The PAM Series ©

Practical Aide Memoirs for the workplace

PAM 5

The Food Safety Miscellany

3nd Edition

Mission 'Establish and maintain a food-safe environment'

Communication Training Improvements

PAM 1 ‘Communication’

PAM 2 ‘Training’

PAM 3 ‘Improvement’

PAM 4 ‘Logistics’

PAM 5 ‘The Food Safety Miscellany’

PAM 6 ‘Projects’

PAM 7 ‘Interaction’

Forward

The decision to write this series of PAMs was taken after witnessing and experiencing the absence of aide memoirs at work to help jog the memory or provide some guidance. Sometimes people just need a reminder, a nudge to get them along the way again. The PAMs provide sufficient information to allow the reader to easily digest the content and put it into practice at the workplace.

Essentially, Practical Aide Memoirs are just that, practical. The PAMs are intended to assist planning, decision making and action. The resultant action is intended to improve the workplace performance of individuals and teams, lifting those Key Performance Indicators, sustainably. The PAMs are about creating an environment of success.

PAM 1 is about laying the foundations. PAM 1 starts with the individual, then places the individual within and around the team. PAM 2 puts the framework in place. It establishes and maintains the learning environment and sets in place a culture of personal and professional development. PAM 3 builds on PAMs 1 and 2 and is all about creating an environment of Continuous Improvement. While based on sound Lean and Projects principles, this PAM remains practical due to the principle of being 'applied'; easy to grasp and transferable into the workplace.

PAM 4 provides a practical guide to logistics. The PAM has been put together to act as a springboard to a review of logistics and planning for the optimisation of operations. There is a degree of overlap in the PAM to facilitate the sections being read in any order. The logistics function is often overlooked in the business, which leads to inefficiencies and loss. A focus on logistics is a major contributing factor to success.

PAM 5 is a tour of topics relevant to Food Safety and is meant to serve as a point of reference. The importance of maintaining a food-safe environment cannot be over-stated; PAM 5 aims to contribute towards that mission. PAM 5 is a handy guide to have at the workplace in support of training and development.

Combined, the PAMs represent a Systems Approach to workplace improvements.

David Browne

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Actions

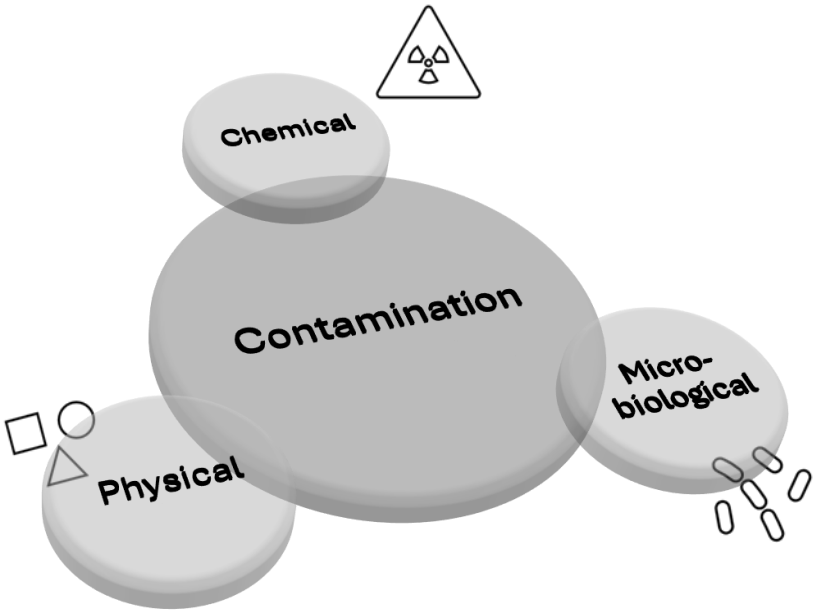
Item	Description	Actions	Stakeholders	Target Date

Notes:

Contamination

Types of Contamination

Chemical	Cleaning chemicals Chemical reactions during the process
Micro-biological	Multiplication (MM) Contamination (MC) Survival (MS)
Physical	Intrinsic- Natural or essential to the nature of something. Extrinsic- Not part of the essential nature of something.



Chemical contamination

Chemical cross-contamination in the food industry is a critical issue that can have severe implications for food safety and public health. It involves the unintended transfer of harmful chemicals from one substance to another, potentially contaminating food products. This can occur at various stages of food production, processing, storage, and transportation. Chemical contaminants can enter the food web from multiple sources, including:

Cleaning materials. Within the food production industry, high standards of cleaning is essential to maintaining food safety. Cleaning chemicals are used that, if not used in accordance with the manufacturer's instructions and Work Instructions, may result in food being contaminated. This could lead to waste and potential harm to the customer.

Environmental contaminants: These include pollutants from industrial activities, agricultural runoff, and contaminated water sources. Examples are heavy metals like lead and mercury, and organic pollutants such as dioxins and polychlorinated biphenyls (PCBs).

Agricultural practices: The use of pesticides, herbicides, and veterinary drugs can lead to residues in food products. These chemicals can persist in the environment and accumulate in the food web.

Food processing and packaging: During food processing, chemicals such as acrylamide can form when starchy foods are cooked at high temperatures. Packaging materials can also leach chemicals into food, especially if they are not food-grade.

Storage and transportation: Improper storage conditions can lead to the growth of moulds that produce mycotoxins, which are harmful to human health. Contaminated containers and equipment used during transportation can also introduce chemicals into food.

Chemical contaminants in food can be broadly categorised into several types:

Heavy metals: These include lead, mercury, cadmium, and arsenic. They can accumulate in the body over time and cause various health issues, including neurological and developmental problems.

Pesticides and herbicides: These chemicals are used to protect crops from pests and weeds but can remain as residues in food products. Long-term exposure to these chemicals can lead to chronic health conditions.

Industrial chemicals: Dioxins, PCBs, and other industrial pollutants can enter the food web through contaminated water and soil. These chemicals are known to be carcinogenic and can disrupt endocrine functions.

Food-processing contaminants: Chemicals like acrylamide, formed during high-temperature cooking, and polycyclic aromatic hydrocarbons (PAHs), produced during grilling or smoking of foods, are examples of contaminants that can form during food processing.

Mycotoxins: These are toxic compounds produced by certain types of moulds. They can contaminate crops like grains, nuts, and fruits during storage under humid conditions.

The health impacts of chemical contaminants in food can range from acute to chronic effects:

Acute Effects: These occur shortly after exposure and can include symptoms like nausea, vomiting, diarrhoea, and abdominal pain. Acute poisoning can result from high levels of contaminants like pesticides or heavy metals.

Chronic Effects: Long-term exposure to low levels of chemical contaminants can lead to serious health issues such as cancer, liver and kidney damage, reproductive and developmental problems, and endocrine disruption.

Vulnerable Populations: Certain groups, such as infants, pregnant women, and individuals with compromised immune systems, are more susceptible to the adverse effects of chemical contaminants.

Notes:

Preventing chemical cross-contamination in the food industry requires a multi-faceted approach involving good agricultural practices, stringent regulatory controls, and effective Food Safety management systems:

Good Agricultural Practices (GAP): Implementing GAP can minimise the use of harmful chemicals in farming. This includes using integrated pest management (IPM) techniques, selecting less hazardous pesticides, and ensuring proper application methods.

Regulatory controls: Governments and food safety authorities have established regulations to control the levels of chemical contaminants in food. These regulations set maximum residue limits (MRLs) for pesticides and other chemicals and require regular monitoring and testing of food products.

Food Safety management systems: Implementing systems like Hazard Analysis and Critical Control Points (HACCP) can help identify and control potential sources of chemical contamination throughout the food production process.

Proper storage and handling: Ensuring that food is stored under appropriate conditions to prevent mould growth and using clean, food-grade containers and equipment during transportation can reduce the risk of contamination1.

Consumer Awareness: Educating consumers about the risks of chemical contaminants and how to minimize exposure, such as washing fruits and vegetables thoroughly and choosing organic products, can also play a role in reducing the impact of chemical cross-contamination

Micro-biological contamination

Microbiological survival refers to the ability of microorganisms to endure and thrive in various environments, including extreme conditions.

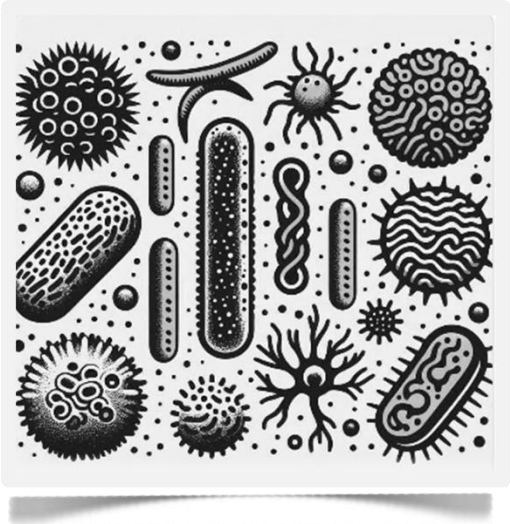
Endospores: Some bacteria, like Bacillus anthracis, can form endospores, which are highly resistant to heat, UV radiation, and disinfectants. This allows them to survive in harsh conditions for extended periods.

Extremophiles: These are microorganisms that can live in extreme environments, such as high radiation or extreme temperatures.

Adaptation mechanisms: Micro-organisms can adapt to various stress factors, such as dehydration, radiation, and chemical exposure.

Environmental factors: The growth and survival of microbes depend on factors like pH, temperature, water activity, and nutrient availability. These intrinsic factors determine how well microorganisms can thrive in a given environment.

Micro-organisms commonly found in food include viruses, bacteria, moulds (fungi) and yeasts.



