APPLICATION OF HACCP PRINCIPLES FOR THE MEAT INDUSTRY

GUIDANCE SHEET NO: 13

CRITICAL CONTROL POINTS – CASE STUDY FERMENTED DRIED SHELF-STABLE SAUSAGE PRINCIPLE 2

FERMENTED DRIED SHELF-STABLE SAUSAGE

Fermented dried shelf-stable sausages are popular products in many CAREC member states. The production process is complex with many steps and multiple food safety hazards that must be managed through the correct identification of the critical control points with associated management controls, critical limits, target values and corrective actions. The following case study puts the theory presented in guidance sheet 12 into practice.

The process of identification of critical control points (CCP's) builds on the outcomes of principle 1 and makes use of the product description & intended use (guidance sheets 6 & 7), process flow diagram (guidance sheet 8) and hazard analysis (guidance sheets 10 & 11).

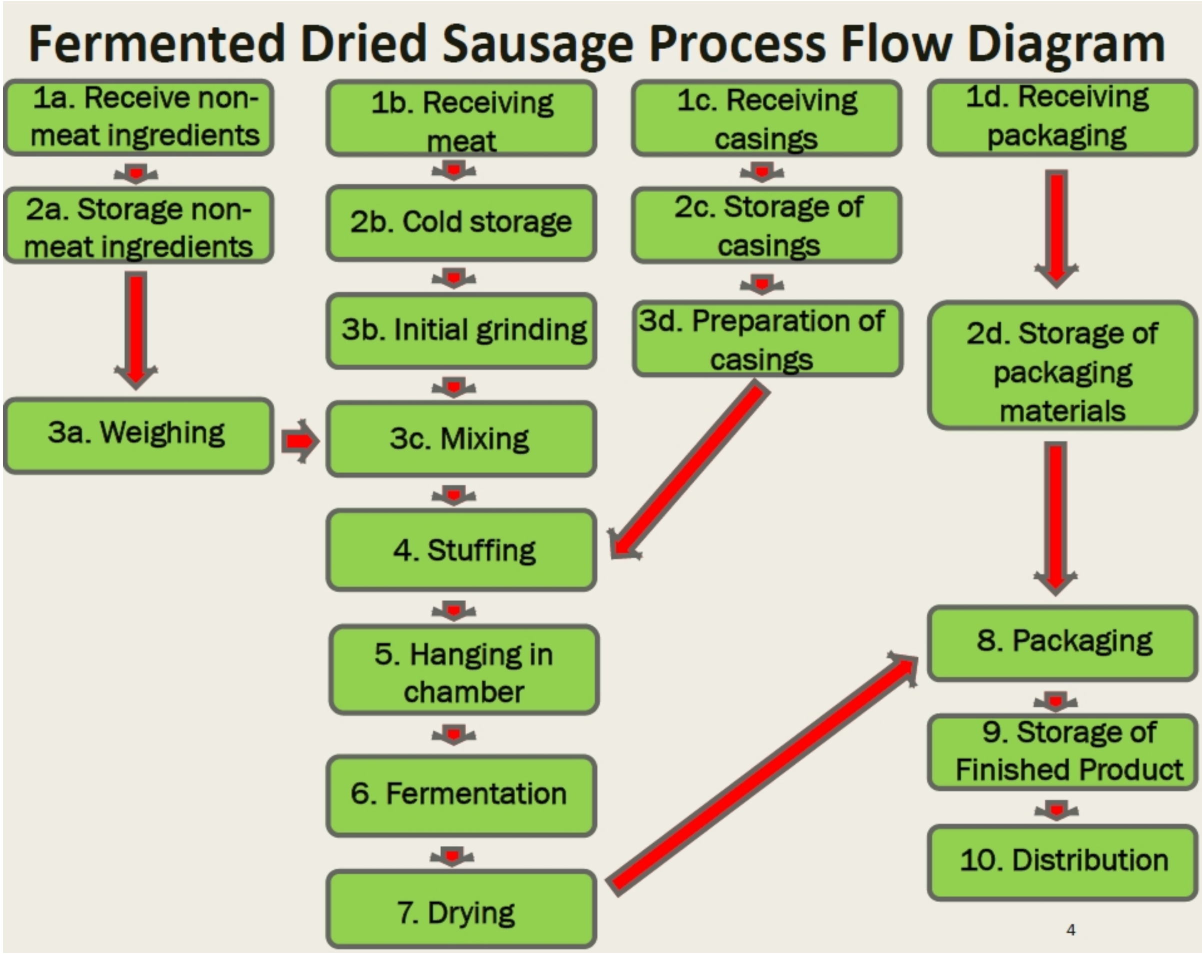
The case study focuses on identification of critical control points in a factory producing fermented dried shelf-stable beef or lamb sausage. Simplified versions of the product description/intended use, process flow diagram and hazard analysis are given to illustrate the process of identifying CCP's. When developing a HACCP system for an actual factory the various documents would be presented in much greater detail than the simplified versions given in this guidance sheet.

