APPLICATION OF HACCP PRINCIPLES FOR THE MEAT INDUSTRY

GUIDANCE SHEET NO: 10

HAZARDS AND HAZARD ANALYSIS PRINCIPLE 1.1 AND 1.2

PRINCIPLE 1 HAZARD ANALYSIS

Principle 1 of HACCP covers the identification and analysis of potential food safety hazards in your factory and the development of suitable control measures to prevent or reduce the hazards to an acceptable level. Principle 1 is divided into three parts namely:

1.1 Identify and list potential hazards
1.2 Hazard analysis
1.3 Development of control measures

Parts 1.1 & 1.2 (hazards and hazard analysis) are discussed in guidance sheet S10, part 1.3 (control measures) is discussed in guidance sheet S11.

1.1 IDENTIFY AND LIST POTENTIAL HAZARDS

A hazard is something that has the potential to cause harm. This principle requires you to identify all such hazards that may reasonably occur in the production of your food. Hazards may be physical, chemical, allergenic or microbiological in nature and, depending on the size and complexity of your food business, you may need to consider each category in turn.

The preliminary stages for listing hazards associated with meat and meat products were discussed in guidance sheet S6. To help you with preparation of your initial list, tables of potential hazards associated with meat and meat products are provided at the end of this guidance sheet (S10).

Once you have produced a list of relevant hazards, you should refer to your process flow diagram (guidance sheet S8) and work through each process step of the flow diagram in a logical way, recording the relevant hazards as you go. When identifying hazards, you should consider:

- The likely presence of the hazard in raw materials;
- Whether the hazard may be introduced during a process step;
- Potential for the survival, multiplication or increase in frequency of a hazard at a process step.

On completion of this stage, you will have completed a list of hazards which are reasonably likely to occur in your food. This can be considered to be a "long list" which will now be subject to a process of evaluation to reduce it to a "short list" of hazards that should be considered further in this study. The process of refining your list is known as hazard analysis.

For a HACCP plan to be effective, control measures need to be targeted at those hazards which are more likely to occur in practice and which if they occur may lead to actual harm. The process of identifying such significant hazards is known as "Hazard Analysis" and requires you to work through each process step in turn, describing the identified hazards and then ranking them in terms of their likelihood of occurrence and severity. At the end of this process, you will be required to identify suitable control measures for those hazards ranked as significant (See Guidance Sheet S11 Principle 1.3 Control Measures) but can ignore any hazards which you have ranked as insignificant.

HOW TO CONDUCT THE HAZARD ANALYSIS

The hazard analysis is divided into four parts, each part is considered in this section.

1. Write a hazard description for each hazard

The first step is to write a brief description for each of the hazards that you identified in Principle 1.1. The description should refer to the source or cause of the hazard and whilst brief, should contain sufficient detail to properly characterise the hazard. When writing the hazard description, you should include one of the following terms which provide an explanation of the nature of the hazards at each process step. Using the same terminology throughout the HACCP plan will help you to produce a coherent plan.

Presence:
Use this description when the hazard is likely to be already present in the food at the process step. For example:
- Presence of *Salmonella* in raw chicken pieces
- Presence of *E.coli* o157 in raw beef mince
- Presence of stones in sacks of chick peas
- Presence of bones in fish

Introduction:
This description should be used where the hazard is potentially introduced at the process step itself. For example:
- Introduction of *E.coli* o157 by cross-contamination from utensils
- Introduction of glass from broken light fittings
- Introduction of *Listeria* from condensate dripping into open food

Growth:
This description should be used where there is potential for growth of microorganisms at a process step. For example:
- Growth of *Salmonella* during ageing process
- Growth of *Clostridium perfringens* during cooling
- Growth of moulds during maturing process

Survival:
This description should be used at a process step which will not adequately remove the hazard. For example:

- Survival of *Clostridium botulinum* spores
- Survival of *Trichenella* parasites
- Survival of spoilage spore-forming bacteria

So far you have identified a "long list" of hazards and briefly described how they are likely to have arisen in the food. The next task is one of the most important of the HACCP process: the identification of those hazards which are significant and the rejection of those which pose no significant risk to the consumer and can be controlled by your prerequisite programme. The purpose is to produce a "short list" of significant hazards which must be considered further by the HACCP study. This will be achieved by you scoring each of the identified hazards in terms of "Severity" and "Likelihood" to obtain a "Significance" score.