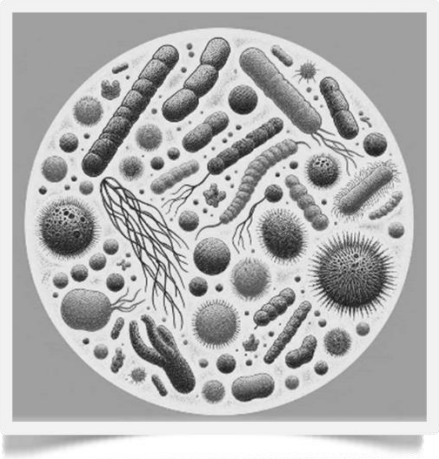
Bacteria

Bacteria are unicellular, prokaryotic organisms that play crucial roles in various ecosystems. They can be found in almost every environment on Earth, from soil and water to extreme environments like hot springs and deep-sea vents. Bacteria are classified based on various characteristics, one of the most important being their oxygen requirements. This classification divides bacteria into two main groups: aerobic and anaerobic.

Bacteria are simple single-celled forms of life which are:

- Microscopic
- Found everywhere
- Mostly harmless
- Some are essential
- Used in food manufacture, for example, yoghurt and cheese.
- Some cause food spoilage
- A few are pathogenic
- Poor hygiene may lead to large numbers in food

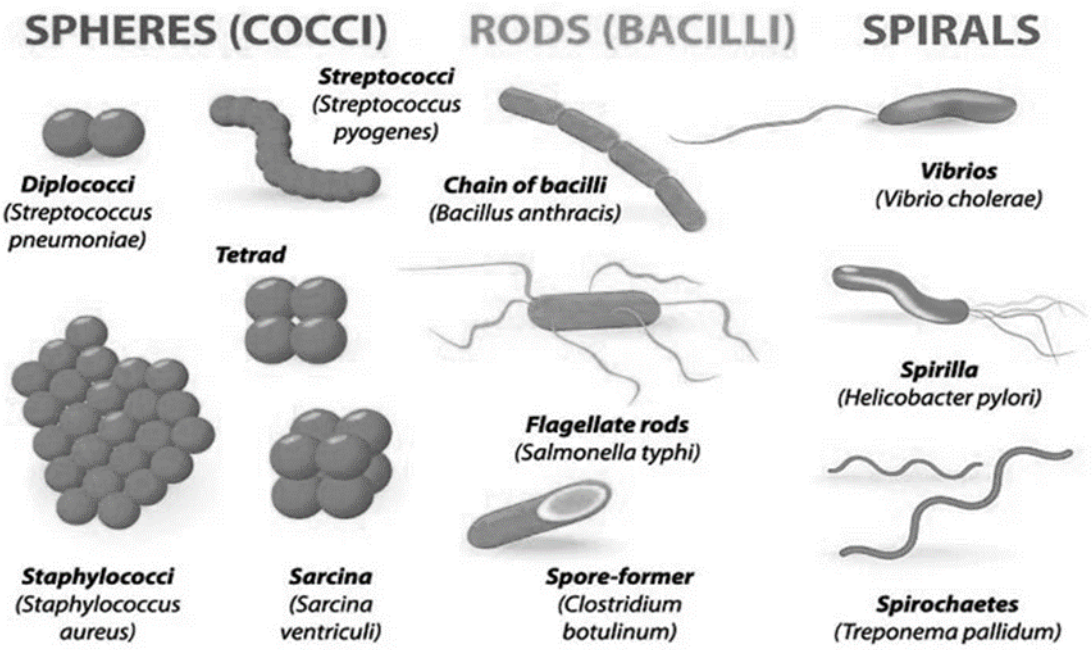
When grown on a suitable nutrient medium bacteria will thrive and form visible populations known as colonies.



Notes:

Classification of bacteria

When observed microscopically it becomes apparent that bacteria vary in size, shape and general appearance as shown in the following diagram.



Typical sizes of bacteria are:

Salmonella: 3 micrometres
Staphylococcus: 0.75 micrometres
(1 micrometre = 1/1000mm)

When observed under extreme magnification (for example, x50,000) the fine details of a bacteria cell can be seen.

Note:

Spore forming: Bacillus, Clostridium

Grain stains: '+' = Blue; '-' = Red

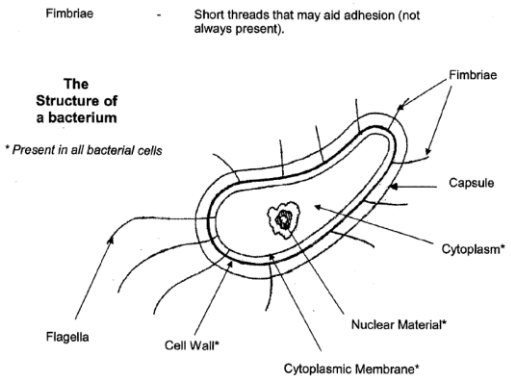
Typical bacteria cell structure

In all bacteria:

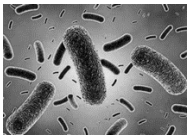
Cell Wall	Gives the cell strength and structure Provides physical protection Determines the shape of the bacterium
Cell Membrane	Semi-permeable Controls the passage of materials in and out of the living cell, for example, food and waste products
Cytoplasm	The contents of the cell where all life activities occur
Nuclear Body (Nucleus, DNA[1])	The genetic material of the cell which determines the cell's characteristics

In some bacteria:

Capsule	Gel-like secretion that gives the cell added protection
Flagellum	A thread-like structure which protrudes from the cell, used for movement
Fimbriae	Short threads that may aid adhesion

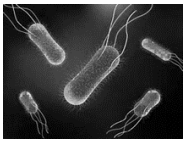


[1] **DNA**. Deoxyribonucleic acid.



Bacilli

Bacilli are typically rod-shaped and can form chains. They are known for their ability to produce endospores, which are highly resistant to extreme conditions such as heat, radiation, and disinfectants. While they are generally Gram-positive, some Bacillus species can appear Gram-negative as they age. Bacilli can be either obligate aerobes, requiring oxygen for growth, or facultative anaerobes, capable of surviving without oxygen. While most Bacillus species are not harmful to humans, some, like Bacillus anthracis (which causes anthrax) and Bacillus cereus (which can cause food poisoning), are pathogenic.



Campylobacter, Enterohaemorrhagic Escherichia coli and Salmonella

These are among the most common foodborne pathogens that affect millions of people annually – sometimes with severe and fatal outcomes. Symptoms are fever, headache, nausea, vomiting, abdominal pain and diarrhoea. Examples of foods involved in outbreaks of salmonellosis are eggs, poultry and other products of animal origin. Foodborne cases with Campylobacter are mainly caused by raw milk, raw or undercooked poultry and drinking water. Enterohaemorrhagic Escherichia coli is associated with unpasteurised milk, undercooked meat and fresh fruits and vegetables.

Cocci

Cocci are typically round or oval-shaped. They can exist as single cells (monococci), in pairs (diplococci), in chains (streptococci), in clusters (staphylococci), in groups of four (tetrads), or in cubical arrangements of eight (sarcinae). Gram-positive cocci, such as **Staphylococcus** aureus and Streptococcus pyogenes, have thick peptidoglycan layers in their cell walls and retain the violet stain during Gram staining. Gram-negative cocci, like **Neisseria** gonorrhoeae, have thinner peptidoglycan layers and do not retain the violet stain. Many cocci are pathogenic and can cause a variety of diseases. For example, **Streptococcus** pneumoniae can cause pneumonia, while Staphylococcus aureus can lead to skin infections and food poisoning.

Cytoplasm

A gel-like substance within the cell membrane that contains all the cell's organelles[2], excluding the nucleus. It is composed mainly of water, salts, and proteins. The cytoplasm plays several crucial roles in the cell: **Support and shape**: It helps maintain the cell's shape and consistency. **Medium for chemical reactions**: Many metabolic reactions occur in the cytoplasm. **Transport**: It facilitates the movement of materials around the cell. **Storage**: It stores nutrients and other essential substances.

[2] **Organelles**. Specialised structures within cells that perform specific functions.

Endotoxins

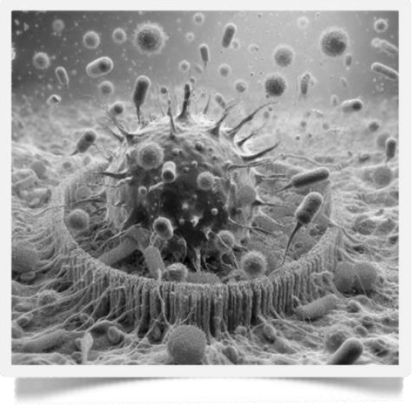
Endotoxins are toxic substances associated with the outer membrane of Gram-negative bacteria. Endotoxins are released when the bacterial cell wall disintegrates or during bacterial cell division. Unlike exotoxins, which are actively secreted by bacteria, endotoxins are part of the bacterial cell wall and are released upon cell death. Endotoxins can trigger a strong immune response in humans and animals. They are potent activators of the immune system and can cause fever, inflammation, and septic shock in severe cases.

Enterotoxins

Enterotoxins are a type of exotoxin produced by certain bacteria that specifically target the intestines. They are typically heat-labile, meaning they lose their toxicity when exposed to high temperatures. Ingestion of enterotoxins can cause symptoms such as nausea, vomiting, abdominal cramps, and diarrhoea. Enterotoxins are produced by several bacteria, including **Staphylococcus aureus**, **Escherichia coli**, and **Bacillus cereus**. Enterotoxins are a major cause of foodborne illnesses. They are particularly concerning in settings where food safety is compromised, such as in cases of improper food handling or storage.

Exotoxins

Exotoxins are **potent toxins secreted by certain bacteria**. Exotoxins are typically proteins, making them heat-labile and capable of being denatured by heat. They often consist of two parts: the A (active) part, which disrupts cellular function, and the B (binding) part, which helps the toxin attach to the host cell. Exotoxins can cause damage by destroying host cells or disrupting normal cellular metabolism. **Cytotoxins** damage host cells directly. **Neurotoxins** affect nerve function, such as botulinum toxin produced by Clostridium botulinum. **Enterotoxins** affect the cells lining the gastrointestinal tract, causing symptoms like diarrhoea. They are responsible for diseases such as diphtheria (caused by Corynebacterium diphtheriae), tetanus (caused by Clostridium tetani), and botulism (caused by Clostridium botulinum). The immune system can produce antibodies against exotoxins, but due to their potency, exotoxins can cause significant damage before the immune response is fully activated.



