HAZARD ANALYSIS CRITICAL CONTROL POINT(HACCP) SYSTEM FOR PROCESSED MEAT MANUFACTURING PROCESS

by

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This thesis is submitted in partial fulfillment of the requirements for the degree of

Bachelor of Science
in
Food science and Technology

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March 2004

Declaration

The work described in this thesis was carried out by me at Ceylon Agro Industries Limited and Faculty of Applied Sciences under the supervision of Mr. P.F.S. Pemasiri and Mrs. W.M.D. Priyadharshani. A report on this has not been submitted to any other university for another degree.

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AFFECTIONATELY DEDICATED TO MY EVER LOVING PARENTS, SISTER & WHO EVER PEOPLE HELPED TO ME FOR MY LIFE TIME

ACKNOWLEDGEMENT

First I should express my deepest gratitude to my external supervisor, Mr. P.F.S. Pemasiri, Quality Assurance/Research and Development Manager, Ceylon Agro Industries limited for his advice, encouragement and guidance throughout the study and sparing his valuable time in bringing this study to a successful completion.

I wish to express my sincere thanks to my internal supervisor Mrs. W.M.D.Priyadharshani, lecturer, Department of Natural Resources, Faculty of Applied Sciences, for her encouragement and guidance throughout this study and for reading the manuscript.

I would like to express my thanks to Mr. D.G.S.Dayarathna, Production Manager, Processed meat manufacturing plant, Ceylon Agro Industries limited for giving me opportunity to successful completion the study.

Finally I should thanks to the staff of Quality Assurance Department for their support in numerous ways.

ABSTRACT

In modern food processing industry it is necessary to use some preventive measure to control the all types of hazards. With this requirement the food safety system named Hazard Analysis Critical Control Point (HACCP) was used. To assure safety in chicken based meat products, chicken sausage, chicken meat balls and chicken rolls, in particular food manufacturing industry, The development of HACCP plan was started with setting up the HACCP team.

All hazards with the ingredients and the process steps were identified with their preventive measures. Critical Control Points(CCP) were identified with the aid of decision tree. According to identified hazards critical limits were established using control chart as a tool. Monitoring procedure were established for each critical limit. Verification procedures were identified and finally documentation was established.

No any critical control points were found for ingredients intended for chicken sausage, meat ball and chicken rolls. Supplier Quality Assurance (SQA) and air separation were the main element of controlling hazards, which are associated with raw materials.

Maximum of 125ppm and minimum of 100ppm No_3^- (Nitrate) level, (72°C-75.91 °C) oven cooking temperature, -18 °C for 3 hours blast freeze temperature, -15 °C for cold storage and transport temperature were identified as critical limits of the manufacturing process, and monitoring procedure were established in order to minimize deviation occurrence.

CONTENTS

LIST OF ABBREVIATIONS

CCP- Critical Control Point

CIP- Clean In Place

CODEX- Codex Alimentarius Commission,an FAO/WHO Organization

FAO- Food and Agriculture Organization

FDA- The us Food and Drug Administration

FIFO- First In,First Out- principle of stock rotation

FMEA-Failure Mode and Effect Analysis

FSIS- Food Safety Inspection Service

GMP-Good Manufacturing Practices

HACCP- Hazard Analysis Critical Control Point

ICMSF- International Commission for Microbiological Specification for Foods

ISO- International Organization for Standardization

LCL- Lower Control Limit

LSL- Lower Specification Limit

MDM- Mechanical Deboned Meat

MSM- Mechanical Seperated Meat

NACMCF- National Advisory Committee for Microbiological Criteria for Foods(USA)

NASA- National Aeronautics and Space Administration(USA)

PPM- Parts Per Million

SLS- Sri Lanka Standards

SPC- Statistical Process Control

SQA- Supplier Quality Assurance

SSOP- Standard Sanitory Operation Practice

UCL- Upper Control Limit

USL- Upper Specification Limit

WHO- World Health Organization

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CHAPTER 1- Introduction

1.1 Introduction:

Modern food processing industry will carry more amount of hazards during their operations hazard is a biological, chemical or physical property, or condition of food with the potential to cause an adverse health effect (Mortimore 1998). This health effect may be food borne disease, illness or injury. Hazards are mainly present as biological, chemical or physical forms.

Biological food hazards are mainly divide into two groups. One is microbiological hazard. Other one is macrobiological hazard.Macrobiological hazards are the presence of either flies or insects. Macrobiological hazards are the production of toxins by pathogenic microorganism. Most of the food-processing operations will be at risk from one or more biological hazards, either from raw materials or during the process.

Chemical contamination of food stuffs can happen at any stage of their production, from growing of the raw materials through to consumption of the finished product. The effect of chemical contamination of the consumer can be long term(such as for carcinogenic) or accumulative chemicals(eg:mercury) which can be short term such as the effect of allergenic foods.Cleaning chemicals, pesticides, toxic metals, allergens, nitrite/nitrates are the main chemical hazard issues in food prodcts.

Physical hazards often refered to as extraneous materials or foreign objects. These hzards also can enter a food product at any stage in it's production.Some of this type of physical hazards described as macrobiological, But only a few of these are hazards to food safety. Glass,metal,wood,plastic,intrinsic materials are the examples for physical hazards.

When we consider the modern food processing company it is necessary to use some preventive measures to control all types of hazards.With these requirements the food safety system named Hazard Analysis Critical Control Point(HACCP) was born.

HACCP is a system of food control based on prevention.In identifying where the hazards are likely to occur in the process, we have the opportunity to put in place

The measures needed to prevent those hazards occurring. The primary objective of a HACCP program is to produce reliably safe food.Which is defined as product that is free of biological, chemical or physical hazards.This will facilitate the move towards a preventative quality assurance approach within a food business, reducing the traditional reliance on end-product inspection and testing.

Use of a HACCP system should therefore give the growers, manufacturers, caterers and retailers confidence that the food they provide is safe. Effective implementation of HACCP system can involve every one in the company and each employee has a role to play.

HACCP system consist with 7 principles.First,by building the controls into the process, failures can be identified at an early stage and therefore less finished product will be rejected at the end of the production line. Secondly, by identifying the critical control points, a limited technical resource can be targeted at the management of these. Thirdly, the discipline of applying HACCP are such that there is almost always going to be an improvement in product quality.

By using of this HACCP system it will give a confidence that food safety is being managed effectively. Chicken based processed meat products like sausages, meatballs, chicken rolls, will carry many hazards contaminating from slaughtering to manufacture. Under this condition application of HACCP system can eliminate or minimize hazard in order to maintain high standard of food safety.

1.2 Objectives:

- Produce a safe food minimizing or eliminating occurrence of hazards at consumer satisfaction level.
- To identify and minimize the specific kind of hazards that are present in the production flow.
- To determine the critical control points, establish critical limits for the control measures and to establish a monitoring system

CHAPTER 2- Literature Review

2.1 Origin of HACCP :

The concepts underlying the Hazard Analysis and Critical Control Point(HACCP) system was developed originally as a Microbiological safety system in the early days of the US manned space programme.as it was vital to ensure the safety of food for the astronauts.At that time, most food safety and quality systems were based on end-product testing,but it was realized that it won't be achieved hundred percent assurance of food safety.After that a preventive system was required which could give a high level of food safety assurance, and the HACCP system was born.

The originally system was first used by the Pillsbury company working alongside NASA and the US Army Laboratories at Natick.It was based on the engineering system,Failure, Mode and Effect Analysis (FMEA) ,which looks at what could potentially go wrong at each stage in an operation together with possible causes and the likely effect .Effective control mechanisms are prevented from occurring.like FMEA,HACCP looks for hazard ,or what could go wrong ,but in the product –safety sense.controls are then implemented to ensure that the product is safe and cannot cause harm to the consumer.

The first HACCP guidelines published in 1973 by the Pillsbury company ,was used to train FDA inspectors in HACCP principles during the process of canned acidified and low-acid foods packed in hermetically sealed containers.This initiated the first widespread use of a food safety regulation based on HACCP principles.AT that time three HACCP principles were in general use.

1.Assessment of hazards associated with growing , harvesting ,processing and manufacturing ,distribution ,marketing ,preparation, and or use of a given raw material or food product.

2.Determination of Critical Control Points required to control any identified hazards.

3.Establishment of procedures to monitor Critical Control Points.

The first standardized system in the united states was developed by the U.S. National Advisory Committee on Microbiological Criteria for Foods.(NACMCF) in 1989 and had seven principles.These are not fundamentally changed since then but there have been numerous change in their application (Donald A and Corlett Jr, 1998).

2.2. HACCP system and food safety:

HACCP is a system of food control based on prevention.In identifying where the hazards are likely to occur in the process, should have to prevent those hazards occurring.This will facilitate the move towards a preventative quality assurance approach within a food business, reducing the traditional reliance on end-product inspection and testing(Donald.A.Corlett,jr.1998). All types of food safety hazards are considered as part of the HACCP system.Use of a HACCP system should therefore give the growers,manufacturers,caters and retailers confidence that the food they provide is safe.But the producers will produce the unsafe food it will be formed a food borne disease.This is the one of the largest public health problem in world wide.This also an important cause of reduced economic productivity.

The importance of the HACCP approaches as a means of preventing foodborne illness has long recognized by the world health organization and many governments in worldwide. HACCP was developed as a simple method of helping manufacturers assure the provision of safe food to the consumer.When we consider about things the food must be safe because of governments require safe food,consumers demand safe food and a company must produce safe food to survive as a business.

2.3 world wide evaluation of the HACCP system:

The hazard analysis and critical control point food safety system (HACCP),may be used to any type of prepared ,processed,or preserved food. The HACCP has been around for thirty years, it is only now undergoing rapid expansion in the U.S.food industry.HACCP is a scientifically based protocol that is applied directly to the food procurement,production and distribution process.beginning in the early 1990 s,some large multinational food companies began requiring that their suppliers and vendors adopt the HACCP system.Regulatory use of HACCP began in 1973,with theU.S food and drug administration's (USFDA) canned food regulation major regulatory application began in late 1995 with promulgation of the FDA's mandatory HACCP regulation for domestic and imported fish and fishery products.This was followed in 1996 by the Food Safety and Inspection service ,U.S.Department of Agriculture(FSIS-USDA) HACCP regulation covering domestic and imported meat and poultry products.

Sanitation Standard and Operating Procedures(SSOP'S) are new type of requirement in the FDA and USDA HACCP regulations.SSOP'S are specific sanitation and related good manufacturing practices that must be developed in a food company to provide a solid foundation for HACCP implementation.

In 1995 it was developed the FDA fish and fishery , and 1996 FSIF-USDA meat and poultry HACCP regulations.because of the regulatory use of the 19992 NACMCF HACCP system ,it

is expected to have application for some time.In early 1998,all seafood processors must comply with the FDA fishery regulation,and large meat poultry processors must comply with the FSIS – USDA regulation.

The 1992 NACMSF system will be replaced by the new 1997 NACMCF HACCP system approved by the NACMCF on august 14,1997.In addition international HACCP programes are expected to be influenced by the june 1997 approval of the UN/FAO Codex Alimentarious HACCP system,which is the standard for international use.The two HACCP systems are similar ,but not identical.there are,however ,differences in the way some principles are applied.

One difference that will be noted by pearsons using the 1992 NACMCF system is that the record-keeping and verification principles traded place in the 1997 NACMCF system.Verification became principle 6 and record-keeping became 7 in the 1997 NACMCF system.This manual is familiarize the reader with the HACCP systems used in the united states as of this writing a complete text of the 1992 (Document1)and 1997 (Document2) NACMCF systems,and the 1997 Codex(Document3)NACMCF systems,are included.

2.4. HACCP definitions and principles:

HACCP is a preventative system of food control.The system when properly applied can be used to control any area or point in the food system that could contribute to a hazardous situation,whether it be from contaminants,pathogenic microorganisms,physical objects,chemicals,raw materials a process, user directions for the consumer or storage conditions(Mortimore1998).The hazard analysis portion of HACCP involves a systematic study of the ingredients, the food product, the conditions of processing, handling, storage, packaging, distribution and consumer use (Mortimor, 1998).

2.4.1.Preliminary steps of HACCP plan

In case of preliminary step of the HACCP plan it contain 5 steps.

2.4.1.1. Assemble the HACCP team:

The HACCP is not carried out by one person alone. But is the result of a multi-disciplinary team effort of the HACCP team. After assemble the HACCP team it is necessary train the team properly. It is recommended that as a minimum the core HACCP team consists of experts."expert" meaning is having knowledge and experience in purticular area. According to Mortimore,1998 experts from following area is essential in developing a team.

1.Quality Assurance/Technical:

Providing expertise in microbiological,chemical and physical hazards,an understanding of the risks,and knowledge of measures that can be taken to control the hazards.

2.Operation or Production:

The person who has responsibility for and detailed knowledge of the day- to- day operational activities required in order to produce the product.

3.Engineering:

He should be able to provide a working knowledge of process equipment and environment with respect to hygiene design and process capability.

4.Additional expertise:

this may be provided both from within the company and from external consultancies.normally the following areas should be considered.

- Supplier Quality Assurance
- Research and Development
- Distribution
- Purchasing
- Microbiologist
- Toxicologist
- HACCP expert

2.4.1.2. Describe the product:

At this stage a product description may be constructed for two reasons.Firstly ,it is essential that the HACCP team is fully familiarized with the products and process technologies to be covered by the HACCP plan.Secondly the product description acts as an introduction and point of historical reference to the HACCP plan.When describe the product we have to consider about the product varieties,labeling instructions, packing material type, shelf life,ingredients like things.

2.4.1.3. Describe the intended use:

This will be useful to identify who are the likely purchase or consumers of the product are.Some groups of the population ,elderly, very young , sick or immune-compromised are much more susceptible to some hazards. It is necessary to lable it appropriately.

2.4.1.4. Construct a flow diagram:

The process flow diagram is used as the basis of the hazard analysis and must therefore contain sufficient technical detail for the study to progress.The prosess flow diagram should be carefully constructed by members of the HACCP team as an accurate representation of the process, and should cover all stages from raw materials to end product.Normally for construct the flow diagram following type of data is being used.

1. Details of all raw materials and product packaging.
2. Details of all process activities.
3. Temperature and time profile for all stages.
4. Types of equipment and design features.
5. Floor plan.

2.4.1.5. Confirm the process flow diagram:

When the process flow diagrum is complete it must be verified by the HACCP team prior to the hazard assessment stage. This involves team members watching the process in action to make sure that what happens is the same as what is written down, and may also involve going in on the shift to ensure that any alternatives are included. After complete it, the HACCP team should have to compare with the factory layout.

2.4.2. Secondary steps of HACCP plan:

The secondary steps of the HACCP plan consist with the 7 principles of the HACCP system.