2. Provide a severity score for each hazard

A 1-3 scoring system is used to specify the severity of each identified hazard, in terms of the potential harm that could be caused to the consumer. A score of 1 indicates low severity of the hazard, and 3 is high severity. You should base your severity score purely on the potential outcome of the hazard remaining in the food at the time it is consumed. Do not consider the likelihood of this happening, as this is covered in the next stage.

Score 1: Low severity

Here there is little risk of serious harm to the consumer although there might be some concerns regarding the quality of the product. Some examples of low severity issues which may score a "1" here include:

- Taints in food where there is no actual chemical contamination; for example, exposure to diesel exhaust fumes or taints from packaging
- Discolouration of food
- Use of wrong ingredient (except if this introduces an undeclared allergen)
- Incorrect "Best before date" applied

Score 2: Medium severity

This type of hazard could cause serious harm to the consumer, for example short term illness or perhaps slight cuts or abrasions. Typical examples of this type of hazard might include:

- Foreign objects which are unlikely to be ingested or to present a choking hazard
- Residual detergent in process equipment
- Enteric viruses such as Norovirus
- Pathogenic bacteria such as *Campylobacter*, *Bacillus cereus* and *Staphylococcus aureus* which rarely cause serious illness
- Pesticide or heavy metal residues in food

Score 3: High severity

This type of hazard could cause actual significant illness such as food poisoning or actual bodily harm such as choking or internal bleeding. Typical examples might include:

- Pathogenic bacteria or their toxins which cause serious illness or may kill such as *E.coli* o157 and other VTEC, *Salmonella*, *Clostridium botulinum*.
- Protozoa such as *Cryptospiridium*
- Sharp glass or metal fragments which might be ingested
- Food allergens

3. Provide a likelihood score for each hazard

This is an assessment of the likelihood that the hazard will actually occur. Careful judgement should be exercised here to ensure that an effective filter is put in place to ensure that you do not spend an inordinate amount of time taking measures to prevent an event that is unlikely to happen in the first place. When considering this score, you should take into account:

- The product description (see guidance sheet S7) and in particular any chemical or physical properties of your food which might encourage or inhibit microbial growth;
- Any published guidance on the likelihood of the hazard, such as food poisoning statistics or information produced by competent authorities (available via the Internet);
- The history of such hazards associated with your food.

You should score the likelihood of the hazard actually occurring on a scale of 1 to 3.

Score 1 indicates "Low" likelihood. Here it is unlikely, although still possible, that the event will occur. In other words, it is possible but not probable that the hazard will occur in practice.

Score 2 indicates "Medium" likelihood. Here it is reasonably foreseeable that the hazard will occur. It could happen although there may not be any evidence of it having happened before.

Score 3 indicates "High" likelihood. It is very likely that the hazard will occur.

4. Determine your significant score

Once you have entered values for the "Severity" and "Likelihood" for a given hazard at a process step, a "Significance" rating score (6 is the maximum score) will automatically be generated.

You should now identify a significance score above which you are going to consider the hazard to be significant and take it forward to the next stage. For example:

If you specify that a score of 3 is significant all those hazards scoring 3 or above will be taken through to the next stage (Principle 1.3), all those hazards scoring 2 and below will be controlled and managed through effective prerequisite programmes (GHP see guidance sheet S5).

If you specify that a score of 4 is significant all those hazards scoring 4 or above will be taken through to the next stage (Principle 1.3), all those hazards scoring 3 and below will be controlled and managed through effective prerequisite programmes (GHP see guidance sheet S5).

FOOD SAFETY HAZARDS IN MEAT AND MEAT PRODUCTS

Hazards may be introduced, increased, or controlled at each step, in meat handling operations. Establishing what those hazards are in a process is a key step in the HACCP process.

Biological hazards
These hazards are normally organisms such as bacteria or parasites that can pose risks associated with food poisoning. They may be associated with the animals/birds themselves, or be introduced to a clean carcase through cross contamination.