Notes:

Facultative

These are organisms, typically bacteria, that **can grow in the presence or absence of oxygen**. They prefer to use oxygen for aerobic respiration because it generates more energy, but they can switch to anaerobic respiration or fermentation when oxygen is not available. Examples include Escherichia coli and Staphylococcus aureus.

Flagella

Flagella are long, whip-like structures that protrude from the cell body of certain microorganisms, providing them with motility[3]. Understanding flagella is crucial for studying microbial motility and behaviour.

Listeria

A genus of bacteria that can cause a serious infection known as **listeriosis**. The most common species responsible for this infection is **Listeria monocytogenes**. Although disease occurrence is relatively low, listeria's severe and sometimes fatal health consequences, particularly among infants, children and the elderly, count them among the most serious foodborne infections. Listeria is found in unpasteurised dairy products and various ready-to-eat foods and can grow at refrigeration temperatures.

Mesophilic

An organism that thrives in moderate temperatures, typically between 20°c and 45°c. The optimal growth temperature for mesophiles is around 37°C (99°F), which is close to the human body temperature. Mesophiles are commonly found in environments like soil, water, and the human body. They play significant roles in various processes, including the fermentation of foods like cheese and yogurt, and are also involved in brewing and winemaking. Many human pathogens, such as **Escherichia coli** and **Staphylococcus aureus**, are mesophiles.

Pathogen

Any organism or agent that can **cause disease in a host**. Pathogens can be classified into several types, including bacteria, fungi, parasites, prions[4] and viruses.

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[3]**Motility**. The ability of an organism to move independently using metabolic energy.

[4] **Prions**. Infectious proteins that can cause neurodegenerative diseases- Conditions that involve the progressive degeneration and death of nerve cells in the brain and spinal cord.

Psychrophilic

Microorganisms that thrive in **extremely cold environments**, typically with optimal growth temperatures around 15°c. They can grow at temperatures as low as -20°C and up to 20°c.

Spirochaetes

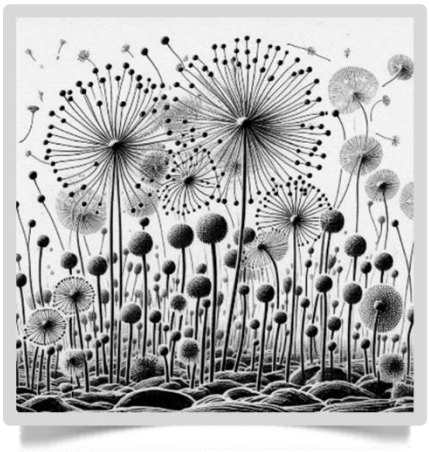
A group of bacteria characterised by their **spiral-shaped**, helical cells. Spirochaetes move using endoflagella; this structure allows them to move in a twisting motion.

Spores

Reproductive cells capable of developing into a new individual without the need for fusion with another cell.

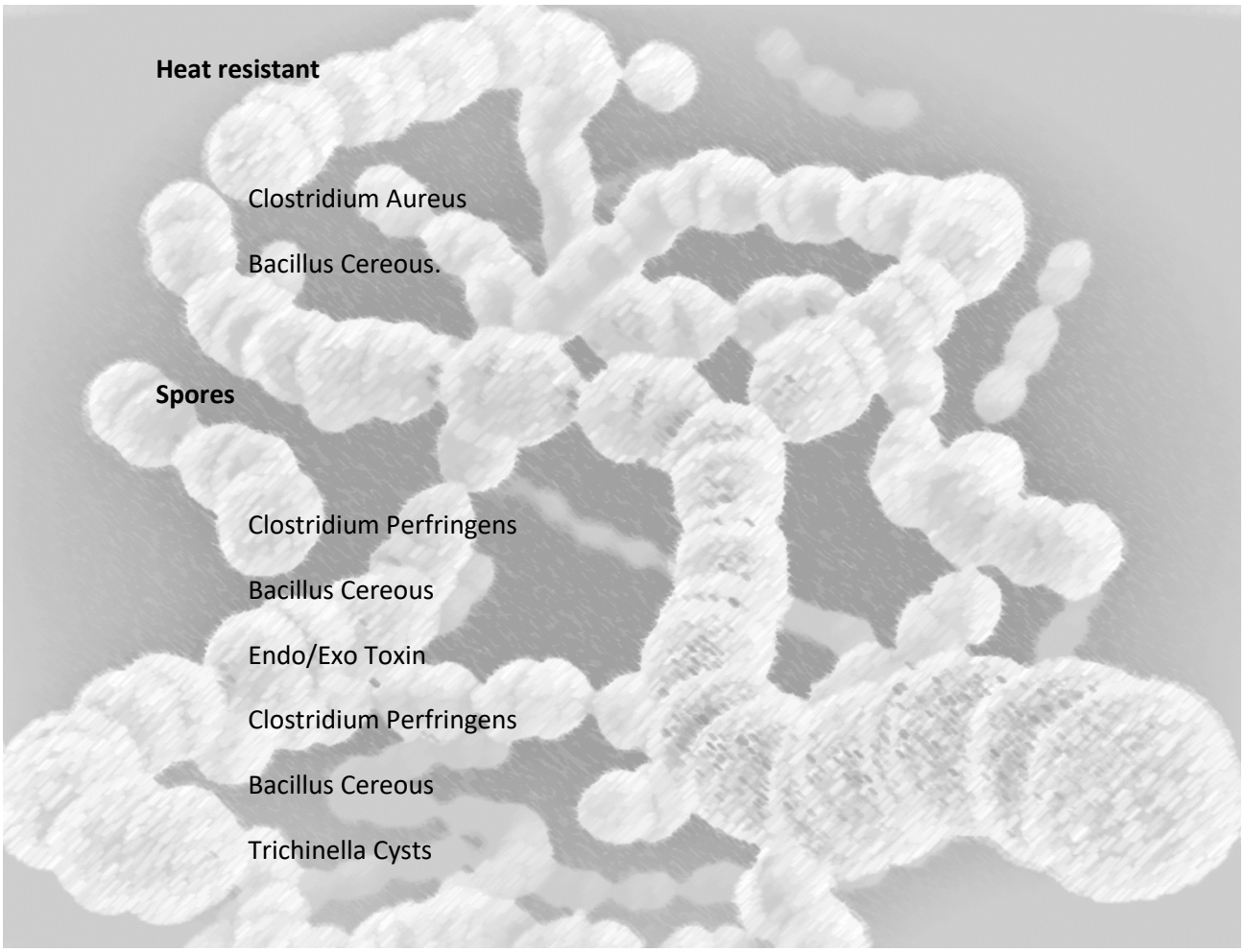
Thermophilic

Thermophilic organisms, or thermophiles, **thrive at relatively high temperatures**, typically between 41°c and 122°c.



Notes:

Pathogens



(See sections ‘Food-borne illnesses’ and ‘Food-borne diseases’)

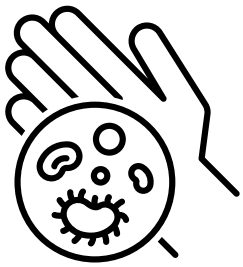
Toxins

Of most concern for health is naturally occurring toxins and environmental pollutants.

Naturally occurring toxins include Mycotoxins, marine biotoxins, cyanogenic glycosides and toxins occurring in poisonous mushrooms. Staple foods like corn or cereals can contain high levels of Mycotoxins, such as Aflatoxin and Ochratoxin, produced by mould on grain. A long-term exposure can affect the immune system and normal development, or cause cancer.

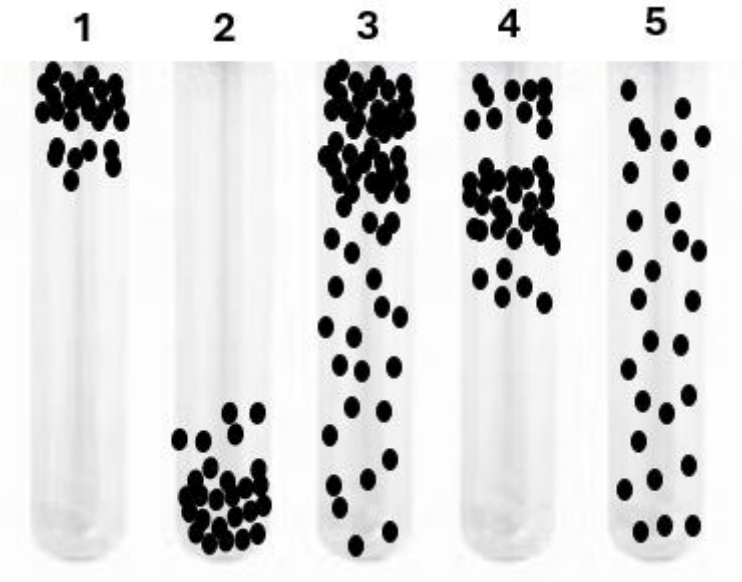
Persistent Organic Pollutants (POPs) are compounds that accumulate in the environment and human body. Known examples are dioxins and polychlorinated biphenyls (PCBs), which are unwanted by-products of industrial processes and waste incineration. They are found worldwide in the environment and accumulate in animal food webs. Dioxins are highly toxic and can cause reproductive and developmental problems, damage the immune system, interfere with hormones and cause cancer.

Heavy metals such as lead, cadmium and mercury cause neurological and kidney damage. Contamination by heavy metal in food occurs mainly through pollution of air, water and soil.



Antimicrobials

Antimicrobials, such as antibiotics, are essential to treat infections caused by bacteria. However, their overuse and misuse in veterinary and human medicine has been linked to the emergence and spread of resistant bacteria, rendering the treatment of infectious diseases ineffective in animals and humans. Resistant bacteria enter the food web through the animals (e.g. *Salmonella* through chickens). Antimicrobial resistance is one of the main threats to modern medicine.



