

The Design of HACCP Plan for Small Scale Chicken Cooked Sausage Plant in Bangladesh

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Abstract: The purpose of this study is to modify the generic HACCP model for chicken cooked sausage production based on actual conditions in this sausage plant. A specific model will be developed to boost the safety and quality of sausage product in this plant. The spread of some diseases by unsafe sausage products due to food borne pathogen reported makes it important to pay attention to the potential contamination in sausage production which could cause hazards to human health. HACCP is most effective when it is plant-specific and product-specific. However, the generic HACCP models have not been applied in most of the small-scale sausage plants. To ensure the food safety in those plants, based on the generic HACCP model this study is pursued to design a specific HACCP model to be suitable in a small-scale chicken cooked sausage plant in Bangladesh.

Key words: HACCP Model, Hazard, Chicken Sausage, Small-scale Plant etc.

Introduction

HACCP is an acronym for the Hazard Analysis Critical Control Point. It is a system that was developed for assuring pathogen-free foods. It provides precise process control measures for each step of the entire food manufacturing process. More recently, HACCP has been used in the cereal products, dairy products and beverage industries in Bangladesh that is regulated by the BSTI, BCSIR, and SGS Bangladesh etc. But Meat & Poultry Processing Technology is relatively new field of study, research and business strategy in Bangladesh. Currently several business groups are starting to develop the product and expanding their business in this field. Meat is low acid food and moreover, in sausage manufacturing, problems associated with the presence of *Listeria monocytogenes*, *Salmonella enteritidis*, *Staphylococcus aureus*, *Escherichia coli* and others have been documented. The traditional quality testing and inspection used in the sausage factory is applied to the product once a problem presents itself. It is thus difficult to maintain fully product inspection because of lack of trained and skilled manpower, human error, obtaining sufficient samples and so on. HACCP is a science-based system used to ensure that food

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safety hazards are controlled to prevent unsafe food from reaching the consumer (**Bardic, 2001; Mortimore & Wallace 1997; Morris, 1997; IFST, 1998**). To fulfill the protein requirements and safe consumption of meat and processed meat, the design of HACCP plan is very essential and has great importance in Bangladesh. This study is specifically designed to develop HACCP model that can be applied in a small-scale sausage plant to replace the traditional inspection and quality procedure in order to prevent the hazards in the sausage product.

Research Design

This study was conducted in a small-scale sausage plant in Bangladesh. The restructuring was aimed at expanding the company's market. Consequently, the company plans for effective quality system to ensure safe and good quality products.

Research Method

This study did not use quantitative research. The purpose of this study was to design a HACCP model not to implement it in the actual situation. Therefore, there is no statistical data. This study matched a qualitative approach. It gives the intricate details of phenomena that are difficult to convey with quantitative methods. Qualitative research is exploratory and open-minded which is applicable to this study (Patton, 1987).

Research Approach

This research was done for a small-scale chicken sausage plant. Based on the principle and several existing generic models of HACCP, the recordkeeping of the model in this study were designed in the following manner. The record keeping form of hazards in ingredient and incoming material analysis chart are modified from Canadian Food Inspection Agency (2001) and material decision matrix, hazard analysis chart and process step decision matrix are modified from Mortimore and Wallace (1997) model.

1. Prerequisite program
2. Product description.
3. Product ingredients and incoming materials.
4. Process flow diagram.
5. Hazard identification.
6. Critical control points determination.
7. HACCP control chart.