Table 1. Biological hazards associated with different types of livestock

Species	Biological hazards
Beef cattle & buffalo	Verocytotoxin producing *E. coli* (VTEC) – the commonest of which is *E. coli* O157, Salmonella
Sheep and goats	VTEC and Toxoplasma
Pigs	Salmonella, Yersinia Enterocolitica, Toxoplasma Gondii and Trichinella
Poultry	Campylobacter, Salmonella, and bacteria carrying Extended Spectrum β-Lactamase (ESBL)/AmpC genes (commonly types of *E.coli* and Salmonella)
Horses	Trichinella
Farmed game (deer)	Toxoplasma
Farmed game (wild boar)	Trichinella
Farmed game (ostrich, rabbit & reindeer)	None

Adapted from European Food Safety Agency (EFSA) data

The risks from these hazards are that:
• food-poisoning bacteria can be transferred to meat/offal during dressing;

• food-poisoning bacteria can be transferred on to raw meat/offal and ready-to-eat products, for example from worker's hands, tools, working surfaces, equipment, water, pests, cleaning equipment, packaging or other meat/offal;

• food-poisoning bacteria on meat/offal can grow during production, storage or transport if the conditions, particularly temperature, are suitable.

Although thorough cooking kills most food poisoning bacteria, meat may be handled many times before it is cooked and the bacteria on it may be spread to other foods that may not be cooked before being eaten.

When conditions are ideal, certain types of bacteria can double their numbers every 20 to 30 minutes. E.coli O157 is reported to have a very low infective dose, and can cause serious illness and death, meaning that it is important to have adequate controls in place. Food business operators and consumers need to take appropriate precautions that include maintaining temperature controls and keeping raw meat completely separate from cooked meat and other ready-to eat-foods.

Table 2. Sources and indicators of foodborne pathogens associated with meat and meat products

Bacteria	Normal Incubation period	Normal duration of illness	Main clinical symptoms	Commonly associated foods
Campylobacter sp	3-5 days	2-7 days	Abdominal pain, diarrhoea sometimes bloody), headache, fever	Poultry, cooked meats, milk
Clostridium botulinum	12-36 hours	Extended	Swallowing difficulties, respiratory failure	Preserved foods, (for example, canned, bottled) and vacuum-packed meats
Clostridium perfringens	10-12 hours	24 hours	Abdominal pain, diarrhoea	Meat stews, roasted meats
E.coli O157	0.5-10 days	Possibly extended	Abdominal pain, diarrhoea (sometimes bloody), may lead to kidney failure	Beefburgers, meat, dairy products
Listeria monocytogenes	3-21 days	Variable	Fever, headaches, spontaneous abortion, meningitis	Soft cheeses, patés, poultry meat
Salmonella sp	12-36 hours	2-20 days	Abdominal pain, diarrhoea, fever, nausea	Meat, poultry, eggs, dairy products
Staphylococcus aureus	2-6 hours	0.5-1day	Vomiting, abdominal pain, diarrhoea	Cooked meat, human source such as workers
Yersinia enterocolitica	3-7 days	1-3 weeks	Acute diarrhoea, abdominal pain, fever and vomiting	Pig meat products

Adapted from European Food Safety Agency (EFSA) data

Chemical hazards
Possible sources of chemical contamination of animals include residues of veterinary medicines or pesticides if conditions of use have not been followed. The European Food Safety Agency (EFSA) have concluded that dioxins and dioxin-like polychlorinated biphenyls (DL-PCBs) are appropriate hazards, as well as Phenylbutazone in horses. Possible sources of chemical cross-contamination of meat/offal during processing, storage or transport include contact with cleaning and disinfecting agents, lubricants, or pest baits used in the meat plant or from a reaction between packaging material and the product.

Physical hazards – foreign bodies
Possible sources of physical hazards that may occur in animals include material such as metal or string that has been eaten or broken needles from veterinary treatment. Possible sources of physical contamination from foreign bodies can include items such as metal from rails, clips, tags, machinery, knife blades, grease, oil, paint flakes, rust, plastic, rubber bands, jewellery, pens, buttons, hair, glass splinters, bone splinters, wood splinters, sawdust, dust, dead insects or animal droppings.

Allergens

Some people have an allergy to meat but the majority of allergic reactions are caused by fourteen foods covered by the requirements for labelling namely: crustaceans, milk, eggs, peanuts, nuts, fish, molluscs, soybeans, cereals containing gluten, lupin, celery, mustard, sesame seeds and sulphur dioxide (where added and present at >10mg/kg). Some of these allergenic substances become relevant in processed meat products where an allergenic substance is used as an ingredient in the meat product. Examples include the use of milk powder and cereals (containing gluten) in the production of sausages.