2.4.2.1. Conduct Hazard Analysis

This is one of the key stages in any HACCP study as the team must ensure that all potential hazards are identified and considered.Hazard analysis is involve the collection and evaluation of information on hazards and conditions leading to their presence,in order to decide which are significant for food safety and therefore should be addressed in the HACCP plan.

The basic three steps procedure for the HACCP team to use in conducting the hazard analysis on a specific food product and its process is,

1.prepare a list of steps in the process. This commonly oncludes listing raw materials and ingredients,process steps and packaging.

2.Identify potential or likely hazards at each step .

3.Describe the control measures.

Prepare a list of steps in the process:

First ,sequentially list all the raw materials and ingredients and process steps column.Second,sequentially list all process steps on the flow diagrum.After above two steps the team is ready to determine where hazards may occur.

Identify potential hazards:

The team may now determine if there are biological,chemical or physical hazards or a combination of these ,that need to be controlled for each raw material. ingredient or process

step.Take one at a time and go down the list on the hazard analysis form (pierson and corlett, 1992).

Describe the control measures:

The inclusion of preventive measures in the hazard analysis developed by the NACMCF in 1992 was an important step in linking the hazard analysis to controls for the identified hazards.The preventive measures meaning is the placing limits on the presence of hazardous microorganisms or requiring testing of a food (pierson,1998).Heat pasteurization requirements, chilling and refrigeration time, and temperature limits ,requirement for food grade materials in packaging ,and use of metal detectors for the potential metal contamination are some examples for the common control measures used in hazard analysis.

2.4.2.2. Determine the Critical Control Points:

A critical control point (CCP) was defined in the 1992 NACMCF HACCP system as "a point, step or procedure in a food process at which control can be applied and ,as a result ,a food safety hazard can be prevented ,eliminated or reduced to acceptable levels. This critical control points(CCP) may be located at any point In the food production and manufacturing system for a food product where hazards need to be prevented.

Different facilities preparing the same food can differ in the risk of hazards and the points , steps ,or procedured that are CCP's.This can be due to differences in each facility such as layout , equipment ,selection of ingredients, or the process that is employed.There are number of approaches for determining what steps are critical control points.Most probably used to determine the CCP,s is the decision tree.Once CCP's are identified , the CCP number and a brief description of each may be entered on the flow diagram.

2.4.2.3. Determine the Critical Limits:

A critical limit is defined as "the maximum or minimum value to which a physical, biological or chemical parameter must be controlled at a critical control point to prevent, eliminate, or reduce to an acceptable level the occurrence of the identified food safety hazard"(Mortimore 1998).This third principle deals with establishing one or more maximum or minimum critical limits that must be controlled at a critical control point.A good example for the critical limit is minimum temperature and the minimum time needed to destroy hazardous microorganisms which is present in the food product. Numerous types of critical limits may be associated with a control measure. These may include temperature,time ,physical dimensions,humidity,moisture level e.t.c.The HACCP team should be considered when set the critical limit (CL) at the point that if not met the safety of the product may be

questionable. Critical limit may meet national/international regulations,company safety standards or scientifically proven values. Before set the critical limits the HACCP team should have an in-depth knowledge of the hazards and control mechanisms of the process.Before set the critical limits they have to important to know where they can obtain the information and advice. Possible sources of information are,

1.Published data:

Information in scientific literature, the internet ,industry and regulatory guide lines.(eg: CODEX, ICMSF,FDA,IDF)

2.Expert advice:

from consultants, research associations, plant and equipment manufacturers.

3.Experimental data:

These are from specific microbiological examination of the product and its ingredients.

4.Mathematical modeling:

Computer simulation of the survival and growth characteristics of microbiological hazards in food systems.

There are so many types of critical limits are available. Chemical limit ,Physical limit, Microbiological limit and Procedural limit are some examples for them.In case of practical matter it is advisable to set an operating limit that is more restrictive than the critical limit.In this way theHACCP team can adjust the process when the operating limit is come within the critical limit(Mortimore 1998)

2.4.2.4.Establish a Monitoring Procedure:

Term monitoring is to conduct a planned sequence of observations or measurements to access whether a CCP is under control and to produce an accurate record for future use in verification.

As, Mortimore,1998, mentioned Purposes of monitoring are:

1.It is essential to food safety management in that it facilitates tracking of the operation. if monitoring indicates that there is a trend toward loss of control, then action can be taken to bring the process back into control before a deviation from a critical limit occurs.

2.Monitoring is used to determine where there is loss of control and a deviation occurs at a CCP.

3.It provides written documentation for use in verification. Monitoring at CCPs can be done on a "continuous basis (100% check) or periodically.As continuous monitoring is reliable. It is

preformed wherever possible.If periodical checks are to be done gap between two checks shall be sufficient to detect deviations to assure safety.

Monitoring procedures ,ideally shall be rapid, because in continuous production process lengthy analytical testing are not practical. Normally physical and chemical measurements or visual observations are mostly employed. Microbiological tests are not often used due to time constrains. All monitoring equipment's at CCPs should be calibrated for accuracy.

Monitoring Procedure:

A monitoring procedure should be include following information.

- What to monitor
- How to monitor
- Frequency of monitoring
- Who will monitor

What to monitor:

Product or process characteristics, which are identified as critical limits, or operating limits are to be measured or observed.

Eg:Time and temperature of thermal process

Temperature of cold storage

P^H

Aw(water activity)

How to monitor:

Use quick methods. Operators at monitoring points shall be trained for correct use of monitoring equipment and taking measurements. eg:in a heat process temperature measurements shall be made at the coldest point.

Monitoring frequency:

To determine the monitoring frequency the HACCP team should have to consider about how much does the process vary,how close the operating limit to the critical limits,what is the risk that the processor prepared to take if there is undetected deviation.

Who will monitor:

Responsibility of monitoring at CCPs shall be clearly defined in the HACCP plan form.Those responsible for monitoring must be trained in monitoring techniques,be fully aware the importance of monitoring ,have ready access to monitoring activity and record and sign monitoring results.

2.4.2.5.Establish a Corrective action Procedure:

Corrective actions are defined as "any action to be take when the results of monitoring at the CCP indicate a loss of control"or in other words deviation from critical limits(pierson, 1992)

Procedure for corrective action:

This procedure shall cover the following.

1.Investigation to determine the cause of deviation.

2.Effective measures to prevent re -occurrence of the deviation.

3.Verification of the effectiveness of the corrective action.

There are mainly two types of action required in corrective actions.

- Control the non-compliant product and disposition
- Correct the cause of non-compliance.

Those actions taken need to be documented and kept for future reference.It is important to understand that at a CCP,deviations of different forms could take place thus more than one corrective actions is required.Deviations from operating limits are corrected by process adjustment(pierson,1992).

2.4.2.6. Establish a Verification Procedure:

Verification is the application of methods,procedures ,tools and other evaluations, in addition to monitoring to determine compliance with HACCP plan or effectiveness of the HACCP plan.

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

1.The frequency of the verification inspection and audits and who will do the audits. Audits may be conducted internally by line supervisors and the HACCP team ,and externally by the QA department or independent auditors.

2.Who will do the verification?the person(s) selected should not have produced the records and also should have successfully completed a course of instruction on HACCP or be responsible official of the company.

3.Procedures that verify that a ccp and it's critical limits are under control and monitoring equipment is 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 limit(s) are correspond to plant records.
- Whether the critical limit(s) are adequate for the hazard.
- Whether corrective actions are adequate.
- Whether records were kept, initiated ,and dated.
- Whether records were approved and dated.

4.Sampling and testing to verify the safety of critical control points and limits. Testing may be biological,chemical or physical.

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.

2.4.2.7. Establish record keeping and documentation procedure:

Establishing Record-keeping and documentation procedures is one of the important characteristics of the HACCP food safety system.Systematic record keeping begins with development and documentation of the HACCP plan.four types of records should be kept as part of the HACCP programme.

- Support documentation for developing the HACCP plan.
- Records generated by the HACCP system
- Documentation of methods and procedures use.
- Records of employee training programme.

They may be in any form,eg:processing chart ,written record,computerized record.

Support Documents:

The HACCP plan support documents include information and support data used to establish the HACCP plan such as the hazard analysis and records documenting the scientific basis for establishing the ccp's and critical limits.

Eg:

- Flow diagram
- Hazard analysis
- Identification of CCP's
- Product description and intended use.
- HACCP team information and responsibilities.
- Data used to establish the control measures to prevent microbiological growth.

- Data used to establish the adequacy of critical limits in ensuring the safety of the product.
- Documented deviation and corrective action plans.
- Planned verification activities and procedures.

Records generated by the HACCP system:

HACCP system records are kept to demonstrate adherence of the HACCP system with the HACCP plan.These records are used to demonstrate at ccp's in the food process. By tracking records generated by the HACCP system,an operator or manager can become aware that a process is approaching it's critical limit.

All records belongs to CCP's shall be documented in the relevant of the HACCP plan.Failure to record at a CCP is a critical departure from HACCP plan and is a critical non conformity.

Monitoring records for all CCP'S:

All HACCP monitoring records be kept on forms that contain the following information.

- Form title
- Time and date
- Product identification (product type,package size,processing line)
  Critical limits
- Monitoring observation or measurement

Deviation and corrective action records include the following information:

- Identification of the divalent lot-product.
- Amount of affected product in the deviant lot.
- Nature of the deviation.
- Information on the disposition of the lot.
- Description of the corrective action.

Verification records:

- In-house on-site inspection
- Equipment testing and evaluation.
- Accuracy and calibration of monitoring equipment.
- Results of verification activities ,including methods,date,individuals or organizations responsible.

Documentation of methods and procedure used:

- Description of the monitoring system for critical limits at of each ccp,including the methods and equipment used for monitoring the frequency of monitoring and the person performing the monitoring.
- Plans for corrective actions for critical limit.
- Description of record keeping procedures.
- Description of verification
- HACCP training records.

2.5. Food industry and HACCP:

The HACCP concept has been around in the food industry for some time, yet it continuous to be debated rigorously at international level. Developments in HACCP over the past 10 years or so have been fairly major, and some governments now see its implementation as a remedy for all of their country's food safety issues.

Those not familiar with HACCP often hold the misconceived belief that it is a difficult, complicated system which must be left to the experts ,and can only be done in large companies with plentiful resources. When we consider the food processing plant it need a certain level of expertise to carry out HACCP, but this expertise includes a thorough understanding of the products, raw materials and processes. with good training,everyone can be able to understand the concept, and it will be a key element of a broader product management system.

HACCP is a proven system which, if properly applied, will give confidence that food safety is being managed effectively.(Mortimore 1998)Therefore it will give the customers confidence in the safety of product operation and will indicate that a company is a professional company that takes its responsibilities seriously. HACCP will support to company in demonstrating this under food safety and food hygiene legislation, and in many countries it is actually legislative requirement.

2.5.1. Benefits of applying in food industry:

HACCP is the most effective method of maximizing product safety. It is a cost-effective system that targets resource to critical areas of processing, and in doing so reduces the risk of manufacturing and selling unsafe products.

Users of HACCP will almost certainly find that there are additional benefits in the area of product quality.This is primarily due to the increased awarness of hazards in general and the participation of people from all areas of the operation.many of the mechanisms that are controlling safety are also controlling product quality(Mortimore 1998).

2.6. Good manufacturing practices(G.M.P):

GMPs are like any policy program of the company has implemented.They require a written program, an appropriate training program and schedule ,a maintenance schedule, and most importantly management commitment(Guideline GMP's and SOPS,1998).

In case of this GMP program facilities and their surroundings should be designed ,constructed and maintained in a manner to prevent conditions that may result in the contamination of food.Included in this area are outside premises,building design and construction,sanitary facilities and water quality.

Outside premises:

All out side areas of the plant should be free of debris and refuse that might be a source of insect and or rodent infestation or cause objectionable odors or other contaminants. Road ways should be properly graded and paired to prevent dust and improper drainage. Standing water, weeds or materials that may pose a hazard to food and employees should also be eliminated to ensure that satisfactory conditions are maintained.

Buildings:

Facilities should be designed, constructed and maintained in good repair to permit easy cleaning, prevent entrance and harborage of pests and entry of environmental contaminants. Floors, walls and ceilings should be constructed of acceptable materials that are durable,smooth and cleanable.Only approved

Coatings and sealants should be used in these surfaces. All walls should be light colored to permit easy cleaning, and floors sufficiently sloped for liquids to drain to properly trapped outlets. windows should be properly screened if opened and doors close fitting.

Stairs, elevators and over head structures within the plant should also be designed and constructed so that there is no possibility of contamination of food or packaging materials.ventilation, where necessary to prevent steam, condensate and heat buildup, should be provided along with positive air pressure in microbiologically sensitive areas. Drainage and sewage systems must be properly designed and equipped with appropriate traps and vents. The traffic patterns of employees,equipment,materials,and product should be such that the possibility of cross contamination between raw and processed food products is eliminated.

Sanitary Facilities:

All washrooms,lunchrooms and change rooms should be separated from food processing areas and should be properly ventilated and maintained.Washrooms should be equipped with a sufficient number of properly installed sinks and plumbed with hot and cold potable water.Processing areas and areas where employees are in direct contact with

microbiologically sensitive product should contain conveniently located hand-washing stations controlled by foot,knee or a timer.

Water quality:

An adequate supply of potable water is of primary importance in sanitation programs and plant operations.There should be no cross-connections between potable and non-potable water supply systems.Non-potable water should not be used in food processing,packaging or storage areas.Ice must be made from potable water and protected from biological,chemical or physical contaminants.

Equipment/utensils:

All equipment or utensils in the production of food should be designed to ensure its sanitary handling.Equipment/utensils must also be maintained in a manner to prevent contamination of the food by microbiological,chemical or physical hazards.

Equipment/utensils design and installation:

All equipment/utensils should be constructed of non corrosion materials that can be cleaned easily. All food contact surfaces should be non-absorbent, non-toxic, smooth, free of pitting and able to withstand repeated cleaning and sanitizing.

Receiving and storage:

Receipt and storage of ingredients, packaging materials and other incoming materials should be conducted in a manner to prevent contamination of food. Inspection of ingredients and other materials should be performed in a sanitary manner to prevent direct or indirect contact with contaminating materials. Receipt of these materials should also be in an area. Separate from the processing area. Restricted materials (such as Nitrite or sulfites) should be stored in a locked area. Also, where applicable, storage of all incoming materials should be in temperature and humidity controlled areas. Any returned goods should be clearly identified and stored in a designated area.

Detergents, sanitizers or other chemical agents must be properly labeled, stored and used in a manner to prevent contamination of food, packaging materials and food contact surfaces. Chemicals must be stored and handled in an area that is kept well ventilated, dry and separate from any food processing areas.

Process control:

Process control deals with the functions directly related to the manufacturing process. This guideline will only focus on the GMPs that support a food safety system not the GMPs that cover economic and quality issues.