To show the relationship between oxygen and bacteria growth, **Aerobic and Anaerobic bacteria** can be identified by growing them in test tubes of Thioglycolate broth:

1. **Obligate Aerobes** need oxygen because they cannot ferment or respire anaerobically. They gather at the top of the tube where the oxygen concentration is highest.

2. **Obligate Anaerobes** are poisoned by oxygen, so they gather at the bottom of the tube where the oxygen concentration is lowest.

3. **Facultative Anaerobes** can grow with or without oxygen because they can metabolise energy aerobically or anaerobically. They gather mostly at the top because aerobic respiration generates more ATP than either fermentation or anaerobic respiration.

4. **Micro-aerobes** need oxygen because they cannot ferment or respire aerobically. However, they are poisoned by high levels of oxygen. They gather in the upper part of the tube but not the very top.

Aerotolerant Organisms do not require oxygen as they metabolise energy anaerobically. Unlike obligate anaerobes however, they are not poisoned by oxygen. They can be found evenly spread throughout the test tube.

Aerobic Bacteria

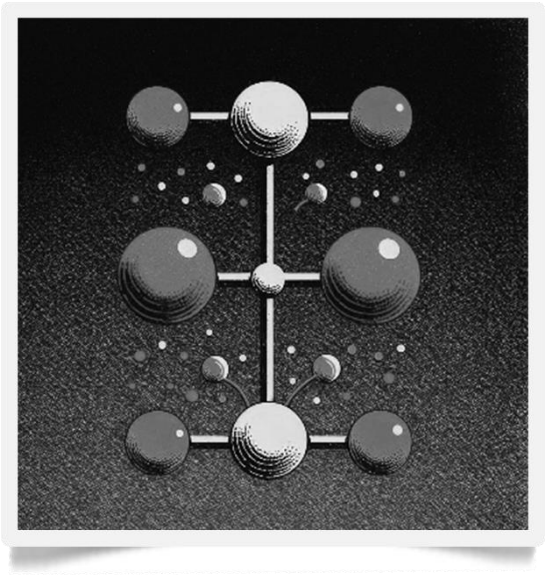
Aerobic bacteria are those that require oxygen for their survival and growth. They use oxygen in their metabolic processes to produce energy. Here are some key points about aerobic bacteria:

Oxygen Requirement: Aerobic bacteria need oxygen to survive. They use oxygen as the final electron acceptor in their respiratory chain, a process known as aerobic respiration.

Energy Production: These bacteria produce energy through the process of cellular respiration, which involves the oxidation of organic compounds. The general equation for aerobic respiration is: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + Energy (ATP). In words: Glucose ($C_6H_{12}O_6$) combines with oxygen (O_2) to produce carbon dioxide (CO_2), water (H_2O), and energy in the form of ATP. This is the process by which cells break down glucose in the presence of oxygen to release energy for cellular activities.

Enzymes: Aerobic bacteria produce enzymes such as catalase, peroxidase, and superoxide dismutase, which help them detoxify harmful byproducts of oxygen metabolism.

Examples: Some common examples of aerobic bacteria include Mycobacterium tuberculosis (causes tuberculosis), Pseudomonas aeruginosa (found in soil and water), and Nocardia.



Types of anaerobic bacteria:

Obligate Anaerobes: These bacteria **cannot survive in the presence of oxygen**. Examples include Clostridium tetani (causes tetanus) and Bacteroides fragilis (found in the human gut).

Facultative Anaerobes: These bacteria **can grow with or without oxygen**, but generally prefer oxygenated environments. Examples include Escherichia coli (commonly found in the intestines) and Staphylococcus aureus.

Aerotolerant Anaerobes: These bacteria **do not use oxygen but can tolerate its presence**. An example is Lactobacillus.

Notes:

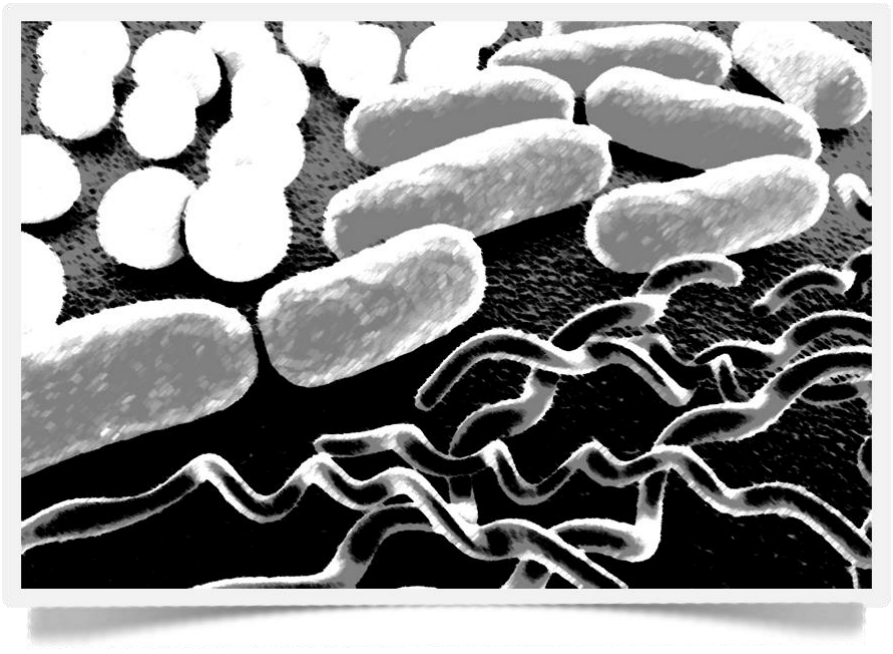
Both types of bacteria play essential roles in various ecosystems and human health:

Decomposition: Aerobic bacteria are crucial in decomposing organic matter, recycling nutrients back into the ecosystem.

Nitrogen Fixation: Some aerobic bacteria, like Azotobacter, fix atmospheric nitrogen into a form usable by plants.

Human Health: Anaerobic bacteria in the human gut help in digestion and maintaining gut health. However, some anaerobic bacteria can cause diseases like tetanus and botulism.

Industrial Applications: Both types of bacteria are used in industrial processes. Aerobic bacteria are used in wastewater treatment, while anaerobic bacteria are used in biogas production and fermentation processes.



Bacterial Growth

Given a suitable environment and conditions bacteria have an incredible capacity to increase in numbers vastly over a short period of time.

Nutrients, pH, Moisture, Temperature

Various factors affect the growth of bacteria:

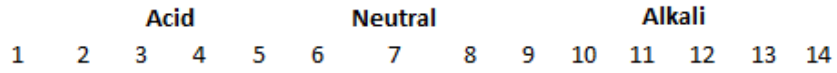
Nutrients (food)

Bacteria require nutrients as a source of energy and to make new cells. These include carbohydrates, protein, vitamins and minerals.

Foods such as milk, cream and meat provide an ideal growth media for bacterial growth.

pH

The pH of a substance refers to its acidity or alkalinity on a scale of 1-14:



pH Scale

Acidic foods have a pH below 7, and alkaline foods a pH of above 7. Water has a neutral pH of 7. Most bacteria prefer a pH of about 7.0 (neutral). Few bacteria grow below pH 4.5. Moulds and yeast are less sensitive to pH then bacteria.

Moisture

Bacteria require moisture to stay alive.

Most foods, even if not appearing to be *wet*, do contain sufficient moisture to enable bacteria to thrive; for example, cooked meat. Thus dry foods; for example, floor, do not provide a good medium for bacterial growth, although bacteria may be present as spores, which will germinate to form bacteria when later encountering moisture.

The degree of moisture available to bacteria in food is usually referred to a *water activity* (Aw). The Aw of pure water is 1.0. This figure decreases to about 0.98 in cooked food. Bacteria usually need an Aw of 0.95 or above to grow.

Temperature

Bacteria have a range of growth temperatures and an optimum growth temperature. For example, particular bacteria may have a growth range of 20°c to 40°c (the temperature range within which it will grow), with an optimum growth temperature of 37°c (the temperature at which maximum growth occurs.

Bacterial Groups

Bacteria are usually placed into one of four groups depending on their properties in relation to temperature. These are:

Psychrophiles Bactria with an o.g.t in the range of -20°c to 10°c. Includes many spoilage bacteria.

Mesophiles Bactria with an o.g.t in the range of 20°c and 45°c. Includes most pathogens.

Thermophiles Bacteria with an o.g.t greater than 45°c. Includes bacteria which cause problems in the canning industry.

Psychrotrophs These bacteria are capable of surviving or even thriving in a cold environment. They are responsible for spoiling refrigerated foods. Psychrotrophic bacteria are of particular concern to the dairy industry. Most are killed by pasteurisation; however, they can be present in milk as post-pasteurisation contaminants due to less than adequate sanitation practices. Psychrotrophs are capable of growth at temperatures at or less than 7°c. At freezing temperatures, growth of psychrotrophic bacteria becomes negligible or virtually stops

Oxygen Requirements

Most bacteria need oxygen to grow, but some can multiply in low levels of oxygen, or do not need oxygen at all.

Obligate Aerobes Organisms that must have oxygen present, for example, Bacillus Cereus.

Obligate Anaerobes Organisms that grow without oxygen, for example, Clostridium Perfringens and Clostridium Botulinum.

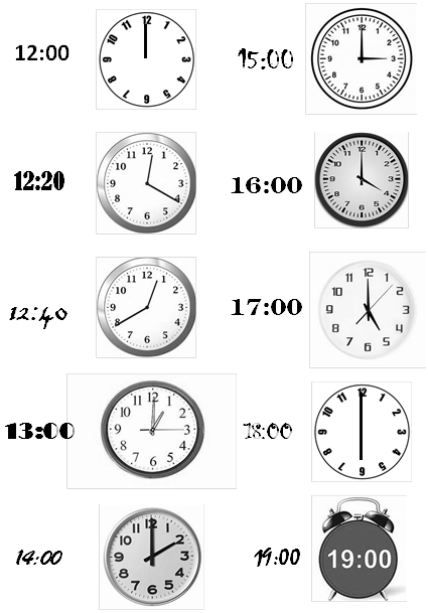
Facultative Anaerobes Organisms that can survive with or without oxygen; for example, Salmonella and Staphylococcus.