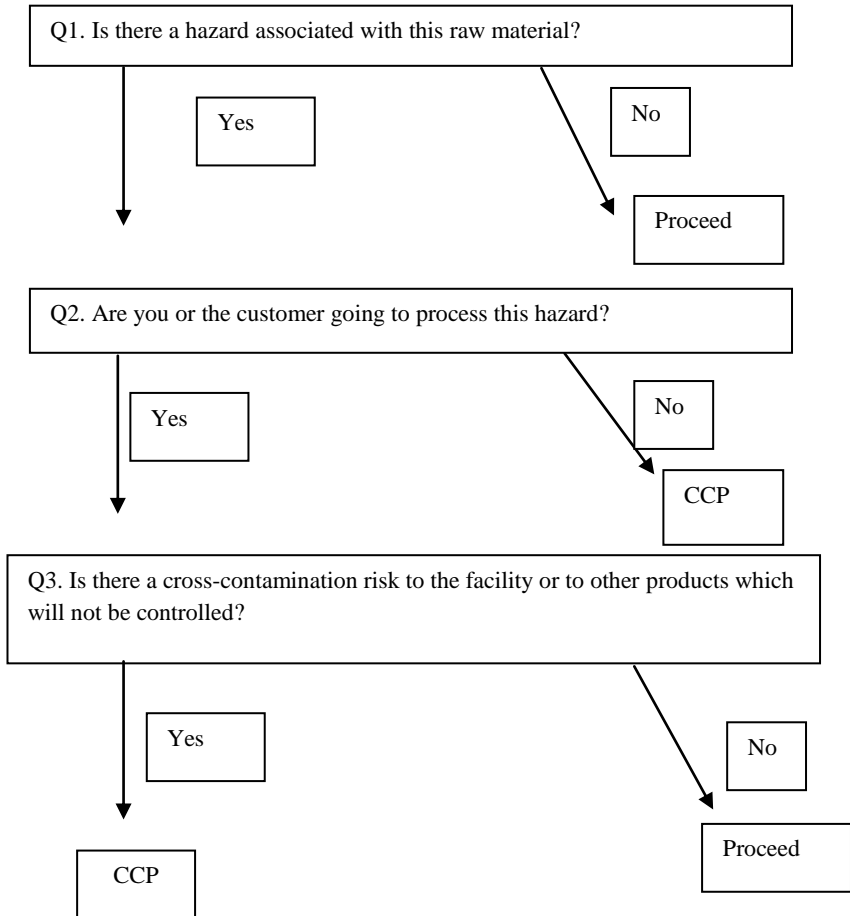


Figure 1: CCP Raw Material Decision Tree

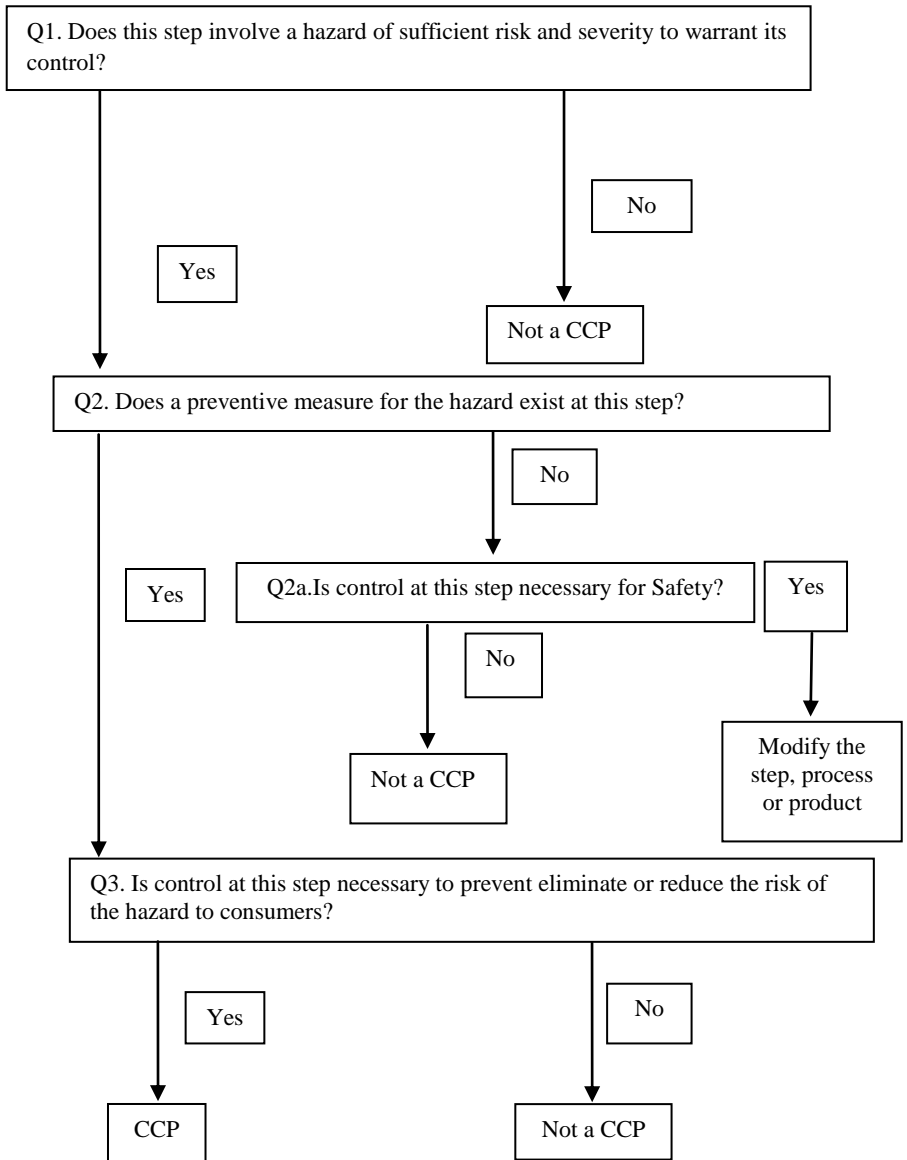


Figure 2: CCP Process Decision Tree

Results & Discussions

Based on the principle of the HACCP and several generic models, the HACCP model was designed to suit the real situation of the Chicken Cooked Sausage plant to produce the safe and quality end product.

Prerequisite program

There are several programs used in this plant:

1. Building design: The building designs are the premises for the production. The floor should be sloped for liquid to drain and the door should be self-closing. The floor should be mosaic and a certain height of wall should be tiles for easy cleaning. It should be routinely cleaned and sanitized by a professional housekeeper. The floor should be cleaned daily.

2. Pest control: The pest control activities should be contracted to professional in food industries. The UV light could eliminate the flies and the mice trap could eradicate the mice.

3. Storage and transportation: The specific conditions of the store room need to provide appropriate temperature and humidity for the raw materials and the final products. Daily inspection of the conditions could ensure a consistent environment to prevent the hazards and produce quality products. Proper transportation equipment should be used and the proper environmental conditions should be monitored for each batch.

4. Sanitation: The sanitation facilities should be properly set up to eliminate possible hazards. The sanitation tube connected with the facilities should be long enough to reach all the areas that need to be sanitized. The strength of the chlorine solution should be 200ppm; daily check is required. The sanitation should be used on all the equipment, containers and tools in the process. Sanitation should be part of the personal hygiene too.

5. Water supply: Potable water should be used in the process. The water potability testing should be verified and recorded at least every half year. The filter for the water needs to be checked monthly.

6. Equipment: All the equipment needs to be checked routinely to ensure a smooth running system. The equipment should be operating properly and should be free of cracks, rust and dents.

7. Personal hygiene: The employee should be well-trained on the personal hygiene. The supervisor should conduct checks daily. The employee needs to wear a hat or a hair net while working and needs to wash and sanitize his/her hands before working. The employee should apply appropriate action based on the personal hygiene requirements in the production area. The employees must also be free of disease.