A few examples food safety oriented GMPs are employee hygiene,formulation control,labeling/code dating and reworking/reconditioning.

Manufacturing environment:

Conditions under which product is manufacturing are an essential part of a food safety system. Room temperature, product temperature and equipment settings are just a few areas that should be considered and monitored.

Employee hygiene:

Employee hygiene is a critical GMP for support of any food safety system. Hygiene practices should cover appropriate apparel, use of disposal gloves ,proper use of hair and beard nets, proper hand washing and sanitizing, use of tobacco and food, jewelery, nail polish, use of writing utensils and the list goes on. It is also important to define important employee practices such as traffic flow and appropriate behaviour.

Formulation Control:

Here what goes into the product is important for a variety of reasons, safety, quality and economic. Amounts used, vendor names/codes, item/part numbers, code dates/lot numbers of every ingredient should be monitored and recorded. It is important to record both the item/part number (what the item is) and the code date/lot number of each raw material(which one).Also ,any rework or other work in process product should be clearly recorded for trace back purposes. On a regular basis formulation records should be compared to both the incoming supply inventory and finished product inventory.

Labeling/code dating:

Applying the appropriate label and code date is important. The label identifies the product for customers and consumers. The code date allows to differentiate between production days and reduce exposure in the event of a crisis. Code dates should be able to provide place of production, date, time, production line and any other information that is pertinent to the facility. Whether the production line, shift will be single or multiple it should be indicated through the code dating system (Guideline GMP's and SOPS, 1998).

2.7. Processed meat and food safety issues:

Term processed meat product is the meat ,mixed with salt ,spices like seasoning agents(pearson and tauber, 1998). There are mainly three types of processed meat products are available. The classification of these type of meat products are as follows.

1.Sausages

2.Cured meat:

Bacon

Ham

3.Miscellanes products:

Meat ball
Chicken rolls
Cold meat
Lunchen meat

When we consider the chicken based processed meat products normally it will contain chicken sausages, meat balls and chicken rolls like products. The main ingredient which is used to produce the processed meat is meat.
When manufacturing process of the above meat products there is a possibility contamination of hazards. These hazards may be either biological, chemical or physical type ones. The biological hazard which is present in the chicken based processed meat products is *Salmonella.* 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.

2.7.1.Raw materials used in processed meat production:
Under processed meat production sausages ,meat balls and chicken rolls are considered. The common types of raw materials used to these products are chicken meat, mixed spices, salt, flavour enhancer, permitted preservatives and colouring.

2.7.1.1. Ingredients used in sausage production process:
In case of chicken sausages production following ingredients are used.
1.Chicken meat
2.Mixed spices
3.Binder
4.Salt
5.Milk powder
6.Flavour enhancer
7.Phosphate
8.Permitted preservatives
9.Colouring
Chicken meat:
Lean meat is the most important ingredient of sausages due to its role in water binding, maintaining the fat component of the mixture and in determining product cohesiveness. The higher the lean meat content, the higher the quality of the end-product. The lean meat must be not less than 50% of the minimum meat content(pearson and tauber 1984).

In practice much of the meat used in sausage manufacture is semi lean consisting of various trimmings, pork belly, flank, etc. This has consequences during processing, since it is not possible to add the meat and fat at separate stages.

Meat is the main ingredient used in sausage manufacturing process. Mechanically Deboned Meat(M.D.M),Mechanically Recovered Meat(M.R.M) and Mechanically separated Meat(M.S.M) are mainly used for sausage production.

Mixed spices:

Spices are aromatic substances derived from vegetative plants or herbs. various parts of the plants are used to produce different spices. For example, cloves come from the flower bud, nutmeg and pepper from the fruit, mace from the aril, cinnamon from the bark of a tree, and ginger from the rhizome. Cardamom, coriander ,and mustard are derived from aromatic seeds.

The aromatic properties of the spices are found in the volatile oils and oleoresins. The aroma and flavour of spices are attractive to man and have long been used as seasoning ingredients for food.

Spices contribute so much to sausage flavour that standardization is necessary to control seasoning formulations. Besides contributing to flavour spices provide some instant bacteriostatic and antioxidant properties. Natural spices are used most frequently for dry or semidry sausages.

The meat industry is reported to be the biggest single user of spices ,black pepper being the largest single item used. others used include all spice, basil, bayleaf, cardamom, capsicum, onion, garlic e.t.c. spices are small portion of the total ingredient cost of sausages.

Binders:

There is a wide variety of nonmeat products that meat processors can incorporate into sausages. These products are referred to as binders or extenders and less frequently as fillers ,emulsifiers, or stabilizers. They are added to meat formulations for one or more of the following reasons.

1. To reduce formulation cost.
2. To improve cooking yield
3. To improve slicing characteristics.
4. To improve flavour.
5. To increase the protein content.
6. To improve emulsion stability.
7. To improve fat binding
8. To increase water binding.

Normally in sausage production process, as a binders starch, vegetable flour, soy flour, soy protein concentrate are used(Wilson,1981).

Salt:

Salt for sausages must be of food-grade quality. salt(Nacl)serves three functions in sausages.

- It dissolves in water to form a brine which acts to retard microbial growth.
- Salt solubilizing the myosin type proteins of comminuted muscle for emulsifying the fat in emulsion sausages.
- It contributes to basic taste characteristics.(pearson and tauber 1984)

Milk powder:

A number of milk protein derivatives are also widely used in processed meat. Those products utilized in processed meats include Non Fat Dry Milk(NFDM),calcium-reduced Non Fat Dry Milk, dried whey, whey protein concentrate like things.

Permitted Preservatives:

The processing, handling and storage of sausages for today's markets has required the use of preservatives to meet the demands of modern consumers. Curing salt($NaNO_3$) is commonly used as a preservative. All the preservatives should be food-grade quality.

Curing salts($NaNO_3$):

The term "curing salt" refers to sodium or potassium nitrate and nitrite. Normally for sausage production it will be used 125ppm of maximum NO_3^- level(pearson and tauber 1984). If the NO_3^- level is exceed more than this amount it will form a nitrosoamine like compounds. This compound is carsinogenic one. So this may be a chemical hazard.

The lowest amount of NO_3^- used for sausage production is 100ppm. When the NO_3^- level is drop down below 100ppm it will form a biological hazard. In finished sausage, Nitrite produces a characteristic flavour. It imparts an antioxidant effect and protects the cooked products against development of warmed-over flavour.

Phosphates:

Phosphates and triphosphates are effective in increasing water binding. Sodium acid pyrophosphate, tetra sodium pyrophosphate and sodium tri polyphosphate are most commonly used. Although the potassium salts are also permitted. Phosphate also enhance the effect of NaCl on meat proteins and thus contribute to meat binding. In addition, the activity of some antioxidants may be enhanced. Phosphate are common ingredients in sausages, especially those of relatively low meat content.

2.7.1.2. Ingredients used in meat ball production process:

In case of meatball production process as ingredients chicken meat, binder, mixed spices, salt, phosphate, flavour enhancer, permitted preservatives and colouring are use. Milk powder is not use in this process.

2.7.1.3. Ingredients used in meat ball production process:

For the chicken roll production process as ingredients chicken meat , salt, milk powder, mixed spices, phosphates, flavour enhancer, permitted colors and preservatives are used.

2.7.2.Process steps used in manufacturing of processed meat products:

In case of manufacturing process of processed meat products like sausages, meatballs and chicken rolls are similar in steps.But there is a small difference in manufacturing process of meatball and chicken rolls rather than the sausage manufacture process.

2.7.2.1.Sausage manufacturing process:

Term "sausage" is the any minced or ground meat or chopped meat which is usually seasoned and commonly encased in natural or artificial caseins(Pearson andTauber,1984) .sausages are classified according to the differences in processing types.

- Degree of chopping:
  1.Coarsely ground
  2.Emulsion or finely chopped.
- Amount of cooking:
  1.Un cooked
  2.Cooked
- Amount of smoking:
  1.Un smoked
  2.Smoked
- Amount of water added:
  1.No added water
  2.Water added
- Amount of curing:
  1.Uncured
  2.Cured
- Amount of fermentation:
  1.unfermented
  2.fermented

In case of sausage manufacturing process mincing, chopping, filling, drying,smoking and cooking ,peeling and packaging are the major steps use.

Mincing:

Here meat chunks of variable size and shape and with variable fat contents are ground to form uniform cylinders of fat and lean.The worm or screw feed in the barrel of the grinder conveys the meat and presses it into holes of the grinder plate.The rotating blade cuts the compressed meat and aids in filling the grinder plate holes.The size of the holes in the grinder plate determines the diameter, and the thickness of the plate determines the length of the cylindrical particles.

Chopping:

A chopper is composed of a revolving metal bowl that contains the meat, while knife blades rotating on an axle cut through the revolving meat mass. A chopper is basically a knife on an axle, speed of the knife, rpm of the bowl, and sharpness of the blades are all factors in its performance. The chopper is also called a silent cutter or a flyer. The temperature of the meat mass during chopping will rise 10°C-20°C in 10-15 minutes of chopping.

Filling/Stuffing:

The sausage emulsion, also known as mix, sausage dough, or batter, is transferred to stuffers for extruding into casings. At this point, the size and shape of the product is determined. Normally there are three types of stuffers are used.

1.Piston

2.pump

3.Combination of the piston and pump in a single unit

The piston-type stuffer is essentially a large barrel or cylinder that has a moving plate. The plate is usually raised by air pressure and pushes the meat mixture through a stuffing lock and finally through a tubular structure called a stuffing horn. The piston type stuffer is recommended for coarse-ground sausages and those having fat chunks, olives e.t.c. Because these items may be damaged by impeller-type pumps, which usually have feed back and pop-off connectors, and are satisfactory for stuffing other emulsion-type products such as frankfurters.

The pumps, however, frequently work on a continuous basis, the by-pass valve handling the cycling of the emulsion when stuffing is not being carried out. To fill the sausage mostly cellulose casings are used. some company is use collagen casings.

Drying, Smoking and Cooking:

The draped smoke sticks are placed on smoke trees or trolleys with 12-18 sticks per tree. The filled trees are transferred to the smoke house, and while houses of two or four trees may be used, The trend is to larger houses holding at least 10 trees. The smoke house operation is essentially a specialized drying and cooking operation in which sausage emulsion is coagulated. dimension, time cycle, temperature range, thermal requirements, relative humidity are the factors effect for the cooking process. The high air velocity and the low humidity effect for the cooking rate of sausages. Normally the drying temperature is 57°C.The product should keep 20 minutes in this temperature.The smoking temperature is around 70°C.The product should keep 25 minutes in this temperature. The whole process will take 1 hour and 15 minutes(Wilson,1981).

Chilling/Showering:

After smoking and cooking the product is showered with cold water and then chilled by refrigeration. Chilling is frequently done with a brine solution by dipping or spraying the products. This brine permits lower chill temperatures and rapid cooling of the product.

Peeling and Packing:

After properly chilling the product, usually the cellulosic casings are removed. This is known as the peeling operation. For remove the casings of sausages peeler machine is use.

Packaging:

Satisfying the consumers preference for the meat product is primary objective of packaging for self-service retailing. This preventing moisture or liquid loss. The over wrapping film may be a vinyl or polyethylene derivatives.

The simplest modified atmosphere package is a vaccum pack.There are two types of vaccum pack methods.

1.Cryovac method:

They are tough, clear and unlike most other vaccum bags are heat shrinkable. After exhaustion, a metal clip is applied (or sealed) around the twisted neck of the bag.

2.Chamber method:

The meat is put into a pre-formed bag which is then placed in an enclosed chamber which is evacuated. At a predetermined low pressure, heated jaws close and weld the mouth of the bag.

2.7.2.2. meat ball manufacturing process:

This process is also same as the sausage manufacturing process. here instead of the filler machine the meat bowl machine is used. In oven only the cooking process was done.

2.7.2.3 Chicken roll manufacturing process:

The chicken roll manufacturing process is also same as the sausage manufacturing process. Only the defference is here a slicer machine is used to cut the slices.

2.7.3.Cold storage, transport and blast freeze conditions:

The cold storage condition of the sausages is –15°C.The blast freezing temperature is –18°C.Transport temperature is –15°C.The temperature upward fluctuations of no more than 3°C during transport.(SLS 143andSLS1065).

2.8. Associated pathogens:

In Manufacturing process of chicken based processed meat products there may be lot of pathogens associated. As a result of the presence of these pathogens food poisoning and food borne insfections takeplace.*Salmonella, E. coli,* and *Staphylococcus aureus* are major bacterial pathogens associated in processed meat production(forsythe and hayes 1998).

2.8.1.*Salmonella*:

Salmonella are short(1-2µm),gram negative non sporing rods ,usually motile with peritrichous flagella(Forsythe and Hayes, 1998).These are facultative anaerobes biochemically characterized by their ability to ferment glucose with the production of acid and gas ,and their inability to attack lactose and sucrose. Their optimum growth temperature ,as with most food poisoning bacteria, is about 38 °C.They fail to grow below 7 or 8°C .*S.newport,S.berby, S.dublin* are some examples for the *salmonella* genus.

Salmonellosis is the collective term used for human and animal infections caused by members of the genus *salmonella. Salmonellas* include the illness by multiplication in the host's gut and their subsequent lysis with the release of the potent endotoxin. Thisendotoxina lipopolysaccharide , forms part of the cell and is primarily responsible for the clinical symptoms..

Salmonella is normally present in meat and poultry products. The intestinal tract of farm animals and birds is the primary habitat of *Salmonella serovars*(forsythe and Hayes, 1998). it is to be expected that carcass meat form these sources may be contaminated with this bacteria. Rates for *salmonella* contamination of meat are variable but it is probable that contamination is highest in poultry.

There are some control measures to prevent the *Salmonella* contamination:

1). Ensure animal feeding stuffs are *Salmonella* –free and imported fees are suitably health treated.

2). Eliminate *Salmonellas* in poultry breeding stocks.

3). Avoid cross-contamination risks, particularly off cooked by raw foods, in processing factories and kitchens.

4). Refrigerate food at below 5°C.

5). Control rodents, birds and pests in and around factory promises.

2.8.2*Staphylococcus aureus*:

Staphylococcus aureus is a small (0.5-1μm in diameter) ,spherical, gram positive, nonmotile organism, typically forming irregular clusters of cells like bunches of grapes(forsythe and Hayes,1998).

These organisms are facultative anaerobic growing better in the presence of air with an optimum growth temperature around 37°C and capable of growing down to 8°C or slightly below. This will grows in fairly high salt concentration levels.

After ingestion of the contaminated food the symptoms appear quickly, within 1-6 h, with an aveage of about 3h. The large numbers of *S. aureus* must be present in foods for them to be hazardous but the precise number necessary to produce enough enterotoxin to induce the symptoms is 1μg.This is sufficient to cause illness to man(forsythe and Hayes,1998).