Binary Fission

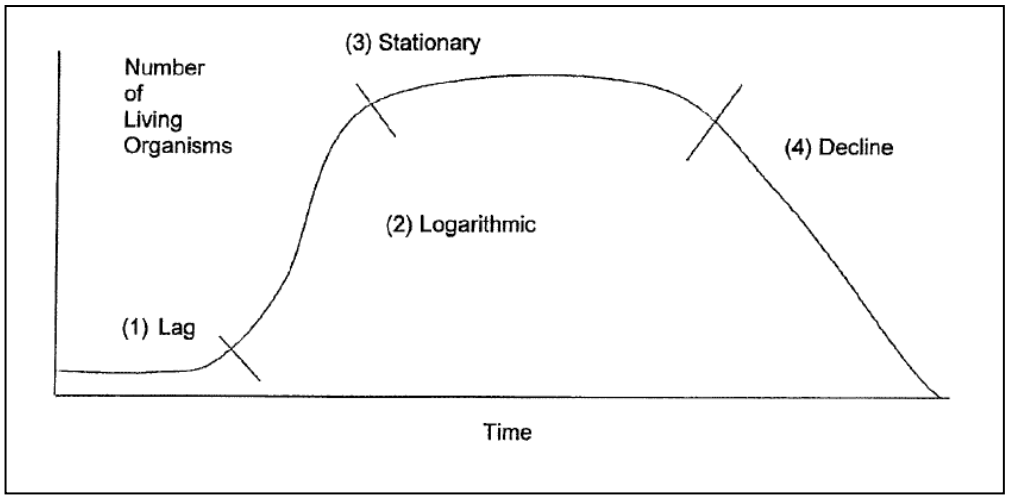
Bacteria multiply by an asexual process known as Binary Fission, **a process where bacteria will grow to maturity then divide in two**, **and in turn, each of these two mature and go through the same process**, with the process being repeated over and over.

The period between each division is known as **the generation time**. Given ideal conditions this may be as frequent as **every 20 minutes**. Clostridium Perfringens can reproduce every 10 minutes at 46°c.

Competition is used to describe the presence of other bacteria competing for the right conditions, for example, in food. A single bacterium at 12:00 hours could result in over 2 million[5] by 19:00 hours.



Phases of growth of micro-organisms



[5] **Bacteria**. 2,097,152.

Spore Formation

Certain bacteria, (for example, Clostridia (anaerobic) and Bacillus (aerobic) species), have the ability to form spores as an aid to survival.

Spores can be seen as growths within the normal bacteria cell (or vegetative cell) and are highly durable structures that are resistant to heat, starvation and disinfectants etc. They are often referred to as endospores.

If a normal spore-bearing bacteria enters unfavourable conditions; for example, extreme heat, it may form a spore. The original bacteria may die but the spore will survive and will germinate to form another bacteria on encountering favourable environmental conditions. Spores in food are not destroyed by cooking. Therefore, food saved for later use must be cooled quickly and refrigerated to prevent the germination of any spores present.

Notes:

Destruction of Bacteria

With an understanding of the nature of bacteria, measures can be taken to control or limit the growth of bacteria in food; for example, freezing or dehydration. Some measures will actually destroy the bacteria present; for example, extremes heat or chemicals. It is important to stress, however, that such measures should not be used as a substitute for good hygiene, but as reinforcement.

Heat	Temperatures above 63°c kill bacteria. However, it is essential that sufficient time is allowed for the food to reach the required temperature, and sufficient time is allowed to enable the heat to kill the bacteria. It is important to note that although vegetative bacteria may be destroyed, spores (for example, from Clostridium and Bacillus species) can resist high temperatures. These may survive and subsequently develop into vegetative cells when lower, more suitable temperatures are achieved. To ensure the destruction of all organisms, spores and toxins (i.e. to ensure sterilisation) extreme temperatures have to be used. In practice, this has to be achieved by using steam under pressure to achieve a temperature of 121°c. Even at this temperature and pressure 15 minutes is required to ensure sterilisation.
Chemicals	Chemicals of a wide variety are used in food preparation in different ways in order to control or destroy unwanted organisms. In this way, the safety and quality of food can be maintained. For example, salt, sugar and additives such as nitrites, nitrates and sulphur dioxide. Chemicals used on premises or equipment are usually described as disinfectants or sanitisers: **Disinfection**. The removal or destruction of micro-organisms to a safe level (i.e. all pathogens destroyed). **Sterilisation**. The removal or destruction of *all* living matter, including viruses and spores. It is not possible to achieve sterilisation of food premises.
Irradiation	Ultraviolet (UV) Light. Commonly used as a sterilising agent. **Gamma irradiation**. Irradiation of food with small doses of gamma rays will kill bacteria; in particular, Salmonella in foods such as boneless meat, animal feeds and dried and frozen egg products.

Toxins

Mycotoxins

These are the toxic product of moulds: mycotoxicosis. For example, Aflatoxin produced by moulds: Aspergillus flavus and Aspergillus parasiticus found on groundnuts, rice, cotton seeds and animal feeds.

Affected feed can lead to affected milk from cows.

Symptoms include jaundice, anorexia, depression, diarrhoea and liver damage. Mycotoxins are controlled by keeping stored products clean and dry.

Toxin Formation

During growth and multiplication, bacteria, like other cells, produce waste products which are secreted from the cell. These waste products may then result in food poisoning. The poisonous waste products are called *toxins*.

Entero and Neuro Toxins

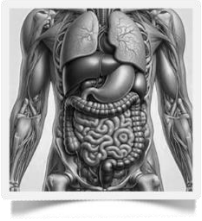
The term **enterotoxin** is a general term used to describe bacterial toxins causing illness related to the **digestive system**.

The term **neurotoxin** describes toxins affecting the **nervous system**.

Exo and Endo Toxins

Exotoxins are **formed by bacteria while multiplying** and passed out into the food; the toxin is thus eaten with the food. Any cooking may kill the bacteria, but the exotoxin may not be destroyed by the cooking process. The presence of bacteria producing exotoxins in food results in a rapid onset of food poisoning as toxins are in the food on ingestion; for example, staphylococcus aureus, which has an incubation period of 2-6 hours, and induced vomiting as a reaction to rid the body of the toxin.

Endotoxins are toxins produced in the bacterial cell which are only **released by the death of the cell or spore formation**. This usually occurs within the body; the bacteria being eaten on contaminated food. As digestion occurs, the bacteria cells are either broken down or spores are produced. In either case the endotoxins are released, causing gastroenteritis. The presence of bacteria producing endotoxins results in a slower onset of food poisoning as the bacterial cells need to be digested before the endotoxins are released; for example, clostridium Perfringens, which has an incubation period of 8-12 hours, and which main symptom is diarrhoea.



(See also ‘Food-borne illnesses’ and ‘Food-borne diseases’)

Escherichia coli (E. coli)

Escherichia coli (E. coli) is a type of bacteria commonly found in the intestines of humans and animals. While most strains are harmless, some can cause serious foodborne illnesses. Here are some key points about E. coli:

Symptoms

- Severe abdominal cramps
- Diarrhoea (which can be bloody)
- Nausea and vomiting
- Fever
- Loss of appetite

Causes

- E. coli infections can occur through:
- Consuming contaminated food or water
- Eating undercooked meat or unpasteurised milk
- Person-to-person contact, especially with unwashed hands

Risk Factors

- Young children and the elderly
- Individuals with weakened immune systems
- Those with decreased stomach acid levels

Prevention

Cook meat thoroughly

Avoid raw milk

Wash fruits and vegetables well

Practice good hand hygiene

Staphylococcus aureus (S. aureus)

Staphylococcus aureus (S. aureus), often referred to as 'Staph,' is a type of bacteria commonly found on the skin and in the noses of healthy people. While it usually doesn't cause harm, it can lead to infections if it enters the body through cuts or other openings.

Common Infections

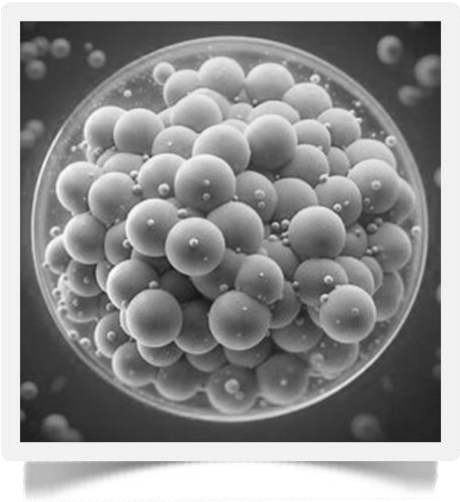
- Skin Infections: Boils, impetigo, cellulitis, and abscesses
- Respiratory Infections: Sinusitis and pneumonia
- Food Poisoning: Caused by toxins produced by the bacteria

Serious Infections

- Bacteraemia: Bloodstream infections
- Endocarditis: Infection of the heart valves
- Osteomyelitis: Bone infections
- Toxic Shock Syndrome: A rare but life-threatening condition

Prevention

- Hand Hygiene: Regular hand washing with soap and water
- Wound Care: Keeping cuts and abrasions clean and covered
- Avoid Sharing Personal Items: Towels, razors, and other personal items



Listeria monocytogenes

Listeria monocytogenes is a type of bacteria that causes the infection known as listeriosis. Here are some key points about it:

Characteristics

- Gram-positive: This means it has a thick cell wall.
- Facultative anaerobe: It can survive with or without oxygen.
- Motility: It can move using flagella at lower temperatures.
- Sources of Infection

Listeria can be found in:

- Soil, water, and vegetation
- Contaminated food, especially unpasteurized dairy products, raw vegetables, and ready-to-eat meats

Symptoms

- Mild Symptoms: Fever, muscle aches, nausea, and diarrhoea.
- Severe Symptoms: Headache, stiff neck, confusion, loss of balance, and convulsions. In severe cases, it can lead to meningitis or septicaemia