The Campden BRI decision tree has been used for CCP identification in this case study.

PRODUCT DESCRIPTION AND INTENDED USE

Product - Fermented & dried non-heat treated shelf stable salami
Intended consumer / use – All types of consumer, ready to eat
Display temperature – ambient
Labelling – contains milk, nitrites and nitrates
Ingredients – beef or lamb meat, natural casing (lamb **NOT** beef), milk powder, salt, spices, sodium nitrate, sodium nitrite, starter culture.

FERMENTED DRIED SAUSAGE – PROCESS FLOW DIAGRAM



HAZARD ANALYSIS

The main hazard analysis for the fermented dried shelf-stable beef/lamb sausage is given in tables 1 (hazards) and 2 (control measures).

The hazard analysis provided is suitable for beef, lamb or poultry meat sausages. If pork meat is used, you must adjust your process to control the hazard of *Trichinella spiralis. Trichinella spiralis* is a parasitic nematode worm, the larvae of the worm are found in pork meat bur cannot easily be seen with the naked eye.

If pork is used as an ingredient for fermented and dried sausage production and extra step lust be added to the production process to destroy the Trichinella larva. Trichinella larvae can be destroyed by heat treatment or by freezing. Storage at -21°C for 82 hours or heating to a core temperature of 63°C for 1 minute* will kill Trichinella larvae. If heat is chosen as a control measure it is essential to ensure that reaches core temperature in less than 2 hours to avoid the possibility of bacterial growth and formation of heat stable bacterial toxins.

Control of Trichinella would be an extra CCP that is only applicable if pork meat is used.

Table 1. Fermented Dried Shelf-Stable Beef/Lamb Sausage - Simplified Hazard Analysis – Hazards

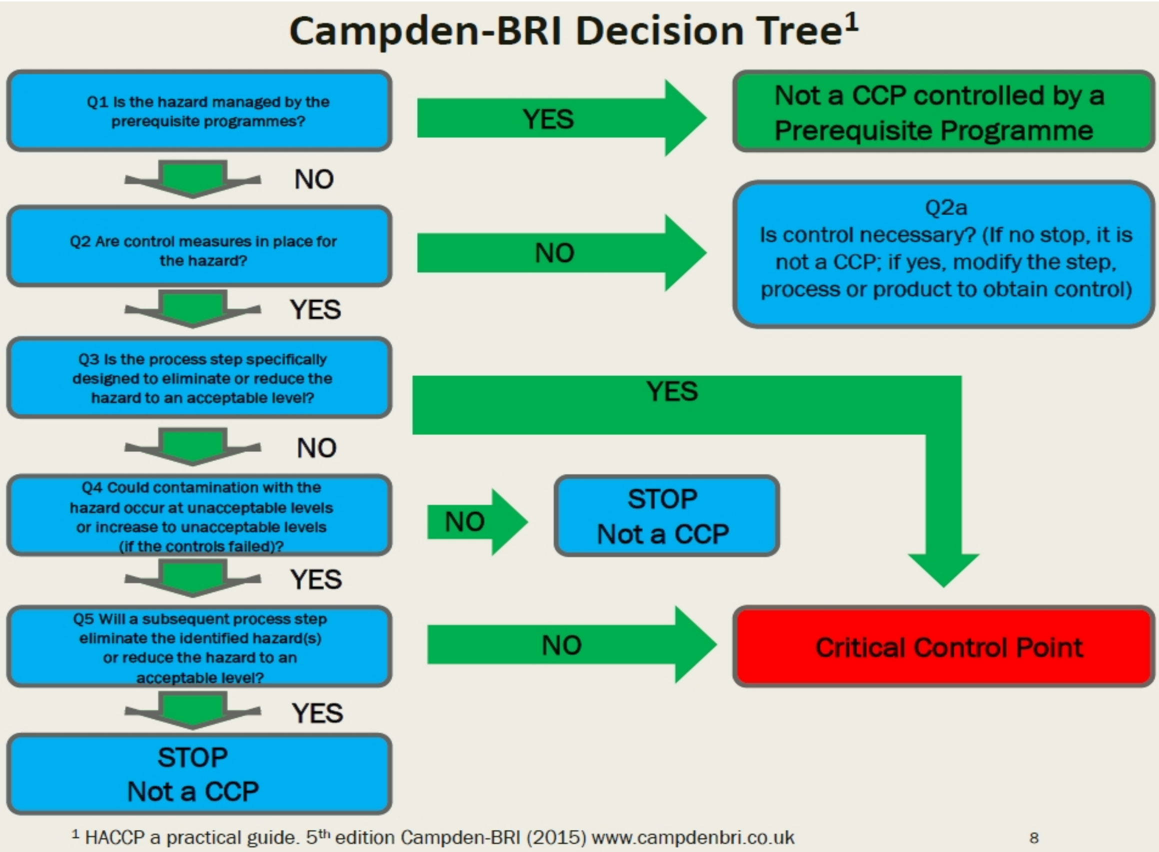
Biological Hazards
Pathogenic bacteria: *Salmonella sp*, *E.coli* (pathogenic strains), *Listeria monocytogenes* & *Staphylococcus aureus* (enterotoxin forming strains)
Chemical Hazards
Unapproved contaminants such as veterinary medical drugs and pesticides, disinfectants, lubricants and paint fragments Excessive levels of approved chemicals such as preservatives, antioxidants, acidifiers etc Leachates & inks from non-food use packaging films
Physical Hazards
Metal, glass, screws, plastic, jewellery
Allergens
Dried milk powder used as a binder – **Milk is an allergen**