Normally this pathogen is present in cold meats and poultry. There are some control measures can be take to prevent the contamination of organism.

1.Keep handling of cooked foods to a minimum. Particular care should be taken with warm cooked foods which should preferably be cooled to below 20°C where subsequent handling is essential.

2.Adequate heat treatment of the food is essential followed by prompt cooling to 10°C or below where foods are to be stored.

3.Minimize cross-contamination from raw to cooked foods and from dirty working surfaces, equipment and utensils.

2.8.3.*Escherichia coli*:

E.coli is a short, typically motile, gram negative rod with many characteristics similar to those of *salmonellas*(forsythe and Hayes,1998). This ability to attack lactose and sucrose with the production of acid and gas. The *E.coli* strains are pathogenic to human.The enteroaggregative *E.coli* (EAEC) are associated with persistant diarrhoea in young children especially those in developing countries.These strains provide three toxins which stimulate intestinal secretion.

The entero pathogenic E. coli (EPEC) cause severe diarrhoea in infants, but certain EPEC strains produce one or more cytotoxins.The Enterotoxigenic E.coli(ETEC), also cause diarrhoea in humans, both infants and adults, the latter group usually succumbing to the world-wide illness known as traveller's diarrhoea(forsythe and Hayes,1998). ETEC strains produce enterotoxins of two distinct types. These are a heat-liable toxin, inactivated at 60°C in 30 Min, and a heat-stable toxin, resistant to 100 °C for 15 Min(Scotland, 1998). The enteroinvasive E.coli(EIEC) produce a cytotoxin and often induce rather more severe illness like colitis and a form of dysentery, accompanied by fever and bloody stools.

CHAPTER 03- Methodology

3.1 Setting up the HACCP team:

After discussed with the company senior management HACCP team was established.

3.2 Identification of products & their intended uses:

products were identified after the final packing. sales reports and SLS regulations were used to determine the product specifications.

3.3 Development of a flow diagram and onsite confirmation:

Initially the production line was thoroughly observed and after that flow diagram was developed.Then establishment of machines,workers canteen,workers toilet,cold rooms, stores were observed.After that the factory layout was developed.In this case workers traffic pattern were considered.Finally the flow diagram was confirmed.

3.4 Identification of hazards (physical, chemical and biological) which are incooperated in the products:

To identify physical hazards visual inspection was done.To determine the biological hazards microbiological standards was taken from the SLS regulations for processed meat products.In case of chemical hazards potential hazards were determined.

3.5 Determine the Critical Control Point:

This was done by using,

- Process flow decision tree(See Appendix i)
- Raw material decision tree(See Appendix ii)

Process flow decision tree:

Decision tree-question1

- were control measures in place?

  Yes-Then gone to question 2

  No-Then following questions were asked.
- were control is necessary for product safety?

  No-This was not a CCP

Decision tree-question 2

- were the step eliminated or reduced hazard occurred to an acceptable level?

At this point the HACCP team were considered the details and properties of the hazard as well as the technical composition of the product.

Yes-Then it was a CCP.

No-Gone to question 3

Decision tree-question 3

- were contamination occurred at acceptable levels or increased to an unacceptable levels?

Team was considered flow diagrum data,hazard data and used their prior experience.

No-This was not a CCP

Yes-Gone to question 4

Decision tree-question 4

- Were a subsequent step eliminated or reduced hazard to acceptable levels?

This were only considered if the answer to Q3-Yes

Yes-Then this was not a CCP

No-It was A CCP.

Raw material decision tree:(See Appendix ii)

This was also same as the above process.In this case three questions were asked.

3.6 Determine the critical limits using control charts:

Initially the critical limits were established using standard specifications.After that control charts were established by used of oven-cooking temperature data.(See Appendix iii)

Procedure for establish control charts:

- At regular 11/2 hour intervals, 3 samples from the oven were taken and the core temperature were checked by used of a sensor.(thermometer)
- Average temperature was calculated and average chart was plotted by using of a MINITAB package.
- The range was calculated (maximum temperature-minimum temperature)and range chart was plotted.

3.7 Establish a monitoring system:

For each critical limit a monitoring procedure was established.

Eg:In cooking temperature for oven is 72°C. The product were kept 2 minutes in this temperature.In this case the process was monitored by using thermometer and stopwatch.The responsible person was production manager.

3.8 Establish a corrective action procedure:

Here when some deviations occurred corrective actions were taken place.

Eg:when the oven cooking temperature were droped down re-heated the product.

3.9 Establish verification procedure:

The accuracy of the each critical limit was verified by the responsible person in same time interval of period.

3.10 Establish record keeping and documentation procedure:

All the hazard identification forms,CCP determination forms,time and temperature log sheets,critical limit establishment records were documented.

HAPTER 4- Results and discussion

4.1.Step 1: Assemble the HACCP team

Table 4.1 HACCP Team

Haccp Team Member	Function	Qualification
1.Qualiy Assurance Manager(HACCP) Team Leader)	Quality Assurance Expert	Bsc,Msc (Food Science)
2.Production Manager	Production Specialist	Bsc(Agri),Msc(Food Science)
3.Engineer	Technical Expert	Bsc(Engineering)
4.Food Technologist	Microbiology Specialist	Bsc , Msc (Food Science)
5.Microbiologist	Microbiology Expert	Bsc(Microbiology)
6.Haccp Expert	Haccp Expert	Bsc,Msc (Food Science)

4.2.Step 2:Describe the product- chicken sausage

Table 4.2 Product description

1.Product Name(s)	Chicken Sausages					
2.Important Product Characteristic of end Product	Lean Meat(%)	Fat Content(%)	Total Solid(%)	Starch Content(%)	Nacl(%)	No_3^-/No_2^- (%)
	40%(Min)	20%(Min)	33%(Min)	4%(Min)	2.5%(Max)	125(mg/Kg) (Max)
3.How is this to be used?(Instruction to Consumer)	This is a Ready to eat food.Defrost Fully.Then Grill,Fry or Toss in curry.					
4.Packaging	Tripple Laminated , Laminated or Polythene.(Food grade material made by LLDP+Nylon)					
5.Shelf Life	6 Months in –18°C Store Condition.					
6.Where the Product will be sold?	Mass Catering: Hotels and Restaurants.(500g,1Kg Packets are available.) Retail Catering: 100g,150g,250g,300g are selling through distributors.					
7.Labelling Instructions	Manufacture Date,Expiry Date,Price,Storage Condition,Ingredients					
8.Special Manufacture,Storage and Distribution Control	Manufacture		Storage		Distribution	
	0°C-4°C		-18°C		0°C-4°C	

4.3. Step 2: Describe the product-chicken meat ball

Table 4.3. Product description

1.Product Name(s)	Chicken Meatball					
2.Important Product Characteristic of end Product	Lean Meat(%)	Fat Content(%)	Total Solid(%)	Starch Content(%)	Nacl(%)	No_3^-/No_2^-(%)
	40%(Min)	20%(Min)	33%(Min)	4%(Min)	2.5%(Max)	125(mg/Kg) (Max)
3.How is this to be used?(Instruction to Consumer)	This is a ready to eat food.Defrost Fully.Then Grill,Fry or Toss in curry.					
4.Packaging	Tripple Laminated , Laminated or Polythene (Food grade material made by LLDP+Nylon)					
5.Shelf Life	6 Months in –18°C Store Condition.					
6.Where the Product will be sold?	Mass Catering: Air Lanka,Hotels and Restaurants.(500g,1Kg Packets are available.) Retail Catering: 100g,150g,250g,300g packets are selling through distributors.					
7.Labelling Instructions	Manufacture Date,Expiry Date,Price,Storage Condition,Ingredients.					
8.Special Manufacture,Storage and Distribution Control	Manufacture		Storage		Distribution	
	0°C-4°C		-18°C		0°C-4°C	

4.4. Step 2:Describe the product- chicken rolls

Table 4.4 Product description

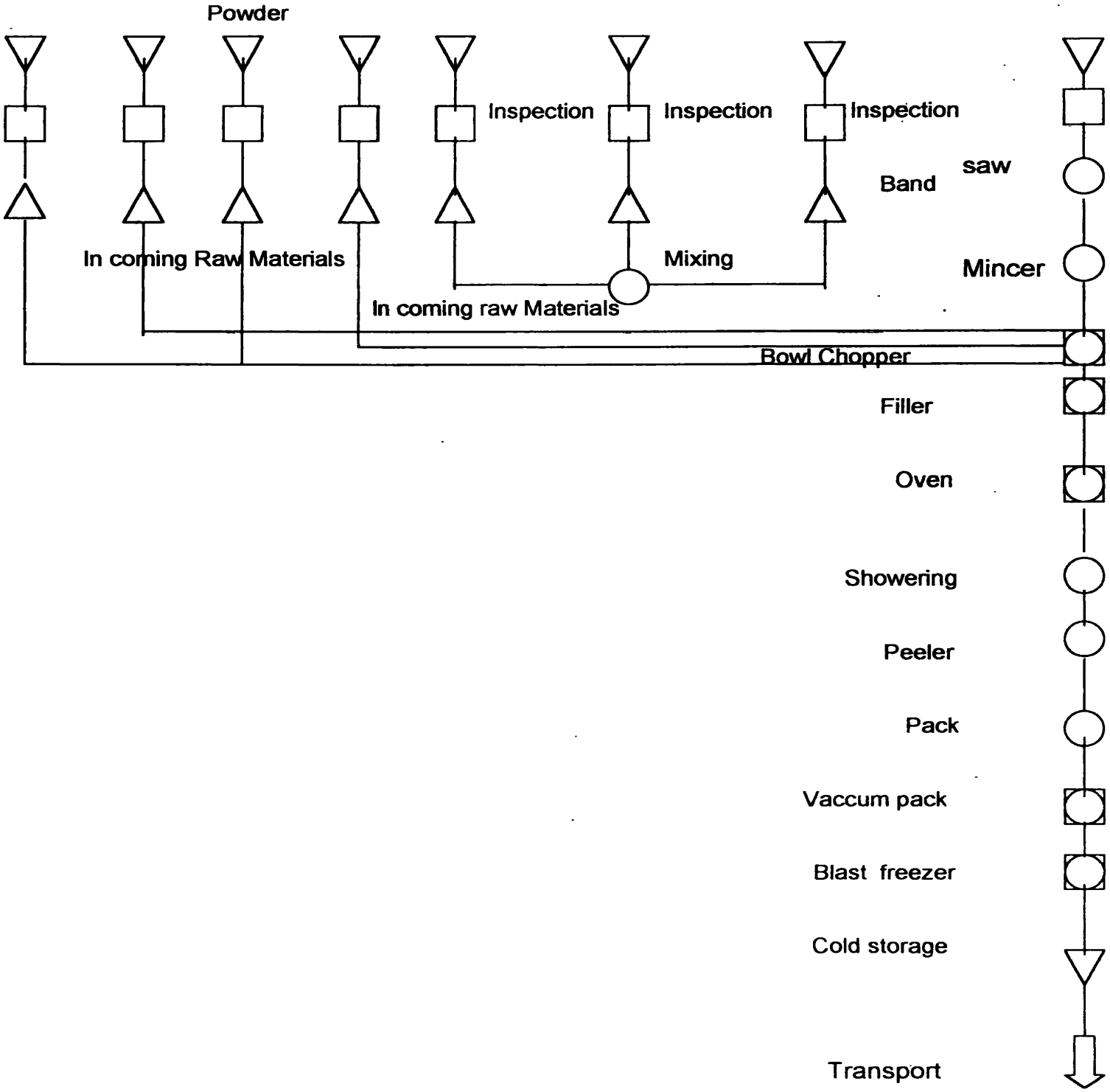
1.Product Name(s)	Chicken Rolls					
2.Important Product Characteristic of end Product	Lean Meat(%)	Fat Content(%)	Total Solid(%)	Starch Content(%)	Nacl(%)	No_3^-/No_2^-(%)
	40%(Min)	20%(Min)	33%(Min)	4%(Min)	2.5%(Max)	125(mg/Kg) (Max)
3.How is this to be used?(Instruction to Consumer)	This is a ready to eat food.Defrost Fully.Then Grill,Fry or Toss in curry.					
4.Packaging	Tripple Laminated , Laminated or Polythene.food grade material made by (LLDP+Nylon).					
5.Shelf Life	6 Months in –18°C storage condition.					
6.Where the Product will be sold?	Retail Catering: 100g,150g,250g,300g are sell through a distributors.					
7.Labelling Instructions	Manufacture Date,Expiry Date,Price,Storage Condition,Ingredients.					
8.Special Manufacture,Storage and Distribution Control	Manufacture		Storage		Distribution	
	0°C-4°C		-18°C		0°C-4°C	

4.5. Step 3: Describe the intended use:

This product is suitable for the general public of the sri lanka.