High-Risk Groups

- Pregnant women (risk of miscarriage or stillbirth)
- Newborns
- Elderly individuals
- People with weakened immune systems

Prevention

- Food Safety: Avoid unpasteurized dairy products, cook meats thoroughly, and wash fruits and vegetables well
- Hygiene: Practice good hand hygiene, especially after handling raw foods

Salmonella

Salmonella is a group of bacteria that commonly cause foodborne illnesses. Here are some key points about Salmonella:

Symptoms

- Gastroenteritis: Diarrhoea, stomach cramps, nausea, vomiting, and fever.
- Incubation Period: Symptoms typically appear 12-36 hours after exposure

Causes

- Contaminated Food: Often found in raw or undercooked meat, poultry, eggs, and unpasteurized milk
- Contact with Infected Animals: Especially reptiles, birds, and pets

Risk Factors

- Young Children and Elderly: More susceptible to severe illness
- Weakened Immune Systems: Higher risk of complications

Prevention

- Food Safety: Cook meat thoroughly, avoid raw eggs, and practice good kitchen hygiene
- Hand Hygiene: Wash hands after handling raw food or animals

Treatment

- Hydration: Drink plenty of fluids to prevent dehydration

Clostridium botulinum

Clostridium botulinum is a bacterium known for producing botulinum toxin, one of the most potent toxins known. Here are some key points about it:

Characteristics

- Gram-positive: It has a thick cell wall.
- Rod-shaped: The bacteria are elongated.
- Anaerobic: It thrives in environments without oxygen.
- Spore-forming: It can produce spores that survive in harsh conditions

Types of Botulism

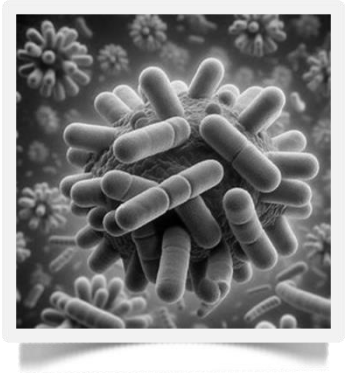
- Foodborne Botulism: Caused by consuming food contaminated with the toxin
- Wound Botulism: Occurs when the bacteria infect a wound
- Infant Botulism: Happens when infants ingest spores that then grow in their intestines

Symptoms

- Early Symptoms: Nausea, vomiting, and abdominal cramps.
- Neurological Symptoms: Double vision, drooping eyelids, difficulty swallowing, and muscle weakness. In severe cases, it can lead to paralysis

Prevention

- Food Safety: Proper canning and cooking of food to destroy spores.
- Wound Care: Keeping wounds clean and properly treated



Clostridium difficile

Clostridium difficile (C. difficile or C. diff) is a bacterium that can cause infections in the bowel, leading to symptoms such as diarrhoea and abdominal pain. Here are some key points about it:

Symptoms

- Mild to Moderate: Watery diarrhoea, mild abdominal cramping, and tenderness
- Severe: Watery diarrhoea 10-15 times a day, severe abdominal pain, fever, nausea, dehydration, and loss of appetite

Causes

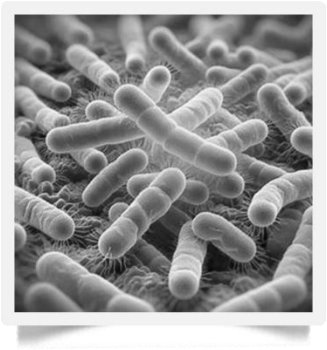
- Antibiotic Use: Long-term use of antibiotics can disrupt the normal bacterial balance in the intestines, allowing C. difficile to overgrow
- Transmission: It can spread through contaminated surfaces, food, and water

Risk Factors

- Hospitalization: Staying in healthcare facilities for extended periods
- Age: People over 65 years old
- Weakened Immune System: Conditions like diabetes, cancer, or treatments like chemotherapy

Prevention

- Hand Hygiene: Wash hands thoroughly, especially after using the bathroom
- Antibiotic Stewardship: Only take antibiotics as prescribed by a healthcare provider
- Cleanliness: Keep surfaces and objects clean, especially in healthcare settings



Clostridium perfringens

Clostridium perfringens is a bacterium known for causing foodborne illnesses and other infections. Here are some key points about it:

Characteristics

- Gram-positive: It has a thick cell wall
- Rod-shaped: The bacteria are elongated
- Anaerobic: It thrives in environments without oxygen
- Spore-forming: It can produce spores that survive in harsh conditions

Types of Infections

- Foodborne Illness: Often results in diarrhoea and abdominal cramps within 6-24 hours after consuming contaminated food
- Gas Gangrene: A severe infection that causes tissue death, often associated with traumatic injuries

Symptoms

- Foodborne Illness: Diarrhoea, abdominal cramps, and nausea
- Gas Gangrene: Severe pain, swelling, and tissue death in the affected area

Prevention

- Food Safety: Cook food thoroughly, especially meat, and refrigerate leftovers promptly
- Wound Care: Keep wounds clean and properly treated to prevent infection

Notes:

Bacillus cereus

Bacillus cereus is a type of bacteria that can cause foodborne illnesses. Here are some key points about it:

Characteristics

- Gram-positive: It has a thick cell wall
- Rod-shaped: The bacteria are elongated
- Facultative Anaerobe: It can survive with or without oxygen
- Spore-forming: It can produce spores that survive in harsh conditions

Types of Infections

- Foodborne Illness: There are two forms:
- Diarrheal Syndrome: Caused by enterotoxins produced in the intestines after consuming contaminated food
- Emetic Syndrome: Caused by toxins formed in food before consumption, often associated with rice
- Non-intestinal Infections: Can affect the eyes, respiratory system, and wounds

Symptoms

- Diarrheal Syndrome: Diarrhoea, abdominal cramps, and nausea, typically appearing 6-15 hours after eating contaminated food
- Emetic Syndrome: Nausea and vomiting, usually within 1-6 hours after eating

Prevention

- Food Safety: Cook food thoroughly, especially rice and other starchy foods, and refrigerate leftovers promptly
- Hygiene: Practice good hand hygiene and keep kitchen surfaces clean

Prevention of food contamination: Raw Foods

Raw food is often contaminated. However, while raw foods should always be considered a potential hazard, hygienic production methods can reduce that contamination.

Meats

- Overcrowded, dirty sheds encourage the spread of infection
- Infected animals should be kept separated from healthy animals
- Short transportation reduces the risk of salmonella (through excreta)
- Laying hens should be vaccinated against salmonella
- Gutting should take place as soon as possible to prevent migration of bacteria from gut to flesh
- Cross-contamination of external packaging of raw meats can occur (3% found to be contaminated)

Fish and Shellfish

- Rapid gutting is essential
- Very cold storage required, for example, on ice. (3°c is necessary to prevent Scombrotoxin)
- Use only reputable suppliers
- Good source, i.e. location

Eggs

- Properties of albumen usually limit growth of salmonella for 21 days at temperatures up to 20°c
- Imported eggs are twice as likely to contain salmonella
- Cracked eggs should be avoided
- 'At risk' groups (those pregnant, young, elderly or infirm) should avoid raw egg
- Pasteurised egg may be an option for 'At risk' groups

Milk Contamination of milk could come from:

- Animals
- Humans
- Unclean pipework
- Unclean tanks

Milk from animals with mastitis should not be used (due to potential harm from Staphylococcus Aureus). Herds should be tested for Brucellosis and Tuberculosis.

Moulds (Fungi)

Moulds cause most food spoilage. They are often thread-like in appearance, forming a network of fine strands that are barely visible. The strands secrete enzymes that breakdown plant or animal matter and absorb the digested food. The fruiting body of moulds are often easily seen, for example, toadstools and mushrooms. Some moulds are pathogenic to man, for example, ringworm.

Moulds require moisture, and usually water. They can and do grow at low temperatures. Moulds usually grow on the outside of food and do not usually make the food harmful; so in most cases it is acceptable to trim mould off.

Black Moulds

- Black moulds are found on meats and may cause taints if extensive. Black moulds may also penetrate the surface. The main reason black mould grows on surfaces is condensation and humidity. Generally, black mould spores are always in the air. They land on condensation that forms on surfaces and start growing. Humid air has a lot of moisture and warmer air holds more moisture in it. When the warm air cools down by touching cold surfaces like walls and ceilings, it forms condemnation and eventually black moulds.

White Moulds

- These are found on the surface of foods only. White mould look like whiskers and do not harm food unless extensive

Blue Moulds

- Blue moulds are often present in food that is also putrefying

Yeasts

These are single celled fungi. They are used in bread-making and brewing.

Viruses

Extremely small, most viruses can only be seen with an electronic microscope. They are 10 to 100 times smaller than bacteria. They can only reproduce in a living host cell. Their presence in the host cell causes the host to be ill.

Viruses are common contaminants of shellfish; for example, 'Small Round Structured Viruses (SRSVs) such as the Norwalk virus.

Norovirus infections are characterised by nausea, explosive vomiting, watery diarrhoea and abdominal pain. Hepatitis A virus can cause long-lasting liver disease and spreads typically through raw or undercooked seafood or contaminated raw produce. Infected food handlers are often the source of food contamination.

Norovirus is a highly contagious virus that causes gastroenteritis, which is an inflammation of the stomach and intestines. Here are some key points about it:

Symptoms

- Gastrointestinal: Sudden onset of nausea, vomiting, diarrhoea, and stomach cramps
- Other Symptoms: Fever, headache, and body aches

Transmission

- Person-to-Person: Through direct contact with an infected person
- Contaminated Surfaces: Touching surfaces or objects contaminated with the virus
- Food and Water: Consuming contaminated food or water

Prevention

- Hand Hygiene: Wash hands thoroughly with soap and water, especially after using the bathroom and before eating
- Disinfection: Clean and disinfect surfaces, especially in areas where food is prepared
- Isolation: Stay home if you are infected to avoid spreading the virus

Viruses cannot multiply on food but can survive for some time and are normally destroyed by cooking. Rotaviruses and Parvoviruses commonly cause gastro-enteritis. The infective dose is thought to be small, and the common source is infected food handlers and shellfish. Therefore, the use of reputable suppliers is advised. The incubation period is 24-48 hours, and the duration is usually 24 hours. Symptoms are the usual food poisoning symptoms. The virus is spread by the faecal/oral route, food-borne or respiratory route (rotaviruses). Norwalk virus has causes very debilitating symptoms and often large outbreaks. The life of the Norwalk virus is prolonged in cold, wet conditions, is difficult to detect and often traced to shellfish.