Product Description

Table 1: Product Description

1	Product Name	Chicken Cooked Sausage
2	Product Description	A small diameter comminuted sausage prepared from chicken meat, salt, sugar, spice, cure, flour etc.
3	How it is to be used	Ready to eat but 1-2 min fry in oil or 2 min boil in hot water or 30 second in oven is recommended.
4	Packaging	Poly bag, Vacuum sealed
5	Shelf life	2-3 weeks
6	Where it will be sold	Retail store
7	Labeling Instruction	Keep chilled (0-4 °C)
8	Distribution condition	Chilled (0-4°C)

Product ingredients and incoming materials:

Table 2: Hazards in ingredient and incoming material Analysis chart

Ingredients and Materials	Hazards	Preventive Measure
Meat	MCP	Store at chilled temperature 0-4 °C Sanitize equipment Proper personal hygiene and handling
Salt	MP	Quality product supply, Store at room temperature Maintain FIFO
Sodium Tri Polyphosphate (STPP)	CP	Quality product supply Store below 20 °C Proper personal hygiene and handling
Sodium Nitrite	CP	Quality product supply Store below 20 °C Proper personal hygiene and handling
Sugar	MP	Quality Product Supply
Spice	MCP	Quality product supply Store below 20 °C Proper personal hygiene and handling

Flour as binder	MCP	Quality product supply Store below 20 °C Proper personal hygiene and handling Maintain FIFO
Flake Ice	MCP	Assure/Use quality water for ice making Proper personal hygiene and handling
Cellulose Casing	M	Quality product supply Store below 20 °C
Linking yarn	M	Quality product supply
Packaging Materials	MCP	Quality product supply

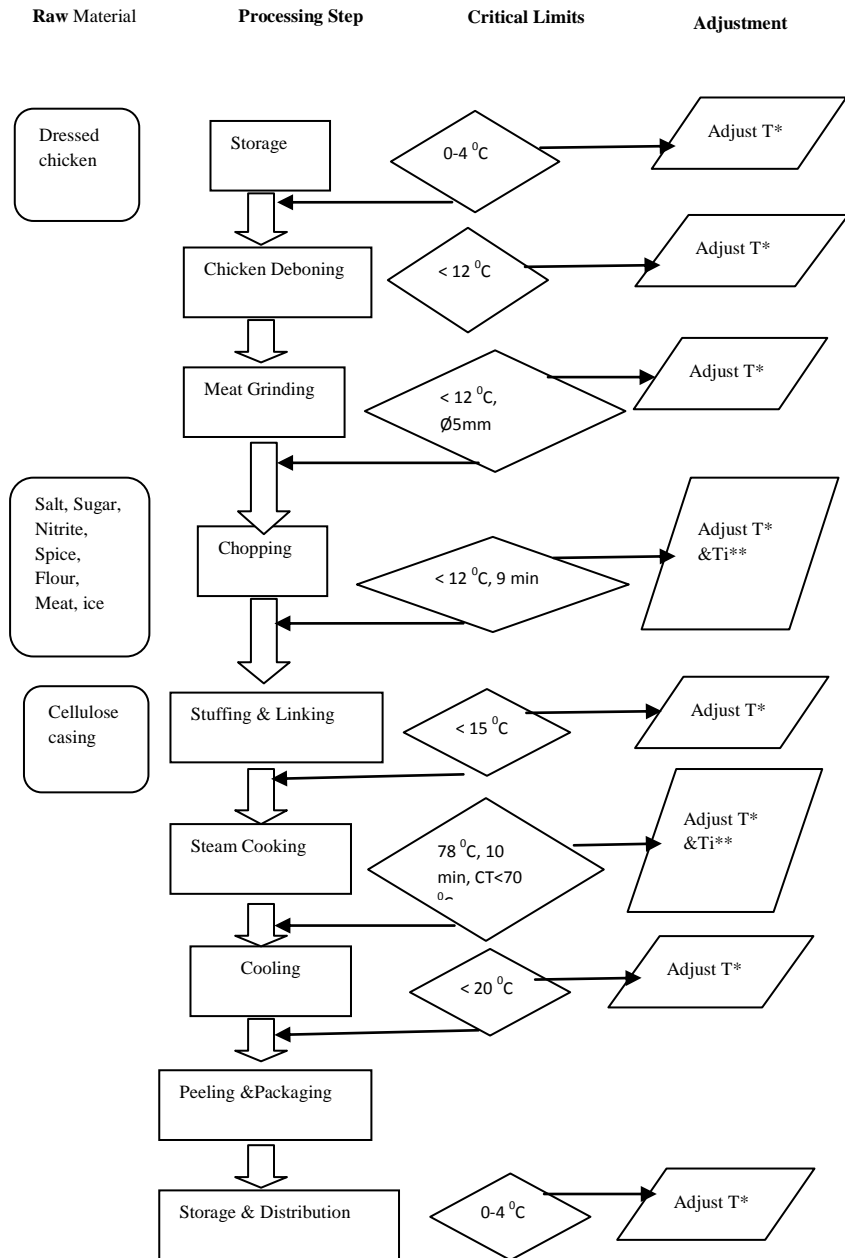
Where, M= Microbial Hazard, C = Chemical Hazard and P= Physical Hazard