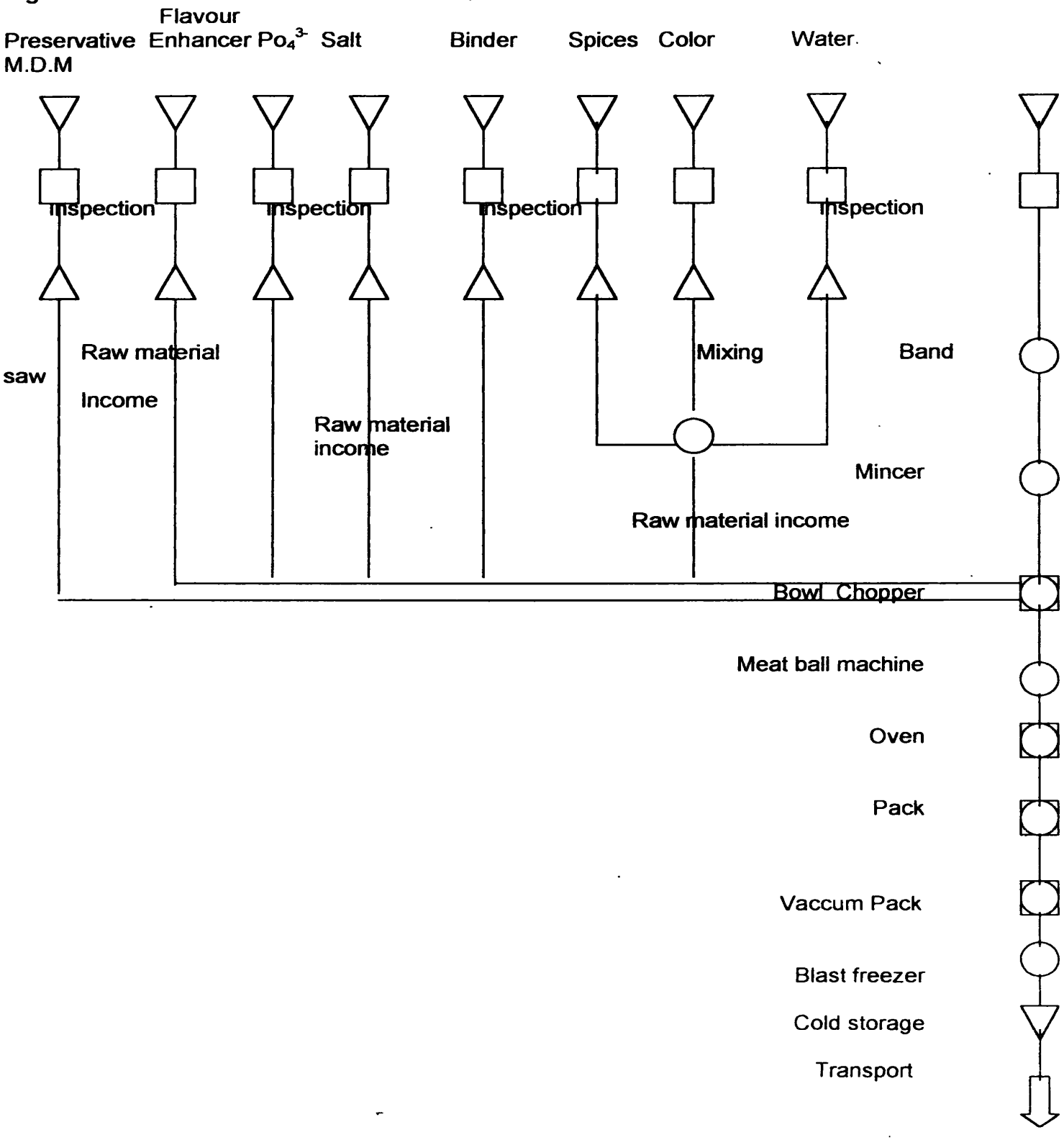
4.6.Step 4:Construction of production flow chart- chicken sausage

Figure 4.1 Production flow chart of chicken sausages



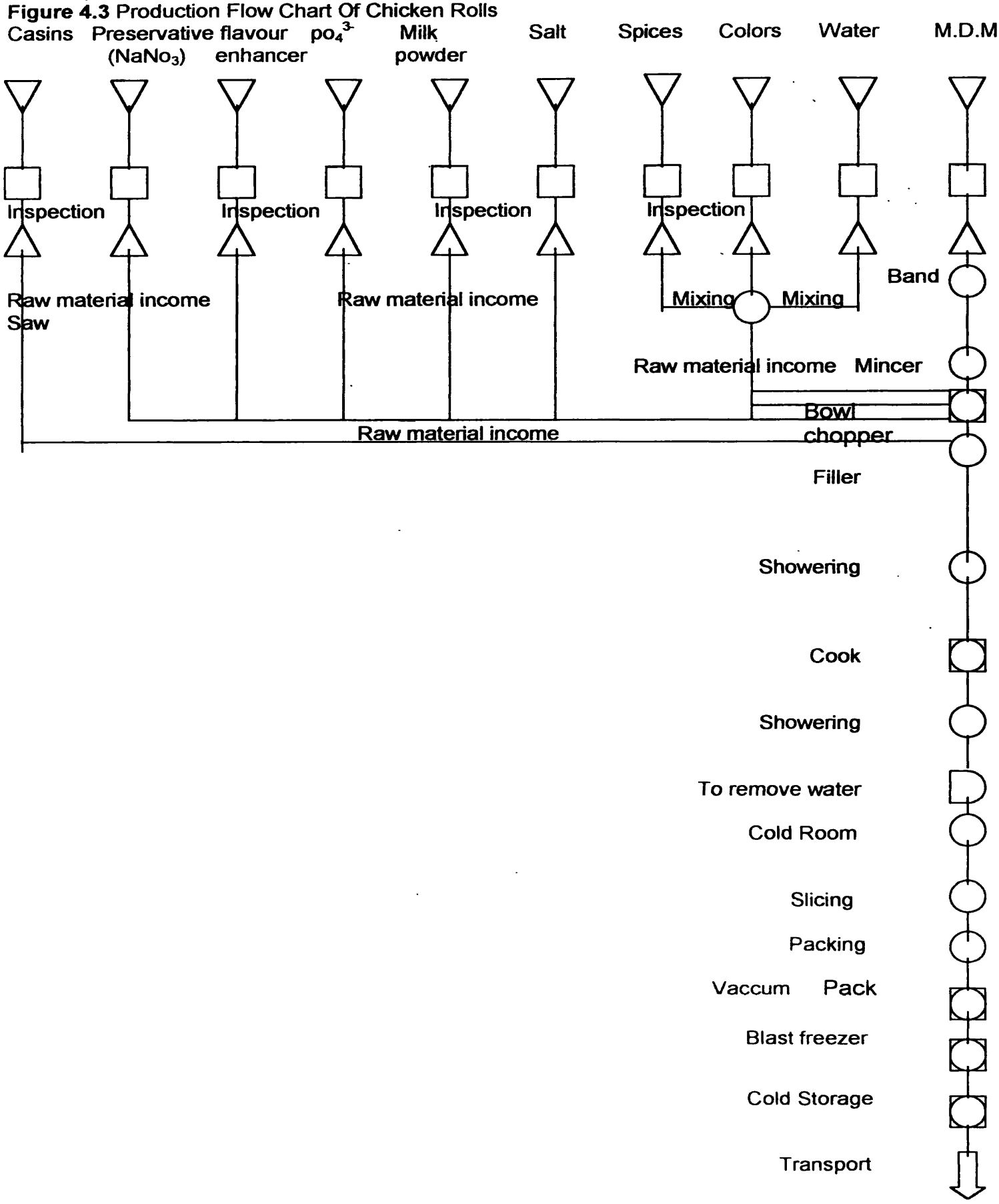
4.7. Step 4: Construction of production flow chart- chicken meat ball

Figure 4.2. Production flow chart of meat balls



4.8. Step 4: Construction of production flow chart- chicken rolls

Figure 4.3 Production Flow Chart Of Chicken Rolls



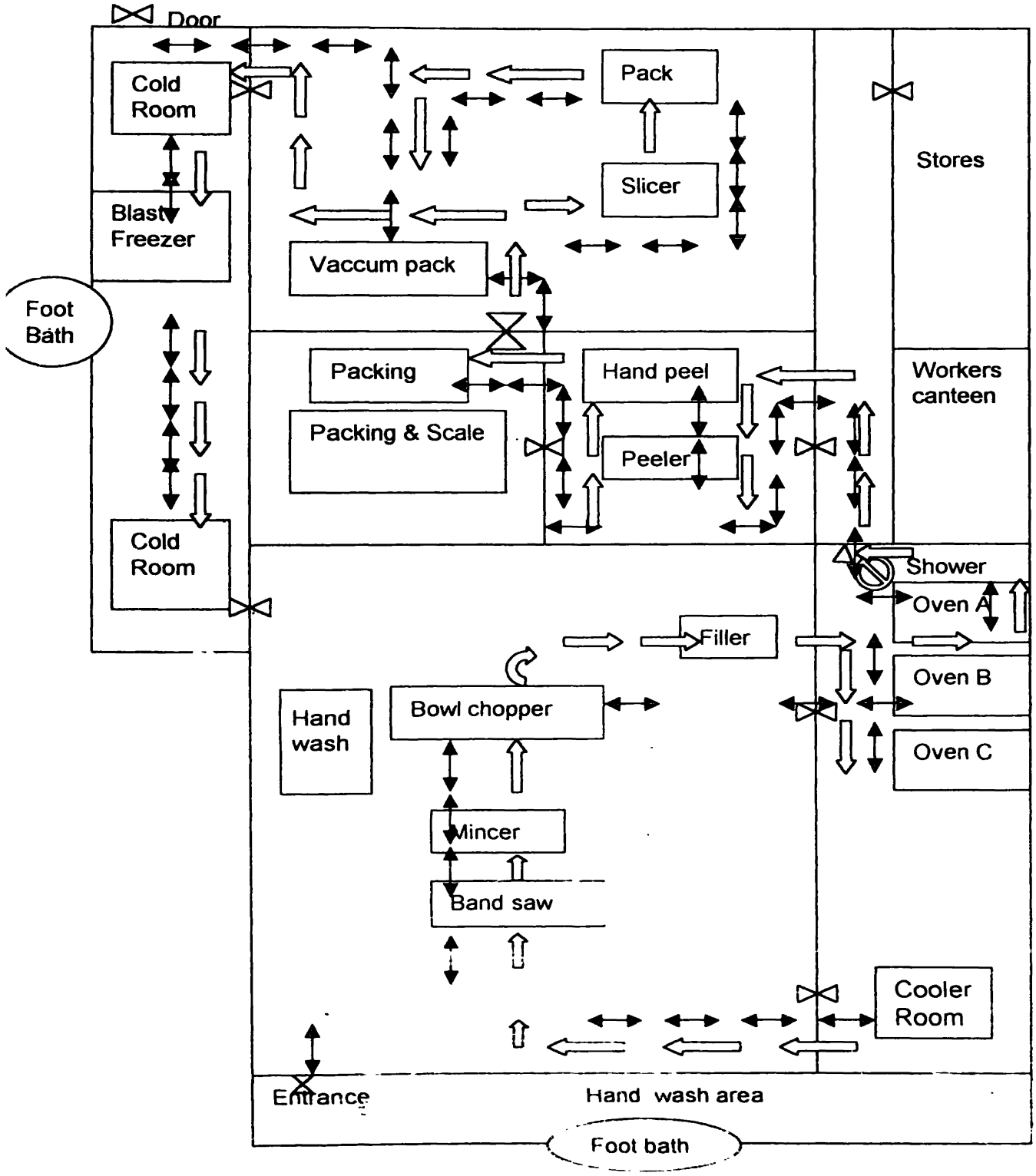
4.9.Step 5:Construction of factory layout

Figure 4.4 Construction of Factory layout- chicken sausage, meat ball, chicken roll production

Door

Employee traffic pattern.

Production line



4.10.Step 6:Principle 1,Condct Hazard analysis:

In sausage, meat ball and chicken roll manufacturing process three major ingredients seems to be contaminated with pathogenic microorganism. Scientific information gathered revealed the potential preventative control measures for such biological hazardsIn sausage, meat ball and chicken roll production. Table 4.5 presents the ingredients of above three products and preventive measures for identified hazards.

4.10.1. Biological Hazard Determination form for Ingredients-Sausage, Meat ball & Chicken Roll

Table 4.5 Biological Hazards determination form for Ingredients - Sausage, Meat ball, Chicken roll

Ingredient	Sausage	Meat ball	Chicken roll	Potential biological hazard	Preventative/control measures
M.D.M	Yes	Yes	Yes	Pathogenic Microorganism: 1.Salmonella 2.Staphylococcus aureus 3.E.coli 4.Clostridium perfringens 5.Listeria monocytogens 6.bacteria viral pathogens and parasites.	1.Reduce the water activity(aw) of the medium. 2.Reduce the p^H value. 3.Maintain the temperature at –21°C
Mixed spices	Yes	Yes	Yes	Pathogenic Microorganism: 1.Salmonella 2.Staphylococcus aureus 3.E.coli 4.bacteria viral pathogens and parasites.	1.Reduce the water activity(aw) 2.Store in low temperature condition.

Ingredient	Sausage	Meat ball	Chicken roll	Potential Biological Hazard	Preventive/control measure
Salt	Yes	Yes	Yes	No	No
Milk powder	Yes	No	Yes	Pathogenic Microorganism: 1.Lysteria monocytogens 2.Mycotoxin M1	Supplier certification
Colours	Yes	Yes	Yes	No	No
Binder	Yes	Yes	Yes	No	No
Flavour enhancer	Yes	Yes	Yes	No	No
Phosphate(Po_4^{3-})	Yes	Yes	Yes	No	No
Preservatives($NaNo_3$)	Yes	Yes	Yes	No	No

The potential chemical hazards that could be occurred in sausage,meat ball and chicken roll ingredients are, Antibiotic residues,Heavy metals & Toxic chemicals.The major control measure too control chemical hazards is supplier certification on such product.Table 4.6 shows the potential chemical hazards in ingredients of three products and there preventive measures.

4.10.2. Chemical Hazard Determination form for Ingredients-Sausage, Meat ball & Chicken Roll

Table 4.6 Chemical Hazard determination form for Ingredients - Sausage, Meat ball, Chicken roll

Ingredient	Sausage	Meat ball	Chicken roll	Potential chemical hazard	Preventative/control measures
M.D.M	Yes	Yes	Yes	1.Antibiotic Residues 2.Heavy metals 3.Cleaning chemicals.	Through a supplier certification.
Mixed spices	Yes	Yes	Yes	1.Pesticides 2.Cleaning chemicals 3.Fumigants	Through a supplier certification

Ingredient	Sausage	Meat ball	Chicken roll	Potential chemical hazard	Preventative/control measures
Salt	Yes	Yes	Yes	No	No
Milk powder	Yes	No	Yes	No	No
Colours	Yes	Yes	Yes	Contamination with toxic chemicals	Through a supplier certification
Binder	Yes	Yes	Yes	Contamination with toxic chemicals	Through a supplier certification
Flavour enhancer	Yes	Yes	Yes	Contamination with toxic chemicals	Through a supplier certification
Phosphate(Po_4^{3-})	Yes	Yes	Yes	Contamination with toxic chemicals	Through a supplier certification
Preservatives($NaNo_3$)	Yes	Yes	Yes	Contamination with toxic chemicals	Through a supplier certification

The potential physical hazards that could be occurred in sausage,meat ball and chicken roll ingredients is foreign impurities.The major control measure to control physical hazards are visual inspection. filtering and Air seperation.

4.10.3. Physical Hazard Determination form for Ingredients-Sausage, Meat ball & Chicken Roll

Table 4.7 Physical hazards determination form for Ingredients-Sausage, Meat ball, Chicken roll

Ingredient	Sausage	Meat ball	Chicken roll	Potential physical hazard	Preventative/control measures
M.D.M	Yes	Yes	Yes	Foreign Impurities	Visual Inspection
Mixed spices	Yes	Yes	Yes	Impurities(food adultrants)	1.food adultration test 2.Filtering 3.Air seperation
Milk powder	Yes	No	Yes	No	No

Ingredient	Sausage	Meat ball	Chicken roll	Potential physical hazard	Preventive/control measure
Salt	Yes	Yes	Yes	Impurities($Mgcl_2$)	1.Air seperation 2.Sieve using filter
Colours	Yes	Yes	Yes	Impurities	1.Air seperation 2.Sieve using filter
Binder	Yes	Yes	Yes	Impurities	1.Air seperation 2.Sieve using filter
Flavour enhancer	Yes	Yes	Yes	Impurities	1.Air seperation 2.Sieve using filter
Phosphate(Po_4^{3-})	Yes	Yes	Yes	Impurities	1.Air seperation 2.Sieve using filter
Preservatives($NaNo_3$)	Yes	Yes	Yes	Impurities	1.Air seperation 2.Sieve using filter

In the process flow of sausage, meat ball and chicken roll manufacturing product can be contaminated with pathogenic bacteria and parasites at any stage of production flow. It is very essential to control the temperature at each step to prevent occurs of microbes. Table 4.7 indicates the potential biological hazards and their control measures at each step.