Table 2. Fermented Dried Shelf-Stable Beef/Lamb Sausage - Simplified Hazard Analysis – Control Measures

Biological Hazards
pH of finished product range 4.7 to 5.3 Moisture content of finished product 30-40% moisture content (water activity 0.92 or lower) Finished product moisture to protein ratio (MPR) is 1.9:1 or lower **NO Thermal Step** – Could modify process to include post-fermentation heat treatment to guarantee destruction of pathogenic *E.coli*
Chemical Hazards
GMP & GHP Sanitary Standard Operating Procedures (SSOP's) to limit risks of chemical contamination including: Approved supplier SSOP, cleaning and sanitation SSOP, SSOP's for use of food additives Packaging SSOP
Physical Hazards
GMP & GHP SSOP's to limit risks of physical contamination
Allergens
Labelling of product – allergenic substance **"Milk"** shown in bold in ingredients list on consumer packaging

DECISION TREE

A copy of the decision tree used for CCP determination must be included as part of the HACCP documentation. In this case study the Campden-BRI decision tree was used.



DETERMINING THE CCP's FOR THE FERMENTED DRIED SAUSAGE

Using the Campden BRI decision tree answer the decision tree questions for each of the process steps in the process flow diagram, making reference to the hazard analysis and information provided in the product description.

For example: **Process step 1b Receiving of meat**

- Significant hazards include: contamination with pathogenic bacteria (*Salmonella, E.coli, S.aureus, Listeria monocytogenes*) and residues of veterinary medical drugs above legal limits;
- The answers for Q1 of the Campden BRI decision tree are as follows;
- Veterinary drug residues are controlled by a pre-requisite programme (approved supplier programme) so step 1b is not a CCP for chemical contamination.

Process step 1b Receiving of meat - pathogens

- Q1: No - The pathogens cannot be controlled by a pre-requisite programme.
- Q2: Yes - Sanitary standard operating procedures are used to reduce the hazard but cannot eliminate pathogenic microorganisms
- Q3: No – Meat receival is not designed to eliminate pathogens
- Q4: Yes – If hygiene controls fail pathogen levels could reach unacceptable levels
- Q5: Yes – Pathogens can be controlled through a combination of fermentation and drying