Prions

Prions, infectious agents composed of protein, are unique in that they are associated with specific forms of neurodegenerative disease. Bovine spongiform encephalopathy (BSE, or 'mad cow disease') is a prion disease in cattle, associated with the variant Creutzfeldt-Jakob Disease (vCJD) in humans. Consuming bovine products containing specified risk material, e.g. brain tissue, is the most likely route of transmission of the prion agent to humans.

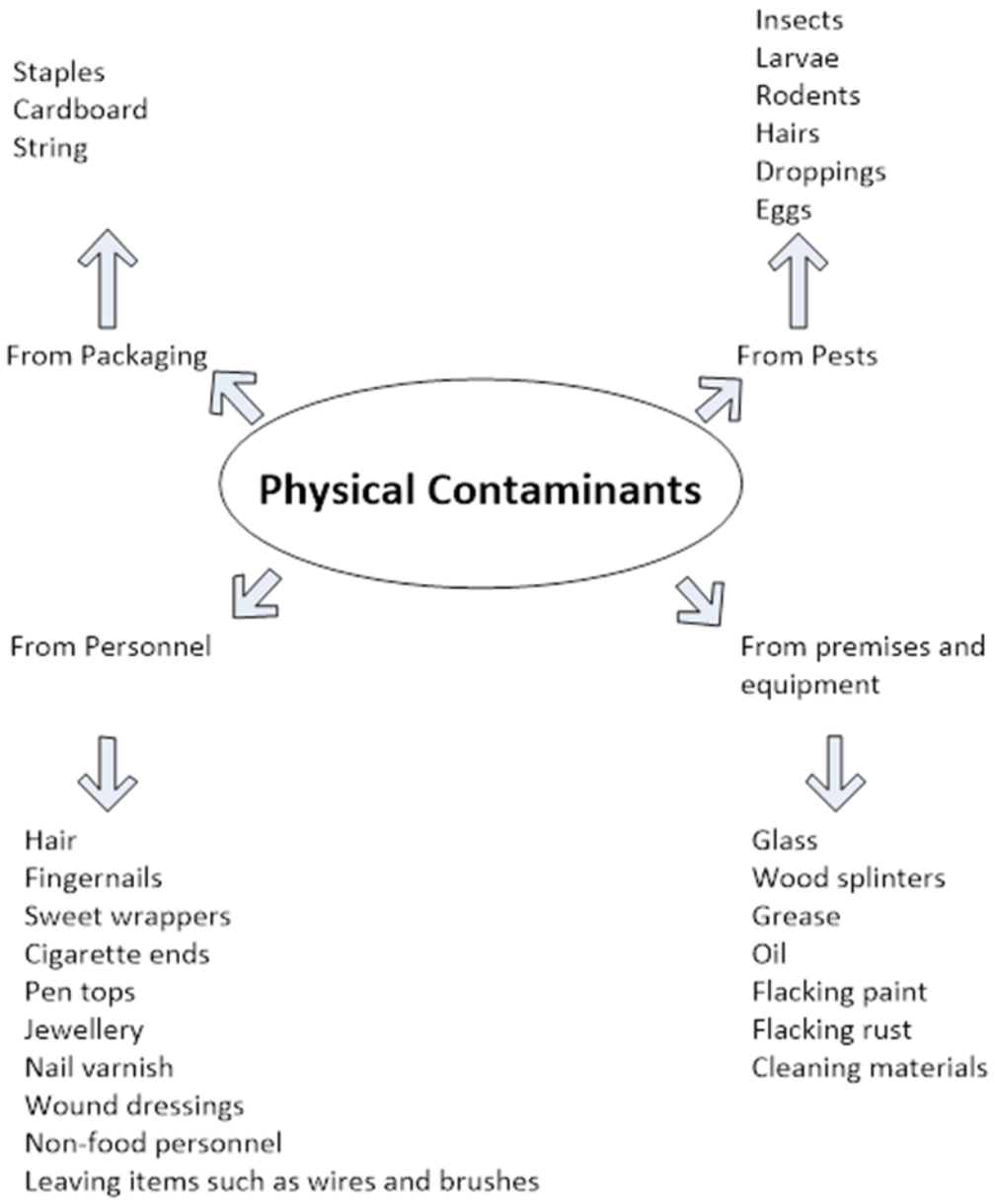
Parasites

Some parasites, such as fish-borne trematodes, are only transmitted through food. Others, for example tapeworms like Echinococcus, or Taenia Solium, may infect people through food or direct contact with animals. Other parasites, such as Ascaris, Cryptosporidium, Entamoeba histolytica or Giardia, enter the food web via water or soil and can contaminate fresh produce.

Notes:

Physical contamination

Physical contamination occurs when foreign objects are introduced into food products. These contaminants can cause injury or illness if ingested.



Human Sources:

- Hair: Hair can fall into food during preparation or packaging
- Jewellery: Rings, earrings, and other jewellery can break and fall into food
- Fingernails: Broken fingernails can end up in food

Environmental Sources:

- Building Materials: Flakes of paint, plaster, or ceiling tiles can contaminate food
- Pests: Insects, rodents, and their droppings can contaminate food

Equipment and Utensils:

- Metal Shavings: From worn-out equipment or machinery
- Plastic Pieces: From broken containers or utensils
- Glass Fragments: From broken light bulbs or containers

Packaging Materials:

- Plastic: Pieces from packaging materials
- Paper: Fragments from labels or packaging

Good Manufacturing Practices (GMP): Implementing GMP can help minimise physical contamination. This includes regular maintenance of equipment, proper storage of materials, and ensuring a clean working environment.

From premises and equipment

- Adequate maintenance and repair schedule
- Avoidance of temporary repairs
- Use of food-grade oil
- Use of self-locking nuts
- Avoidance of unsuitable materials such as metals and wood
- Satisfactory state of décor
- Good lighting

Personal Hygiene: Workers should follow strict personal hygiene practices, including wearing hairnets, gloves, and clean uniforms.

From personnel

- Adequate staff training; including non-food handlers
- Prohibition of jewellery, sweets and cigarettes
- Use of PPE

Pest Control: Regular pest control measures should be in place to prevent contamination from insects and rodents.

Inspection and Monitoring: Regular inspection of raw materials, equipment, and finished products can help identify and remove physical contaminants.

From raw materials

- Use of reputable suppliers
- Care taken when unpacking
- Liquids filtered
- Powders sieved
- Inspection belts, spotters, metal detectors and scanners

Sources of Environmental Pollution

Environmental pollution can significantly impact food safety and quality. The main sources of environmental pollution include:

Air pollution: Industrial Emissions: Factories release pollutants like sulphur dioxide, nitrogen oxides, and particulate matter into the air.

Vehicle emissions: Cars and trucks emit pollutants such as carbon monoxide, hydrocarbons, and nitrogen oxides.

Water pollution: Agricultural Runoff: Pesticides, fertilizers, and animal waste can contaminate water bodies.

Industrial discharges: Factories may release chemicals and heavy metals into rivers and lakes.

Sewage and wastewater: Untreated or inadequately treated sewage can pollute water sources.

Soil pollution: Pesticides and Herbicides: Chemicals used in agriculture can persist in the soil and contaminate crops.

Industrial waste: Improper disposal of industrial waste can lead to soil contamination with heavy metals and toxic chemicals.

Noise Pollution: Industrial Activities: Factories and construction sites generate noise pollution.

Transportation: Traffic noise from vehicles, trains, and airplanes contributes to noise pollution.

Notes:

Chemical Contaminants: Pollutants from air, water, and soil can introduce harmful chemicals into the food web. These include heavy metals, pesticides, and industrial chemicals.

Microbial Contaminants: Polluted water and soil can harbour harmful microorganisms that contaminate food.

Physical Contaminants: Environmental pollution can also introduce physical contaminants like dust and debris into food products.

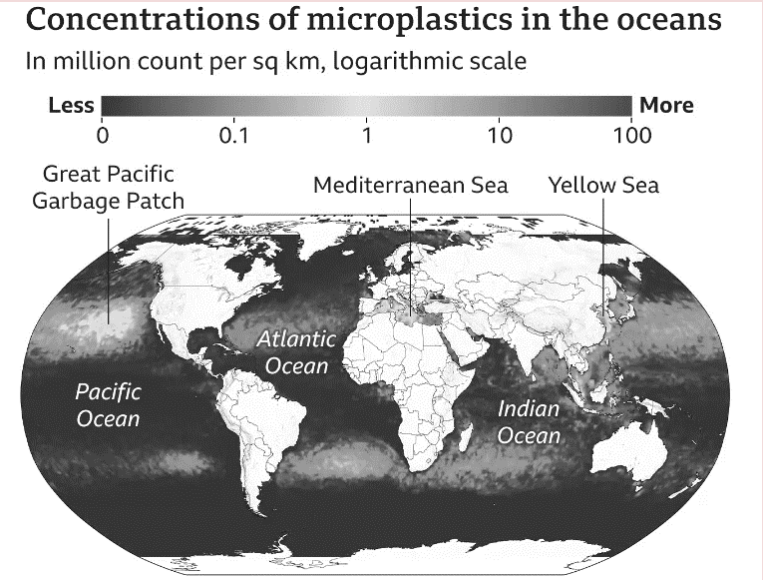
Article 1 'Oceans littered with plastic'

Oceans littered with 171 trillion plastic pieces, Rannard, BBC 2023

More than 171 trillion pieces of plastic are now estimated to be floating in the world's oceans, according to scientists. Plastic kills fish and sea animals and takes hundreds of years to break down into less harmful materials. The concentration of plastics in the oceans has increased from 16 trillion pieces in 2005, data suggests. It could nearly triple by 2040 if no action is taken, scientists warn.