4.10.4 Biological Hazard Determination form for Process steps - Sausage, Meat ball & Chicken Roll

Table 4.8 Biological Hazard Determination form for process steps- Sausage, Meat ball, Chicken roll

Process step	Sausage	Meat ball	Chicken roll	Potential Biological hazard	Preventive/control measure
Cold room	Yes	Yes	Yes	Pathogenic Microorganism: 1.Bacteria (spores) 2.Parasites	Controll the temperature in –20°C
Band saw	Yes	Yes	Yes	Pathogenic Microorganism: 1.Bacteria (spores) 2.Parasites	Controll the temperature below 4 °C

Programme (G.M.P) in the processing industry. Cleaning shedule adopted according to G.M.P. can prevent the occurrence of chemicals in manufacturing process.

4.10.5. Chemical Hazard Determination form for Process steps - Sausage, Meat ball & Chicken Roll

Table 4.9 Chemical Hazard Determination form for process steps- Sausage, Meat ball, Chicken roll

Process step	Sausage	Meat ball	Chicken roll	Potential Chemical hazard	Preventive/control measure
Cold room	Yes	Yes	Yes	No	No
Band saw	Yes	Yes	Yes	1.Oil 2.Cleaning chemicals	Through a G.M.P.Programme.
Mincer	Yes	Yes	Yes	1.Oil 2.Cleaning chemicals	Through a G.M.P.Programme.
Bowl chopper	Yes	Yes	Yes	1.Oil 2.Cleaning chemicals	Through a G.M.P.Programme.
Meat ball machine	No	Yes	No	1.Oil 2.Cleaning chemicals	Through a G.M.P.Programme.
Oven	Yes	Yes	Yes	1.Oil 2.Cleaning chemicals	Through a G.M.P.Programme.
Wash	Yes	No	Yes	Naocl	Validation of levels through usage rates.
peeler	Yes	No	Yes	1.Oil 2.Cleaning chemicals	Through a G.M.P.Programme.
Slicer	No	No	Yes	1.Oil 2.Cleaning chemicals	Through a G.M.P.Programme.

4.10.6. Physical Hazard Determination form for Process steps - Sausage, Meat ball & Chicken Roll

Table 4.10 Physical Hazard Determination form for process steps- Sausage, Meat ball, Chicken roll

Process step	Sausage	Meat ball	Chicken roll	Potential Physical Hazard	Preventive/control measure
Cold room	Yes	Yes	Yes	Impurities	Visual Inspection
Band saw	Yes	Yes	Yes	Impurities(polythene)	Visual Inspection
Mincer	Yes	Yes	Yes	Foreign Impurities(Rust)	Through a G.M.P.Programme.
Bowl chopper	Yes	Yes	Yes	Foreign Impurities	1.Through a G.M.P.Programme. 2.Visual Inspection.
Meat ball machine	No	Yes	No	Foreign Impurities	Through a G.M.P.Programme.
Oven	Yes	Yes	Yes	Foreign Impurities(smoked particles)	1.Through a G.M.P.Programme. 2.Visual Inspection
Wash	Yes	No	Yes	Foreign Impurities	Filter the water and use.
peeler	Yes	No	Yes	Foreign Impurities(Rust,polythene)	1.Through a G.M.P.Programme. 2.Visual Inspection
Slicer	No	No	Yes	Foreign Impurities	1.Through a G.M.P.Programme. 2.Visual Inspection

4.10.7. Biological Hazard Determination form for Packing, Storage & Transport - Sausage, Meat ball & Chicken Roll

Table 4.11 Biological Hazard Determination form for Packing, Storage and Transport steps- Sausage, Meat ball, Chicken roll

Process step	Sausage	Meat ball	Chicken roll	Potential biological hazard	Preventive/control measure
Packing	Yes	Yes	Yes	Pathogenic Microorganism: Bacteria,Parasites	Control the temperature below 4°C
Vaccum pack	Yes	Yes	Yes	Pathogenic Microorganism: Bacteria,Parasites	Control the vaccum pressure
Blast freeze	Yes	Yes	Yes	Pathogenic Microorganism: Bacteria,Parasites	Maintain the temperature around –40°C
Cold storage	Yes	Yes	Yes	Pathogenic Microorganism: Bacteria,Parasites	Maintain the temperature around –21°C
Transport	Yes	Yes	Yes	Pathogenic Microorganism: Bacteria,Parasites	Maintain the temperature around –21°C

In these process steps there were no any potential chemical hazards identified.

4.10.8. Chemical Hazard Determination form for Packing, Storage & Transport - Sausage, Meat ball & Chicken Roll

Table 4.12 Chemical Hazard Determination form for Packing, Storage and Transport steps- Sausage, Meat ball, Chicken roll

Process step	Sausage	Meat ball	Chicken roll	Potential Chemical Hazard	Preventive/control measure
Packing	Yes	Yes	Yes	No	No
Vaccum pack	Yes	Yes	Yes	No	No
Blast freeze	Yes	Yes	Yes	No	No
Cold storage	Yes	Yes	Yes	No	No
Transport	Yes	Yes	Yes	No	No

4.10.9. Physical Hazard Determination form for Packing, Storage & Transport - Sausage, Meat ball & Chicken Roll

In case of physical hazards only the physical hazard were identified in packing section.

Table 4.13 Physical Hazard Determination form for Packing, Storage and Transport steps- Sausage, Meat ball, Chicken roll

Process step	Sausage	Meat ball	Chicken roll	Potential Physical Hazard	Preventive/control measure
Packing	Yes	Yes	Yes	Foreign Impurities	Visual Inspection.
Vaccum pack	Yes	Yes	Yes	No	No
Blast freeze	Yes	Yes	Yes	No	No
Cold storage	Yes	Yes	Yes	No	No
Transport	Yes	Yes	Yes	No	No

4.11.Step 7:Principle 2, Determine the critical control points for Ingredients-sausages

Table 4.14 CCPdetermination form for ingredients - sausages

Ingredient	Type of Hazard	Q1	Q2	Q3	CCP/Not a CCP
1.M.D.M	Biological	Yes	Yes	No	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
2.Mixed Spices	Biological	Yes	Yes	No	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
3.Salt	Biological	No	-	-	Not a CCP
	Chemical	No	-	-	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
4.Milk Powder	Biological	No	-	-	Not a CCP
	Chemical	No	-	-	Not a CCP
	Physical	No	-	-	Not a CCP
5.Colors	Biological	No	-	-	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
6.Binder	Biological	No	-	-	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
7.Flavour enhancer	Biological	No	-	-	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
8.Po_4^{3-}	Biological	No	-	-	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
9.Preservatives($NaNo_3$)	Biological	No	-	-	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP

4.12.Step 7: Principle2, Determine the Critical Control Points for process steps-sausage

Table 4.15 CCP determination form for process steps-sausages

Process Step	Type of Hazard	Q1	Q2	Q3	Q4	CCP or NOT
1.Cold Room	Biological	No	-	-	-	Not a CCP
	Chemical	No	-	-	-	Not a CCP
	Physical	Yes	No	Yes	Yes	Not a CCP
2.Band Saw	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
3.Mincer	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
4.Bowl Chopper	Biological	Yes	Yes	-	-	A CCP
	Chemical	Yes	Yes	Yes	No	A CCP
	Physical	Yes	No	No	-	Not a CCP
5.Filler	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
6.Oven	Biological	Yes	Yes	-	-	A CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
7.Wash	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
8.Peeler	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP

4.13.Step 7: Principle2, Determine the Critical Control Points for Packing, storage and Transport- sausage

Table 4.16 CCP determination form for packing, storage & transport

Process Step	Type of Hazard	Q1	Q2	Q3	Q4	CCP or NOT
1.Packing	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
2.Vaccum Pack	Biological	Yes	No	No	-	Not a CCP
	Chemical	No	-	-	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
3.Blast Freezer	Biological	Yes	Yes	-	-	A CCP
	Chemical	No	-	-	-	Not a CCP
	Physical	No	-	-	-	Not a CCP
4.Cold Storage	Biological	Yes	Yes	-	-	A CCP
	Chemical	No	-	-	-	A CCP
	Physical	No	-	-	-	Not a CCP
5.Transport	Biological	Yes	Yes	-	-	A CCP
	Chemical	No	-	-	-	Not a CCP
	Physical	No	-	-	-	Not a CCP

4.14. Step 7: Principle 2, Determine Critical Control Points for Ingredients- meat balls

Table 4.17. CCP determination form for ingredients-meat balls

Ingredient	Type of Hazard	Q1	Q2	Q3	CCP/Not a CCP
1.M.D.M	Biological	Yes	Yes	No	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
2.Mixed Spices	Biological	Yes	Yes	No	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
3.Salt	Biological	No	-	-	Not a CCP
	Chemical	No	-	-	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
4.Colors	Biological	No	-	-	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
5.Binder	Biological	No	-	-	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
6.Flavour enhancer	Biological	No	-	-	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
7.Po_4^{3-}	Biological	No	-	-	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
8.Preservatives($NaNo_3$)	Biological	No	-	-	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP

4.15. Step 7: Principle 2, Determine Critical Control Points for Process steps- meat balls

Table 4.18. CCP determination form for process steps-meat balls

Process Step	Type of Hazard	Q1	Q2	Q3	Q4	CCP or NOT
1.Cold Room	Biological	No	-	-	-	Not a CCP
	Chemical	No	-	-	-	Not a CCP
	Physical	Yes	No	Yes	Yes	Not a CCP
2.Band Saw	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
3.Mincer	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
4.Bowl Chopper	Biological	Yes	Yes	-	-	A CCP
	Chemical	Yes	Yes	Yes	No	A CCP
	Physical	Yes	No	No	-	Not a CCP
5.Meat Ball Machine	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
6.Oven	Biological	Yes	Yes	-	-	A CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP

4.16. Step 7: Principle 2, Determine Critical Control Points for Packing ,Storage and Transport - meat balls

Table 4.19.CCP determination form for packing, storage & transport-meat balls

Process Step	Type of Hazard	Q1	Q2	Q3	Q4	CCP or NOT
1.Packing	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
2.Vaccum Pack	Biological	Yes	No	No	-	Not a CCP
	Chemical	No	-	-	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
3.Blast Freezer	Biological	Yes	Yes	-	-	A CCP
	Chemical	No	-	-	-	Not a CCP
	Physical	No	-	-	-	Not a CCP
4.Cold Storage	Biological	Yes	Yes	-	-	A CCP
	Chemical	No	-	-	-	Not a CCP
	Physical	No	-	-	-	Not a CCP
5.Transport	Biological	Yes	Yes	-	-	A CCP
	Chemical	No	-	-	-	Not a CCP
	Physical	No	-	-	-	Not a CCP

4.17. Step 7: Principle 2, Determine the Critical Control Points for Ingredients-Chicken roll

Table 4.20 CCP determination form for ingredients- chicken roll

Ingredient	Type of Hazard	Q1	Q2	Q3	CCP/Not a CCP
1.M.D.M	Biological	Yes	Yes	No	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
2.Mixed Spices	Biological	Yes	Yes	No	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
3.Salt	Biological	No	-	-	Not a CCP
	Chemical	No	-	-	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
4.Colors	Biological	No	-	-	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
5.Milk Powder	Biological	No	-	-	Not a CCP
	Chemical	No	-	-	Not a CCP
	Physical	No	-	-	Not a CCP
6.Flavour enhancer	Biological	No	-	-	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
7.Po_4^{3-}	Biological	No	-	-	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP
8.Preservatives($NaNo_3$)	Biological	No	-	-	Not a CCP
	Chemical	Yes	Yes	No	Not a CCP
	Physical	Yes	Yes	No	Not a CCP

4.18. Step 7: Principle 2, Determine the Critical Control Points for Process steps - Chicken roll

Table 4.21CCP determination form for process steps-chicken roll

Process Step	Type of Hazard	Q1	Q2	Q3	Q4	CCP or NOT
1.Cool Room	Biological	No	-	-	-	Not a CCP
	Chemical	No	-	-	-	Not a CCP
	Physical	Yes	No	Yes	Yes	Not a CCP
2.Band Saw	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
3.Mincer	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
4.Bowl Chopper	Biological	Yes	Yes	-	-	A CCP
	Chemical	Yes	Yes	Yes	No	A CCP
	Physical	Yes	No	No	-	Not a CCP
5.Filler	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
6.Showering	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
7.Oven	Biological	Yes	Yes	-	-	A CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
8.Showering	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
9.Cold Room	Biological	Yes	Yes	-	-	A CCP
	Chemical	No	-	-	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
10.Slicer	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP

4.19. Step 7: Principle 2, Determine the Critical Control Points for Packing, Storage and Transport-Chicken roll

Table 4.22 CCP determination form for packing, storage & transport-chicken roll

Process Step	Type of Hazard	Q1	Q2	Q3	Q4	CCP or NOT
1.Packing	Biological	Yes	No	Yes	Yes	Not a CCP
	Chemical	Yes	No	No	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
2.Vaccum Pack	Biological	Yes	No	No	-	Not a CCP
	Chemical	No	-	-	-	Not a CCP
	Physical	Yes	No	No	-	Not a CCP
3.Blast Freezer	Biological	Yes	Yes	-	-	A CCP
	Chemical	No	-	-	-	Not a CCP
	Physical	No	-	-	-	Not a CCP
4.Cold Storage	Biological	Yes	Yes	-	-	A CCP
	Chemical	No	-	-	-	A CCP
	Physical	No	-	-	-	Not a CCP
5.Transport	Biological	Yes	Yes	-	-	A CCP
	Chemical	No	-	-	-	Not a CCP
	Physical	No	-	-	-	Not a CCP

4.20.Critical limit Validation levels for sausage, meat ball and chicken roll Production

Table 4.23 Critical limit Validation levels for sausage, meat ball and chicken roll production