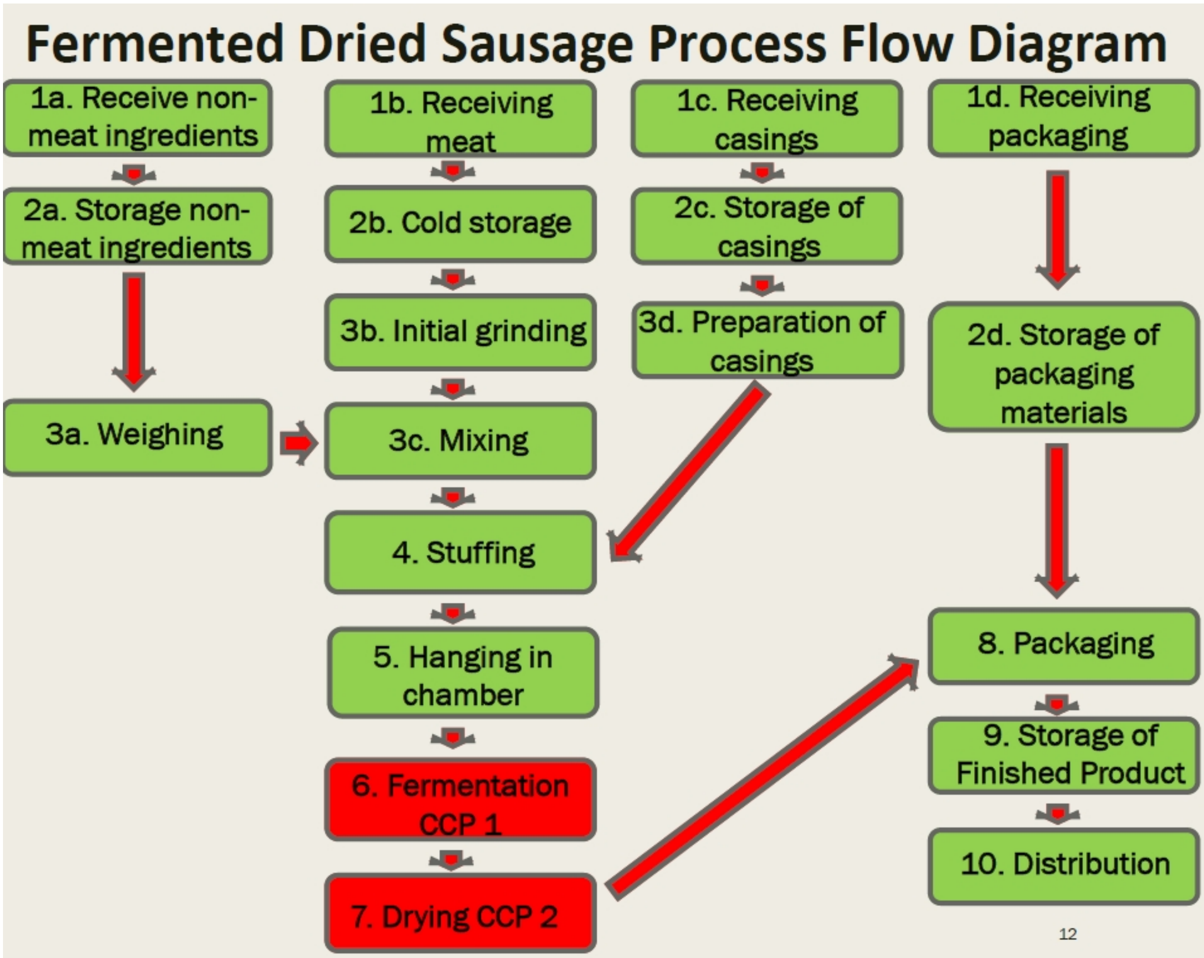
Conclusion Process step 1b is NOT a CCP for pathogens

If you work through all of the process steps in the process flow diagram you will find that the chemical, physical and allergenic hazards can be controlled by pre-requisite programmes.

The pathogenic microorganisms cannot be controlled completely by the pre-requisite programmes. Effective control of the pathogens is achieved by correct use of fermentation and drying (steps 6 & 7). Control cannot be achieved by any subsequent step, hence steps 6 & 7 (fermentation and drying) are the CCP's for pathogenic microorganisms.

The CCP's are numbered and recorded on a revised process flow diagram (see below) and in summary tables.

REVISED PROCESSED FLOW DIAGRAM SHOWING CCP's



DOCUMENTING THE CRITICAL CONTROL POINTS

When you have identified your critical control points the details should be recorded in a CCP summary table (table 3) and HACCP plan summary (table 4). The tables contain details of critical limits, monitoring procedures, corrective actions, verification and record keeping requirements as this is required as part of a complete HACCP system. Details of these steps are provided in sessions guidance sheets 14-20.