Table 3: Material Decision Matrix

Raw material	Q1 Q2 Q3	CC P?	Notes
Chicken Meat			
M	Y Y N	N	Steam cooking will deal with the microbial hazard of meat
C	Y Y N	N	Prerequisite Program: Equipment and Sanitation
P	N -- --	N	Personal Hygiene and Physical Inspection
Salt			
M	Y Y N	N	Personal Hygiene and Cooking of final product
P	Y Y N	N	Personal hygiene, sieving and physical inspection
STPP			
C	Y N --	Y	Quality Product supply is critical
P	Y Y N	N	Personal hygiene and physical inspection
Sodium Nitrite			
C	Y N --	Y	Quality Product supply is critical
P	Y Y N	N	Personal hygiene and physical inspection
Sugar			
M	Y Y N	N	Personal Hygiene, food storage and final cooking process
P	Y Y N	N	Personal hygiene, sieving and physical inspection

Spice			
M	Y Y N	N	Personal Hygiene, food storage and final cooking process
C	Y N --	Y	Quality Product supply is critical
P	Y N --	Y	Quality Product supply is critical
Wheat Flour			
M	Y Y N	N	Personal Hygiene, food storage and final cooking process
C	Y N --	Y	Quality Product supply is critical
P	Y Y N	N	Personal Hygiene and Physical Inspection
Flake Ice			
M	Y Y N	N	Personal hygiene and heat processing of final product
C	Y Y N	N	Prerequisite program: Quality water supply
P	Y Y N	N	Filter water
Cellulose casing			
M	Y Y N	N	Personal Hygiene, food storage and final cooking process
Linking yarn			
M	Y Y N	N	Personal Hygiene, food storage and final cooking process
Packaging Material			
MCP	Y N --	Y	Quality Product supply is critical

Process Flow Diagram



*T: Temperature

**Ti: Time

Hazards Identification

Table 4: Hazards Analysis Chart

Process Step	Hazards	Preventative Measure
Raw Material Meat Storage	MCP	Proper equipment setting Sanitize all the transfer equipment 0-4 °C
Deboning	MCP	Proper Personal Hygiene and handling Clean and Sanitize associated equipment < 12 °C
Grinding	MCP	Proper Personal Hygiene and handling Clean and sanitize associated equipment < 12 °C
Chopping	MCP	Proper Personal Hygiene and handling Clean and sanitize associated equipment < 12 °C, 9 min
Stuffing & Linking	MP	Personal Hygiene Clean and sanitize stuffer and linking machine Physical inspection < 15 °C
Steam Cooking	M	78 °C, 10 min, RH=100% CT> 70 °C
Cooling	M	Quality water supply for spray
Peeling & Packing	MCP	Proper vacuum packer setting Sanitize the container, scale and tools Proper personal hygiene and handling
Storage & Distribution	M	0-4 °C Proper storage and distribution condition setting

CCP Determination

Table 5: Process Step decision matrix

Process Step and Hazard	Q1	Q2	Q2a	Q3	CCP?	Notes
RMM Storage						
-M	Y	Y		Y	Y	Correct storage Time & temperature is critical
-C	N				N	PRP: Sanitation
-P	Y	Y		N	N	PRP: Personal Hygiene