CCP	Justification	Validation for Critical Limit
1.Bowl Chopper $NaNo_3$ Level	When increase the No_3^- level it will form a nitrosoamine.this compound is carsinogenic one.	125ppm (SLS 1218:2001)
2. Bowl Chopper $NaNo_3$ Level	When decrease the No_3^- level it will form a Biological Hazard.	100ppm(USDA)
3.Cooking in Oven	When decrease the temperature it tends to form pathogenic Microorganism.	72°C at least 2 Minutes (s.j.forsythe,p.r.hayes.1998)
4.Blast Freezer	When drop down the temperature it tends to form pathogenic Microorganism.	-18°C at least 3 hours (SLS1161:1997)
5.Cold storage	When drop down the temperature it will form pathogenic Microorganism.	-15°C(SLS 1218:2001)
6.Transport	When drop down the temperature it will form Pathogenic Microorganism.	-15°C(SLS1218:2001)

4.21.HACCP control charts:

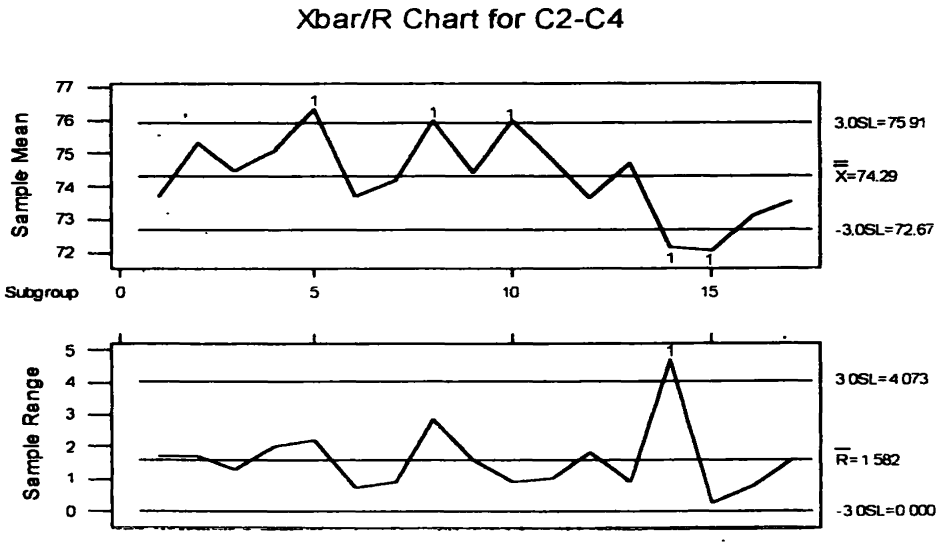
When the HACCP team have established appropriate critical limits for all ccps, they should be added to the HACCP control charts.

In addition to the critical limits it is beneficial to have another layer of control to help to manage the pocess.This can be done by setting the upper control limit or action levels within the critical limits.The upper control limit can be used as an additional measure to indicate drift in the process and it is help to adjust the process to maintain control before the ccp actually deviates from it's critical limits.

According to the following graph the upper control limit is 75.91.The critical limit for cooking process is 72°C in 2 minutes.In order to make sure that deviation does not occur, the process parameters might be set at 75.91°C fo2 minutes,the upper control limit.Therefore when the operators are set the oven cooking temperature in between 75.91 °C and 72 °C, it is possible to maintain the critical limit.

When operating the system to target levels should ensure that a deviation from the critical limit never occurs.

Figure 4.7 HACCP control chart



4.22. Process Capability Analysis:

As part of the HACCP plan the critical limit for each critical control point within the process has been established. These limits may some times only be a minimum value, such as the time and temperature requirement of for heat treatment process. Alternatively, it may also be necessay to have a minimum limit in terms of food safety, ut also to have a maximum limit in terms of product quality.

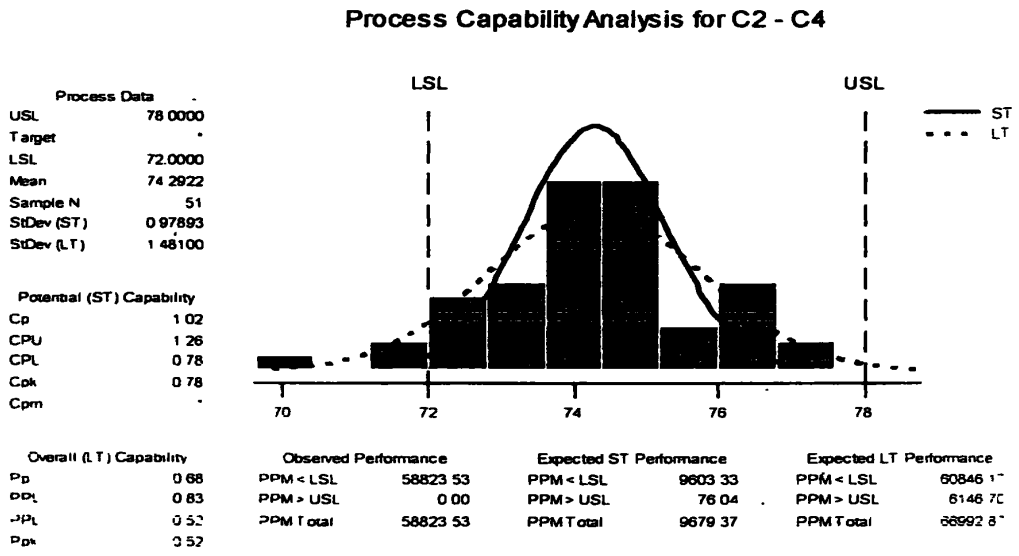
For each ccp should need to verify that, under normal operating conditions, the process can be realistically and consistently maintained within these defined limits.

One way of assessing whether a process is capable is to use statistical analysis.

The statistical verification of a process in order to establish the probability or it's ability stay within specified limits is known as establishing the process capability.

According to the following chart the limits(LSL) are 72 and 78(USL) the cp value is 1.02.When the cp value is higher than 1.00,meaning is the process is capable.There fore in this case process is capable.

Figure 4.8 Process Capability Analysis



4.23 Step 8:Principle 3, Establish critical limits for sausage, meat ball and chicken roll products

Table 4.24 Critical limits for sausage, meat ball and chicken roll products

Hazard	CCP	Critical Limit
1.Chemical Hazard (Nitrosoamine)	Bowl Chopper $NaNo_3$ Level	125ppm(Maximum)
2.Pathogenic Microorganism	Bowl Chopper $NaNo_3$ Level	100ppm(Minimum)
3.Pathogenic Microorganism	Cooking in Oven	72°C-75.91 °C for at least 2 Minutes.
4.Pathogenic Microorganism	Blast freezer	-18°C for at least 3 hours.
5.Pathogenic Microorganism	Cold storage	-15°C
6.Pathogenic Microorganism	Transport	-15°C

4.24.Step(9,10,11&12):Principle(4,5,6&7) HACCP plan for sausages

Table 4.25 HACCP plan- sausage production

Process Step	Hazard Description	CCP Description	Critical Limit	Monitoring Procedure (Who/What/ When/How)	Corrective Action	Haccp Records	Haccp Verification Procedure
1.Bowl Chopper $NaNo_3$ level	Chemical Hazard.Excess of No_3 level will cause Carsinogenic Compounds	CCP-1C	125ppm(Max)	Production Manager will Weigh out the correct weight of ingredients in once per hour by using a scale.	Ingredients will be re weighed and the amount corrected as needed.	1.Scale weight 2.Report forms of deviation and corrective actions.	1.Daily calibrate the scale by engineer. 2.Verify the weight before addition to the batch by production manager
2.Bowl Chopper $NaNo_3$ level	Biological Hazard.Inadequate amount of No_3 level will cause growth of Pathogenic Microorganism.	CCP-1B	100ppm (Min)	Production Manager will Weigh out the correct weight of ingredients in once per hour by using a Scale.	Ingredients will be re-weight and the amount corrected as needed.	1.Scale weight 2.Report forms of deviations and corrective actions.	1.Daily calibrate the scale by engineer. 2.Verify the weight before addition to the batch by production Manager.

Process Step	Hazard Description	CCP Description	Critical Limit	Monitoring Procedure (Who/What/When/How)	Corrective Action	HACCP Records	HACCP Verification Procedure
3.Cooking Temperature in oven	Biological Hazard.(Pathogenic Microorganism)	CCP-2B	Keep the product in72°C-75.91 °C for 2 Minutes.	Production Manager will Measure the core temperature of the product in each 3 ovens by using a thermometer in each batch.measure the time using stop watch.	Continue the cooking until the core temperature reach 72°C.after that keep the product in that temperature minimum of 2 Minutes.	1.Room temperature log. 2.Corrective action log 3.Thermometer calibration log. 4.Product core temperature log.	1.Quality Assurance Manager will audit the daily oven log. 2.Thermometer Calibrated once per month.

Freeze Temperature	Hazard.(Pathogenic Microorganism)		Product in -18°C for 3 hours.	Weigh out the correct weight. of ingredients in once per hour by using a scale.	product more time in blast freezer till the core temperature reach to –18°C	ve action log. 2.Blast freezer temperature log. 3.Thermometer calibration log	Manager will verify the accuracy of blast freezer temperature once a shift 2.Thermometers will be calibrated once a month.
5 Cold storage Temperature	Biological Hazard(Pathogenic Microorganism)	CCP-4B	Keep the Product in –15°C	Production Manager will measure the core temperature of the product in every two hours by using a thermometer.	Keep the product more time in cold storage till the core temperature reach to –15°C	1.Cold storage log. 2.Thermeter calibration log. 3.Correcti ve action log.	1.Production Manager will verify the accuracy of cold storage temperature once a shift. 2.Thermometers will be calibrated once a month.
6 Transportation Temperat	Biological Hazard(Pathogenic	CCP-5B	Keep the product in –15°C	Production Manager will Measure the core temperature of the	Keep the product more time	1.Transport temperatu	1.Production Manager will verify the accuracy of

m)			hours by using a thermometer.	transport vehicle till the temperature reach to –15°C	2.Thermometer calibration log 3.Corrective action log.	temperature once a day. 2.Thermometers will be calibrated once a month.

Table 4.26.HACCP plan-meat ball production

Process Step	Hazard Description	CCP Description	Critical Limit	Monitoring Procedure (Who/What/ When/How)	Corrective Action	Haccp Records	Haccp Verification Procedure
1.Bowl Chopper $NaNo_3$ level.	Chemical Hazard.Excess of No_3 level will caus Carsinogenic Compounds	CCP-1C	125ppm (Max)	Production Manager will Weigh out the correct weight of ingredients in once per hour by using a scale.	Ingredients will be re weighed and the amount corrected as needed	1.Scale weight 2.Report forms of deviation and corrective actions	1.Daily calibrate the scale by engineer. 2.Verify the weight before addition to the batch by production manager
2 Bowl Chopper $NaNo_3$ level	Biological Hazard.Inadequate amount of No_3 level will cause growth of Pathogenic Microorganis	CCP-1B	100ppm (Min)	Production Manager will Weigh out the correct weight of ingredients in once per hour by using a Scale.	Ingredients will be re-weight and the amount corrected as needed.	1.Scale weight 2.Report forms of deviations and corrective	1.Daily calibrate the scale by engineer. 2.Verify the weight before addition to

3.Cooking Temperature in oven	Biological Hazard.(Pathogenic Microorganism)	CCP-2B	Keep the product in72°C-75.91 °C for 2 Minutes.	Production Manager will Measure the core temperature of the product in each 3 ovens by using a thermometer in each batch.measure the time using stop watch.	Continue the cooking until the core temperature reach 72°C.after that keep the product in that temperature minimum of 2 Minutes.	1.Room temperature log. 2.Corrective action log 3.Thermometer calibration log. 4.Product core temperature log.	production Manager. 1.Quality Assurance Manager will audit the daily oven log. 2.Thermometer Calibrated once per month.

Step	Description	Description	Limit	(Who/What/ When/How)	Action	Records	Verification Procedure
4.blast freezer Temperature	Biological Hazard.(Pathogenic Microorganism)	CCP-3B	Keep the Product in –18°C for 3 hours.	Production Manager will measure the core temperature of the product in every three hours by using a thermometer.	Keep the product more time in blast freezer till the core temperature reach to –18°C	1.Corrective action log. 2.Blast freezer temperature log. 3.Thermometer calibration log	1.Production Manager will verify the accuracy of blast freezer temperature once a shift. 2.Thermometers will be calibrated once a month.
5.Cold storage Temperature	Biological Hazard(Pathogenic Microorganism)	CCP-4B	Keep the Product in –15°C	Production Manager will measure the core temperature of the product in every two hours by using a thermometer.	Keep the product more time in cold storage till the core temperature reach	1.Cold storage log. 2.Thermeter calibration log. 3.Correc	1.Production Manager will verify the accuracy of cold storage temperature once a shift.

						action log.	eters will be calibrated once a month.
6.Transpo rtation Temperat ure	Biological Hazard(Patho genic Microorganis m)	CCP-5B	Keep the product in –15°C	Production Manager will Measure the core temperature of the product in every two hours by using a thermometer.	Keep the product more time in transport vehicle till the temperatu re reach to –15°C	1.Trans port tempera ture log. 2.Therm ometer calibrati on log 3.Correc tive action log.	1.Productio n Manager will verify the accuracy of transportatio n temperature once a day. 2.Thermom eters will be calibrated once a month.

4.26. Step(9,10,11&12): Principle (4,5,6&7) HACCP plan for chicken rolls

Table 4.27 HACCP plan-chicken roll production

Process Step	Hazard Description	CCP Description	Critical Limit	Monitoring Procedure (Who/What/ When/How)	Corrective Action	Haccp Records	Haccp Verification Procedure
1.Bowl Chopper $NaNo_3$ level.	Chemical .Hazard.Excess of No_3^-level will cause Carsinogenic Compounds	CCP-1C	125ppm (Max)	Production Manager will Weigh out the correct weight of ingredients in once per hour by using a scale.	Ingredient s will be re weighed and the amount corrected as needed.	1.Scale weight 2.Report forms of deviation and corrective actions.	1.Daily calibrate the scale by engineer. 2.Verify the weight before addition to the batch by production manager
2.Bowl Chopper $NaNo_3$ level	Biological Hazard.Inadequate amount of No_3^- level will cause growth of Pathogenic Microorganism.	CCP-1B	100ppm (Min)	Production Manager will Weigh out the correct weight of ingredients in once per hour by using a Scale.	Ingredient s will be re-weight and the amount corrected as needed.	1.Scale weight 2.Report forms of deviations and corrective actions.	1.Daily calibrate the scale by engineer. 2.Verify the weight before addition to the batch by production Manager.

3.Cooking Temperature in oven	Biological Hazard.(Pathogenic Microorganism)	CCP-2B	Keep the product in72°C-75.91 °C for 2 Minutes.	Production Manager will Measure the core temperature of the product in each 3 ovens by using a thermometer in each batch.measure the time using stop watch.	Continue the cooking until the core temperature reach 72°C.after that keep the product in that temperature minimum of 2 Minutes.	1.Room temperature log. 2.Corrective action log 3.Thermometer calibration log. 4.Product core temperature log.	1.Quality Assurance Manager will audit the daily oven log. 2.Thermometer Calibrated once per month.