Table 3. CCP Description, Critical Limits, Monitoring, Corrective Actions - Not Heat Treated, Shelf-Stable

Product: Fermented dried not heat-treated shelf-stable beef sausage					
Process Step	**CCP No**	**CCP Description**	**Critical Limits**	**Monitoring Procedure**	**Corrective Actions**
6. Fermentation	1	pH	pH of 5.3 or less must be reached within 665 degree C hours. **Note: The concept of degree C hours is discussed at the end of this guidance sheet.**	**What:** Every product must reach a pH of 5.3 or less within 665 degree C hours **How/Who;** Designated staff member will measure pH of every batch of product **Frequency:** Once per batch **Responsible person;** Designated staff member and production manager	1. Identify and correct cause of deviation 2. Bring CCP under control after corrective action is taken 3. Measures to prevent reoccurrence 4. Potentially unsafe product is NOT released 5. Production manager is responsible for corrective actions
7. Drying	2	Water activity	Product must reach a water activity of 0.92 or less.	**What:** Every product must reach a water activity of 0.92 or less Rest of items as above.	Items 1-5 above.

Table 4. Beef Salami HACCP Plan Summary

CCP	Hazard	Critical Limit	Monitoring	Corrective Action	Verification	Records
CCP 1 – Step 6 fermentation	Pathogens: *Salmonella*, *S.aureus*, *E.coli*	pH of 5.3 or less must be reached within 665 degree C hours	**What:** pH **How/Who:** Designated member of staff will probe product **Frequency:** x1 per batch	1. Identify and correct cause of deviation 2. Continue to ferment until correct pH reached 3. Measures to prevent re-occurrence 4. No unsafe product is released 5. Manager is responsible for corrective actions	Visual observation of pH monitoring once per week by HACCP manager Weekly calibration of pH meter HACCP manager review of records	Fermentation log pH meter calibration log Deviation / corrective action log
CCP 2 – Step 7 Drying	Pathogens: *Salmonella, Listeria*	Product must reach a water activity of 0.92 or less	**What:** water activity **How/Who:** Designated member of staff will measure water activity **Frequency:** x1 per batch	Steps 1-5 above applied to CCP 2 continue drying until correct water activity is reached	As above but applied to CCP 2 Step 7 drying	Drying log Water activity meter calibration log Deviation / corrective action log

Calculation of degree C hours for fermented sausage products

Staphylococcus aureus is a pathogenic microorganism that can tolerate the low water activity levels found in fermented sausages, it is also tolerant of high salt levels and not much affected by nitrites or nitrates at legally permitted levels. It cannot grow at temperatures below 15.6°C or at pH levels of 5.3 or lower.

In a sausage fermentation process the objective is to bring the pH of the sausage down to pH5.3 or below. However, the fermentation process will cause the temperature of the meat to rise to above 15.6°C. If the temperature of the meat is above 15.6°C for longer than a certain time there is a risk of *S.aureus* growing and producing thermostable toxins that will cause food poisoning.

The term degree C hours refers to the maximum time that the product can be fermented at a temperature above 15.6°C without creating a risk of *S.aureus* growth and toxin formation. This is also the maximum time for the fermentation to reach pH5.3 or below (inhibition of *S.aureus*).

The degree C hours are calculated as time (hours) x temperature in °C above 15.6°C.

The calculation can be used to generate standard tables that provide values for safe fermentation conditions.

If the degree C hours is 665 the maximum fermentation temperature must be below 33°C. If the fermentation chamber temperature is set at 30°C the maximum number of hours to reach pH5.3 will be 46.2 hours.

The degree C hours calculation can be used to check whether the practical conditions in your fermentation will produce a safe or unsafe product.

For example:

1. Fermentation temperature is 26°C time to reach pH5.3 is 55 hours.

Degree C hours = 26-15.6 = 10.4, Hours = 55

10.4x55 = 572 degree C hours. The maximum degree C hour value equals 665 so this process will produce a safe product.

2. Fermentation temperature is 35°C time to reach pH5.3 is 40 hours.

Degree C hours = 35-15.6 = 19.4, Hours = 40

19.4x40 = 776 degree C hours. The maximum degree C hour value equals 665 so this process will produce an **unsafe product**. In this example it would be necessary to modify the fermentation process conditions (maximum temperature) to achieve a process within the required value of 665 degree C hours.