Deboning					
-M	Y	Y	N	N	Proper Temperature inhibit the bacterial growth
-C	N			N	PRP: Sanitation
-P	Y	Y	N	N	PRP: Personal Hygiene
Grinding					
-M	Y	Y	N	N	Proper Temperature inhibit the bacterial growth
-C	N			N	PRP: Sanitation
-P	Y	Y	N	N	PRP: Personal Hygiene
Chopping					
-M	Y	Y	N	N	Proper Temperature inhibit the growth
-C	N			N	PRP: Sanitation
-P	Y	Y	N	N	PRP: Personal Hygiene
Stuffing & Linking					
-M	Y	Y	N	N	Proper Temperature inhibit the growth
-C	N			N	PRP: Sanitation
-P	Y	Y	N	N	PRP: Personal Hygiene
Steam Cooking					
-M	Y	Y	Y	Y	Correct cooking temperature and time is critical
Cooling, Peeling & Packing					
-M					Proper personal hygiene and handling
-C	N			N	PRP: Sanitation
-P	Y	Y	Y	Y	Presence of foreign materials is critical
Storage & Distribution					
-M	Y	Y	Y	Y	Storage & distribution temperature and time is critical

The storage temperature of raw meat is very important and critical to prevent the microbial growth and off-flavor. The time and temperature of Steam cooking, core temperature depend on which, is most critical point for cooked chicken sausage due to killing of pathogens. Peeling & Packing are also critical to minimize the post processing contamination. Vacuum packaging system has advantages like retention of the product colour and restriction of bacterial

growth. Storage and distribution temperature is critical to comply with shelf-life.

HACCP Control Chart

Process Step	Hazards	Preventive measure	Critical Limits	Monitoring Procedure	Monitoring Frequency	Corrective action
Raw & Packaging Material CCP#1	Microbiological Chemical & Physical Contamination	Qualified raw material supply	No unqualified product be used	Apply supply quality assurance	Each supply	Change supplier or brand Employee training
RMM Storage CCP#2	Microbial growth	Proper storage temperature and time	<4 °C Max. 3 days	Temperature log is properly running and monitored	Routinely (morning & evening)	Reject the raw meat
Steam Cooking CCP#3	Survival of Pathogens	Check The Core Temperature (CT) of product	CT≥71 °C	Check the CT, follow up the time and temperature and record keeping	Each Batch	Adjust the temperature and time by setting the equipment well Call the engineer to repair
Peeling & Packing CCP#4	Physical contamination	Personal hygiene and physical inspection	No foreign material	Visual Inspection by Packing operator	Each Pack	Retain, rework or discard based foreign material identified
Storage & Distribution CCP#5	Microbial Growth	Check the time and temperature	≤ 4 °C Shelf-life 14 days	Check the storage temperature and shelf-life and record keeping	Routinely	Retain or reject based on product testing by panelist

The HACCP control chart shows all the potential critical hazards that can occur during processing in this small scale chicken sausage plant along with preventive measure, critical limits, monitoring procedure and frequency and corrective action.

Conclusion

The study designed a HACCP plan model for a small-scale chicken sausage plant to improve the safety and quality of products. The form of this HACCP plan model was modified from several generic HACCP models which is then further modified based on the identified CCPs that were found from the observation and research that was conducted in the plant. The model is

developed step-by-step based on the seven principles of HACCP system .The prerequisite program was provided to deal with some hazards before the production; therefore, to simplify the HACCP plan. The product description was used to alert the consumer to the potential hazards in the final products. Then, the potential control points of the hazards appeared in both raw material and the process along with the prevention measures. By answering the questions in the decision trees, the critical control points were determined. Finally, the HACCP control chart was developed to include components of several HACCP principles which are critical limits, monitoring and corrective action. Five CCPS were found in the production in this chicken sausage plant. These are qualified supply of raw material and packaging material, Proper storage temperature and time for raw meat, Proper temperature and time for steam cooking, Proper inspection during peeling and packing for foreign materials and Proper storage & distribution temperature and time of final product.

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