Process Step	Hazard Description	CCP Description	Critical Limit	Monitoring Procedure (Who/What/ When/How)	Corrective Action	Haccp Records	Haccp Verification Procedure
4.Cold room temperature	Biological hazard(Pathogenic Microorganism)	CCP-3B	Keep the product in –15°C	Production Manager will measure the core temperature of the product in every two hours by using a thermometer.	Keep the product more time in cold room till the core temperature reach to –15°C	1.Cold room log 2.Thermometer calibration log 3.corrective action log	1.Production Manager will verify the accuracy of cold storage temperature once a shift. 2.thermometers will be calibrated once a month.

5.blast freezer Temperature	Biological Hazard.(Pathogenic Microorganism)	CCP-4B	Keep the Product in –18°C for 3 hours.	Production Manager will measure the core temperature of the product in every three hours by using a thermometer.	Keep the product more time in blast freezer till the core temperature reach to –18°C	1.Corrective action log. 2.Blast freezer temperature log. 3.Thermometer calibration log	1.Production Manager will verify the accuracy of blast freezer temperature once a shift. 2.Thermometers will be calibrated once a month.
6.Cold storage Temperature	Biological Hazard(Pathogenic Microorganism)	CCP-5B	Keep the Product in –15°C	Production Manager will measure the core temperature of the product in every two hours by using a thermometer.	Keep the product more time in cold storage till the core temperature reach to –15°C	1.Cold storage log. 2.Thermeter calibration log. 3.Corrective action log.	1.Production Manager will verify the accuracy of cold storage temperature once a shift. 2.Thermometers will be calibrated once a month.

Process Step	Hazard Description	CCP Description	Critical Limit	Monitoring Procedure (Who/What/ When/How)	Corrective Action	Haccp Records	Haccp Verification Procedure
7.Transportation temperature	Biological hazard(Pathogenic Microorganism)	CCP-6B	Keep the product in –15°C	Production Manager will measure the core temperature of the product in every two hours by using a thermometer.	Keep the product more time in transport vehicle till the core temperature reach to –15°C	1.Transport temperature log. 2.Thermometer calibration log 3.corrective action log	1.Production Manager will verify the accuracy of Transportation temperature once a day.. 2.thermometers will be calibrated once a month.

4.27.Validation of HACCP plan:

It is the act of assessing the HACCP plan of a particular product/process to ensure that all significant food hazards are correctly identified and controlled or reduced to acceptable levels. Following activities should be carried out to validation the HACCP plan time to time.

- Reviewing of hazard Analysis
- Reviewing of CCP determination
- Justification for critical limits based on current scientific information and regulatory limits.
- Determination of adequacy of monitoring activities, corrective action, record keeping.
- Reviewing of audit Reports
- Reviewing of changes made to HACCP plan and reasons for such changes
- Reviewing of deviation and corrective action reports
- Reviewing of consumer complaints
- Reviewing of G.M.P. Practices

4.28 Discussion:

The major hazard associated with raw materials Mechanical Deboned Meat(M.D.M) is biological hazard. Among them *salmonella, E.coli* and *staphylococcus aureus* (SLS 1218:2001) are the major pathogens to likely to be found in meat products. According to reference the suitable time-temperature combination to kill *salmonella*, a major hazardous pathogen, is 72°C for 2 minutes. The routine operational condition in any industry does not has a system to maintain 72°C for 2 minutes as a critical limit. Therefore use of range of time- temperature combination is the practical solution for the industry. The plotted past data of cooking temperature, in the oven, in control chart revealed the most appropriate time-temperature range on 72 °C-75.91 °C. So within this operation range critical limit can be achieved without any hesitation.

In addition to above microorganism, *Clostridium botulinum* like potential biological hazards may be present in M.D.M.

The lowest amount of No_3^- used for sausage production is 100ppm. When the No_3^- level is drop down below100ppm it will form a biological hazard, because of *Clostridium botulinum* will grow substrate under heteroautotrophic conditions. Nitrate (No_3^-) will block the acetyl- co-a path way alterating electron transport system.

In normally processed meat production No_3^- is used up to 125ppm of maximum concentration. If the No_3^- level is exceeded more than this amount it will form a nitrosoamine like compounds. This compound is a carsinogenic one. So this may be a chemical hazard to consumer. So it is better to use the No_3^- level in between 100ppm and 125ppm. In addition to above ccp's there are some ccp's identified like blast freeze temperature, cold storage temperature and transport temperature. The critical limit which are incooperated with these ccp's are in blast freezer –18°C for 3 hours(SLS 1161:1997), cold storage -15 °C (SLS 1218:2001) and transport -15 °C(SLS 1218:2001). All the operating limits should be set within these critical limits.

CHAPTER 5- Conclusion and Recommendation

5.1.Conclusion

With developed HACCP plan it can be concluded that no CCP are occurred in raw materials for chicken sausage, chicken meat balls and chicken roll in this particularly food industry. Decision tree concluded that bowl chopping (nitrate)NO_3^- level , oven cooking, blast freezing, cold storage and transporting temperature found to be the critical control points.

Result of control chart and resources concluded that 125ppm of maximum bowl chopper, 100ppm of minimum bowl chopper NO_3^- level, 72°C-75.91 °C for 2 minutes oven cooking temperature and-18°C for 3 hours blast freeze temperature, -15 °C cold storage temperature and -15 °C transport temperature established as critical limits of the manufacturing process.

Activities like thermometer calibration, scale calibration, auditing of oven temperature log were identified as verification activities.

5.2. Recommendation:

- As a control measure introduction of air separation for raw materials was suggested as a process modification to be made.
- As a control measure introduction of metal detector for finished packed sausages was suggested.

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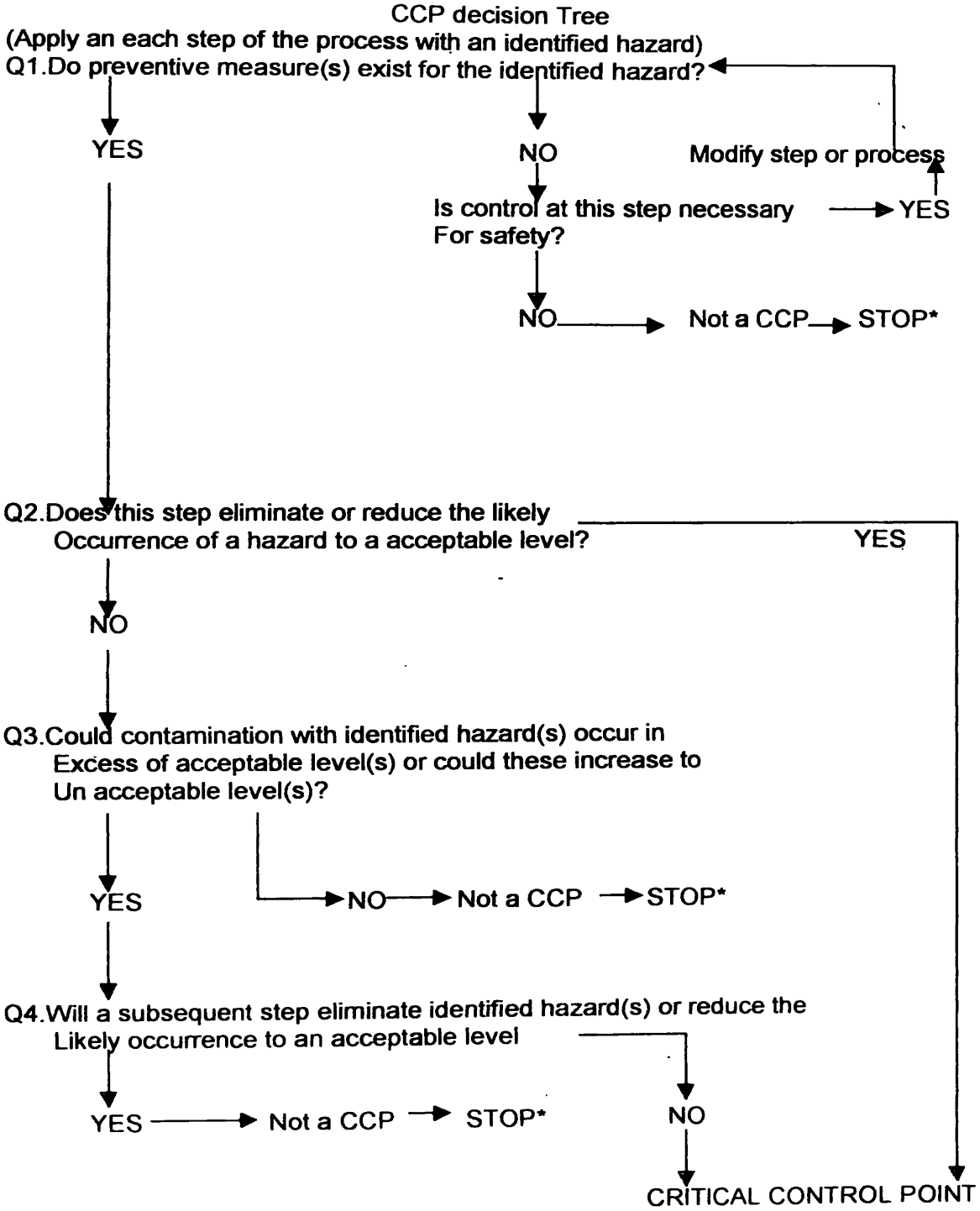
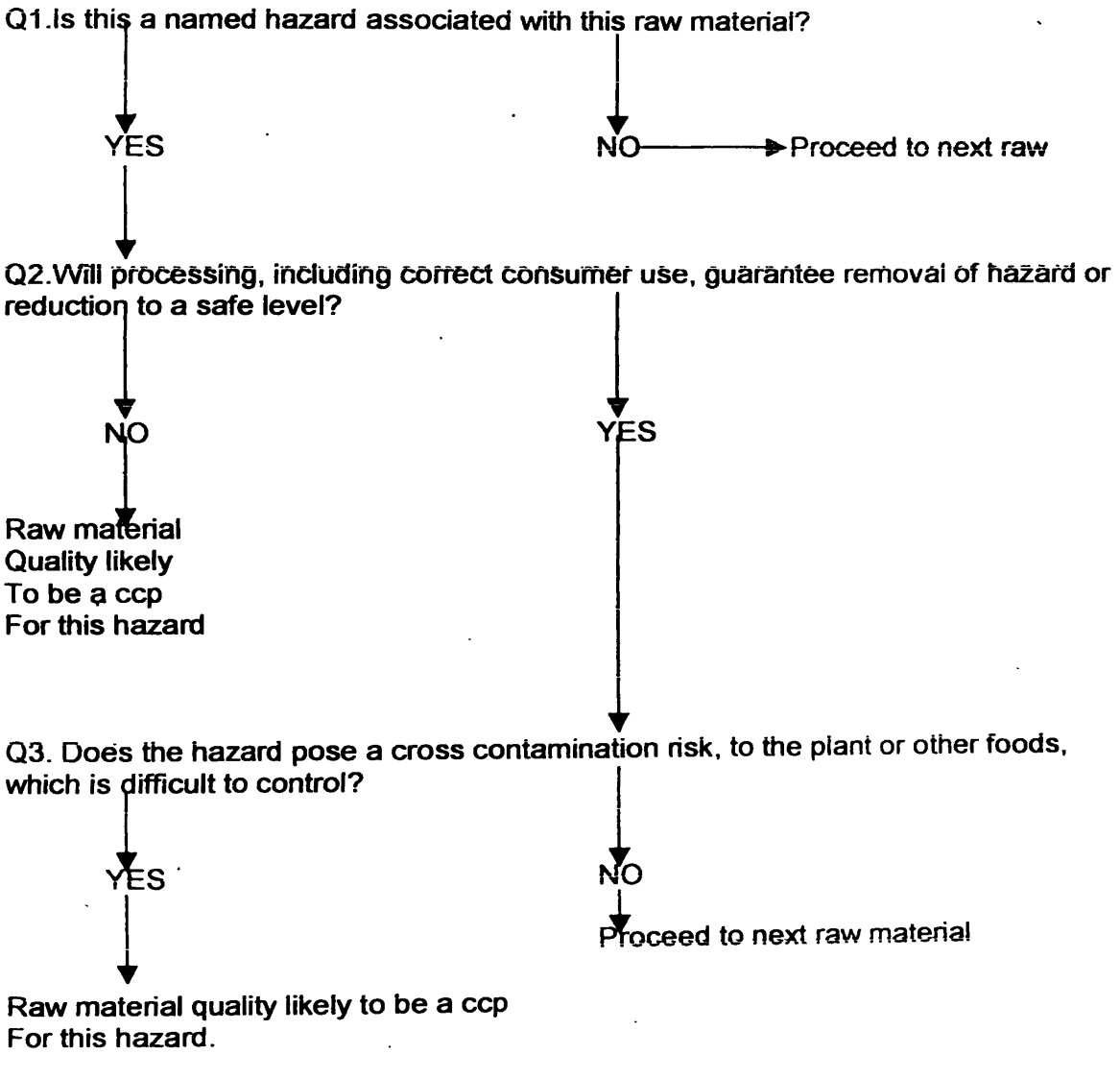
Appendix i



* Proceed to the next step in the described process

Appendix ii

Raw material decision tree(These should be part of the supplier quality assurance programme)



Appendix iii

Oven cooking temperature data sheet

Time	Sub group Number	Temperature			Average (°C)	Range(max-min)
		1(°C)	2(°C)	3(°C)		
8.00am	1	74.5	73.7	72.8	73.66	1.7
9.30am	2	75.2	74.5	76.2	75.3	1.7
11.00am	3	74.5	75.1	73.8	74.46	1.3
12.30pm	4	76.2	74.8	74.2	75.06	2.0
2.00pm	5	77.3	75.1	76.7	76.36	2.2
3.30pm	6	73.5	74.1	73.4	73.66	0.7
5.00pm	7	74.2	74.6	73.7	74.16	0.9
6.30pm	8	77.2	76.5	74.3	76	2.9
8.00pm	9	74.7	73.5	75.1	74.43	1.6
9.30pm	10	76.3	76.2	75.4	75.96	0.9
11.00pm	11	75.3	74.9	74.3	74.83	1.0
12.30am	12	72.5	74.3	74.1	73.63	1.8
2.00am	13	74.2	75.1	74.8	74.7	0.9
3.30am	14	74.8	70.1	71.4	72.1	4.7
5.00am	15	71.9	72.1	72.00	72.00	0.2
6.30am	16	73.5	72.7	73.1	73.1	0.8
8.00am	17	73.9	74.1	72.5	73.5	1.6

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