrite)

The hazards of primary concern during formulating (eg: preparing of pickle solutions, boning, Weighing, pumping, grinding, blending, mixing and tumbling) are chemical and physical in nature, the potential chemical hazards include adding excess Sodium Nitrite and inadvertent mixing of meat from different species of animals. The physical hazards include bone fragments, metal glass and other foreign material. Buying ingredients from supplier with effective SQA system and verifying control by monitoring ingredients as they are received and used best controls these.

Nitrates and nitrites must be used with caution during curing. Both are poisonous and therefore, strict limits, the maximum level for all studied products is 125mg per Kg of meat, on their use have been established. Excessive use of nitrates and nitrites not only presents a health hazard but may also result in nitrite burn that is a green or white discoloration in the cured meat. In addition to the color role these products perform other very critical functions in cured meats. Nitrates and nitrites have a pronounced effect on flavor. They further affect flavor by acting as a powerful antioxidant. Antioxidants are compounds that prevent the development of oxidative rancidity. The bacteriostatic properties of nitrites are also important in cured meats. Sodium nitrite is a very effective inhibitor of the growth of *Clostridia*, particularly *Clostridium botulinum*, the bacteria that causes botulism. Without nitrite you could not safely produce almost meat products. Nitrate in itself is not effective in producing the curing reaction. It must first be broken down to nitrite by microorganisms to cause color change. Only small amounts of nitrites are needed, they must be handled carefully. To insure distribution they should be carefully dissolved in the brine and the brine properly mixed. Premixed cures offer a simple solution to the control problem. Many suppliers have a mixture of salt and nitrite that is often sold to customers. If Nitrite level keep between 100ppm and 125ppm, there would not be health risk but if it is increased the maximum level it cause carcinogenic problem to human and decreased from the minimum level it cause quality level of the product.

4.2.2 Cooking in Chamber

Cooking is to prevent excessive microbial multiplication during heating, before lethal temperatures are reached. Pathogens can multiply during very slow heating in the range of 10°C (50°F) to 52°C (126°F). Accordance of the SLSI Standards for these products should be prevented from *Escherchia coli* 0157: H7, *Staphylococcus aureus* and *Salmonellae*. Thermal inactivation of *Escherchia coli* 0157: H7 is more sensitive to heat than typical

Salmonellae spp. hence, heat treatments that are sufficient to kill *Salmonella* should also kill *Escherchia coli* 0157: H7. Accumulation of heat stable toxin (eg: enterotoxin of *Salmonellae)* could be result during the heating range of10°C to 52°C. When lethal temperatures are reached then the vegetative cells would be destroyed.

In large diameter products the risk of non-spore forming pathogens surviving the cooking process should be negligible. The minimum USDA (United State Department of Agriculture) temperature requirements for these products, eg: Cooked Ham and Chicken Ham often exceed the minimum needed for microbiological safety. In addition, the slow penetration of heat results in substantial thermal destruction, particularly as temperatures exceed 60°C.

Critical Limits for all Critical Control Points identified are mentioned in tables under each and every products. The temperature of the cooking process is an obvious Critical Limits since it kills vegetative pathogenic bacteria. The recommendation of cooking core/internal temperature is designed to reduce vegetative pathogens to negligible levels. Sufficient heating to obtain a 7-$\log_{10}$ reduction of *Salmonella* per g of an enteric pathogens in the coldest area of the product. The Critical Limits could be visual observation if the correct temperature has been reached. All Critical Limits of products can be denoted as follows:

Table 4.21 Critical limits of products

Product Name	**Critical Limits**	
	Core Temperature	**Time**
Chicken Sausage	68°C/155°F	23sec
Chicken Meatballs	68°C/155°F	23sec
Chicken Ham	64°C/148°F	115sec
Cooked Ham	64°C/148°F	115sec
Streaky and Back Bacon	50°C	30min

Source: (USDA: FSIS: Appendix A)

4.2.3 Vacuum Packaging

Under HACCP study, Vacuum packed products are Chicken Sausage, Chicken Meatball, Chicken Ham and Cooked Ham exception of Bacon. After cooking stage, the product should be vacuum packed, this is the third CCP has been found in here. In this stage the product could be cross contamination in case of poor management of packaging area because of that there is no reprocess on this manner. If there is any vacuum leaked product that could be contaminated with *Salmonella.* In the Vacuum Packaging stage, Critical Limit was any vacuum leaked product should not be allowed to leave. The risk of contamination with microbial pathogens is manageable with a suitable environmental control program and employee education.
Another hazard could be metal fragments from all over the process therefore Metal Detector just after Vacuum Packaging is recommended.

4.2.4 Storage (Chiller and Blast Freezer)

Meat and meat products are stored as Chilled products and Freeze products. Chicken Sausages, Chicken Meatballs and Bacon are stored in Blast Freezer condition. Cooked Ham and Chicken Ham are stored in Chillers. Most of Pathogens do not grow below 10°C and spores germination is not a problem. However, *Staphylococcus aureus* multiplies at 6.1°C although toxin production only occurs at 10°C or above. Since *Staphylococcus aureus* toxin is very heat stable it is not inactivating by reheating to 68°C, thus *Staphylococcus aureus* growth to sufficient level at 10°C or above for toxin production must be prevented.
Critical Limit of Freeze products is –18°C hold 3hrs.
Critical Limit of Chill products is –10°C or below.

Critical Limits, Monitoring Procedures, Corrective Actions, Verification Procedures and Record keeping should be applied for all of identified CCPs.

CHAPTER 05

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Critical Control Points (CCP) are not found in developed HACCP plan of raw materials for Chicken Sausage, Chicken Meatballs, Chicken Ham, Cooked Ham, Streaky and Back Bacon in Company. Decision tree concluded that weighing of restricted ingredients (Nitrite) NO_2^- level, cooking, blast freezing, cold storage (Chilling) and vacuum packaging are found as the critical control points.

Results of control chart and resources concluded that 125ppm of maximum Nitrite level for Weighing of restricted ingredients for all products, no any vacuum leaked product should be allowed to leave for vacuum packed products, 68°C for 23 seconds cooking temperature and -18°C for 3 hours blast freeze temperature for Chicken Sausages and Chicken Meatballs, 64°C for 115 seconds cooking temperature and 10°C or lower chilling temperature for Chicken Ham and Cooked Ham and Drying temperature for Streaky and Back Bacon is 50°C for 30min and -18°C for 3 hours blast freeze temperature established as critical limits of the manufacturing process.

Thermometer and scale calibrations, checking of related charts/logs are the verification activities.

5.2. Recommendation:

- Developing of a HACCP manual is suggested to implement for products.
- Introduction of metal detector after Vacuum packaging is suggested to implement for vacuum packed products.
- Since HACCP is most effective when used with other control systems. Total Quality Management programs or ISO 9000 and Standard Operating Procedures are suggested to apply.

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APPENDIX

Minimum internal temperature from 9 CFR, Section 318, Part B	
Temperature	**Time**
120 °F	21hr
122 °F	9.5 hr
124 °F	4.5 hr
126 °F	2 hr
128 °F	1 hr
130 °F	30min
132 °F	15 min

Selected time-temperature values from Appendix A1 (Appendix A FSIS Appendix A: Compliance guidelines for meeting lethality performance standards for certain meat and poultry products, June 1999)	
Final internal temperature	**Time**
140 °F	12min
145 °F	4min
148 °F	115sec
155 °F	23sec
158 °F	0sec (instantaneous)

Final internal temperature regulations	
Product	**Final internal temperature**
Cooked uncured poultry	160 °F
Cooked cured poultry	155 °F

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