Last week, nations signed the historic UN High Seas treaty aiming to protect 30% of the oceans. To produce this new estimate, external, a group of scientists analysed records starting in 1979 and added recent data collected on expeditions that trawl the seas with nets to collect plastics. The plastic counted in nets is then added to a mathematical model to produce a global estimate.

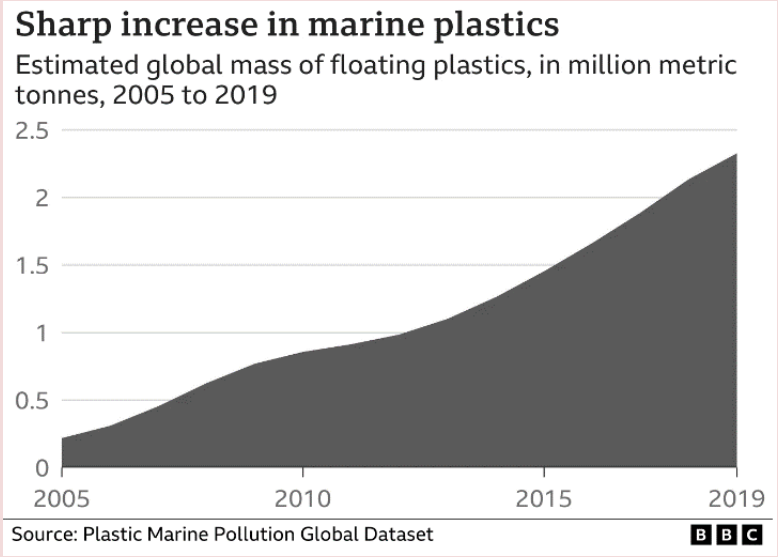
The 171 trillion pieces are made up of both recently discarded plastics and older pieces that have broken down, […a…] lead author […] from the 5 Gyres Institute told BBC News.



Single-use plastics like bottles, packaging, fishing equipment or other items break down over time into smaller pieces due to sunlight or mechanical degradation. Wildlife like whales, seabirds, turtles and fish mistake plastic for their prey and can die of starvation as plastic fills their stomachs.

They also make their way into our drinking water, and microplastics have been found in human lungs, veins and the placenta. Scientists say we do not yet know enough about whether microplastics negatively affect human health.

The concentration of plastics in the oceans has significantly increased from around 16 trillion pieces in 2005 to 171 trillion in 2019.



Before 2005 the concentrations fluctuated. Dr Eriksen says scientists are not sure why this is, but it could be explained by stronger legislation being replaced by voluntary agreements, the breakdown of plastics, or the fact that less data was collected.

Prof Richard Thompson at Plymouth university, who was not involved in the study, said the estimate adds to what scientists know about marine pollution. 'We are all agreed there is too much plastic in the ocean. We urgently need to move to solutions-focused research,' he told BBC News.

The highest concentration of ocean plastic is currently in the Mediterranean Sea, with some large floating masses found elsewhere including the Great Pacific Garbage Patch. The authors also suggest that the changing levels of pollution before 2000 may be due to the effectiveness of treaties or policies that govern pollution.

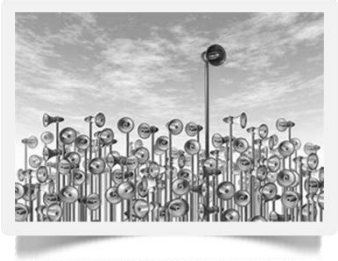
In the 1980s several legally binding international agreements mandated countries to stop discarding fishing and naval plastics in the oceans, as well as to clean up certain amounts. These were later followed by voluntary agreements which the authors say may have been less effective and could explain the rise in plastics from around 2000 onwards.

Regulations and policies: Governments should enforce strict regulations to control emissions from industries and vehicles. Policies promoting sustainable agricultural practices can reduce pollution from farming activities.

Waste management: Proper disposal and treatment of industrial waste, sewage, and agricultural runoff can minimise environmental pollution.

Sustainable practices: Adopting sustainable practices in agriculture, industry, and transportation can help reduce pollution. This includes using eco-friendly pesticides, reducing emissions, and promoting renewable energy sources.

Public awareness: Educating the public about the impacts of environmental pollution and encouraging eco-friendly practices can contribute to reducing pollution.



Sources and preventative measures

Staff	Preventative Action
Blowing into bags, licking fingers, picking nose Coughing and sneezing Handling open food Smoking Cuts and sores Clothing	Regular training sessions and effective supervision Turn away from food Hand hygiene Use of clean tongs Prohibition of smoking Exclusion Waterproof dressings Hand hygiene PPE. E.g. Mobcap or hat Effective training and compliance (Discipline)
Customers	**Preventative Action**
Coughing and sneezing Smoking Animals	Covered food Sneeze screens Restricted access Pre-wrapped product 'No Smoking' notices Deny animal access Food stored at higher locations

Food Spoilage

Causes of food spoilage

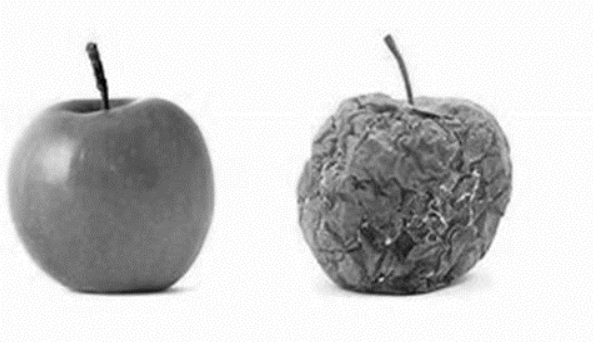
- Mould
- Yeast
- Bacteria
- Enzymes
- Physical damage
- Chemical contamination

Effects of food spoilage

Food spoilage refers to food that is not fit to eat due to:

- Smell
- Taste
- Appearance
- Texture

Food can become spoiled due to the process of decomposition, attacks by pests, contamination by chemicals, or through physical damage (for example, poor handling resulting in bruising).



Cost of poor food hygiene

- Loss of working days and productivity due to illness
- Customer complaints resulting in loss of reputation
- Loss of business
- Civil action taken by those affected by food poisoning
- Fines and cost of legal action
- Food loss due to premature spoilage or infestation
- Pest infestation
- Higher staff turnover
- Closure of the premises

Benefits of good food hygiene

- Enhanced reputation
- Increased productivity
- Compliance with the law
- Increased shelf-life
- Reduced risk of food-borne diseases
- Higher staff moral
- Lower staff turnover

Notes:

Milk preservation

❖ **Pasteurisation**	71.7°c	15 minutes
❖ **Sterilisation**	100°c	20 minutes
❖ **Ultra Heat Treatment** (UHT)	132°c	15 seconds

Notes:

Food Poisoning

Major foodborne illnesses and causes

Foodborne illnesses are usually infectious or toxic in nature and caused by bacteria, viruses, parasites or chemical substances entering the body through contaminated food or water.

Foodborne pathogens can cause severe diarrhoea or debilitating infections including meningitis.

Chemical contamination can lead to acute poisoning or long-term diseases, such as cancer. Foodborne diseases may lead to long-lasting disability and death. Examples of unsafe food include uncooked foods of animal origin, fruits and vegetables contaminated with faeces, and raw shellfish containing marine biotoxins.

Common gastrointestinal infections

Common gastrointestinal infections in England and Wales

Table 1: Laboratory reports of common gastrointestinal infections in England and Wales reported to Public Health England: weeks: 31 to 35 (27 July to 30 August 2020)

Laboratory reports*	31/20	32/20	33/20	34/20	35/20	Total reports 31-35/20	Cumulative total to 35/20	Cumulative total to 35/19
Campylobacter spp.	1078	1093	1161	1229	1106	5667	30165	38147
Cryptosporidium spp.	31	35	36	34	58	194	1375	2148
Giardia spp.	42	45	32	42	51	212	2121	3100
Salmonella spp.	81	100	133	120	149	583	2936	4823
Shigella spp.	15	17	18	20	11	81	1069	1909
STEC O157	10	7	16	39	28	100	223	307
Rotavirus	9	12	7	11	6	45	538	2481
Norovirus	7	3	6	4	9	29	2620	4345

Assets Publishing Service (Accessed 2024)

Food-borne illnesses – Food poisoning

Bacteria	Source	Onset (Hrs)	Duration	Symptoms	Risks	Control
Salmonella (infection) Facultative Anaerobe Enterotoxin Gram- o.g.t 7-47°c	Man/Animal (pets) Eggs. Esp. cracked and duck eggs, milk, poultry, rodents, animal feed, sewage/water, (Shellfish)	6-72 Usually 12-36	1-7 Days	Abdominal pain Diarrhoea Vomiting Fever/Headache	Carries Poor hygiene Cross-contamination Raw milk and meat Inadequate thawing and cooking	Heat treatment of animal feed Hygienic slaughter (incl. Poultry) Good personal hygiene Separate areas for raw/cooked Adequate cooking Pasteurisation Sterilisation
Clostridium Perfringens Endotoxin Enterotoxin Spore producing Obligate Anaerobe o.g.t 43-47°c	Human/Animal intestine Soil Dust Dry foods	8-22	12-48 Hours	Abdominal pain Diarrhoea Nausea	Cross-contamination Improper handling and cooking of meat etc.	Good personal hygiene Carrier detection Separate areas for raw/cooked Correct cooling and storage of cooked meat
Staphylococcus Aureus Exotoxin Enterotoxin Facultative Anaerobe Gram+ Very heat resistant Halophilic	Human nose, throat and skin Boils and cuts Dry foods	1-6	6-24 Hours	Abdominal pain Severe vomiting Cramps /Diarrhoea Fever Headache	Sneezing, coughing etc Cuts and boils Poor personal hygiene Raw milk (mastitis) Improper cooking	Good personal hygiene Waterproof dressings Careful storing, handling and cooking of food
Clostridium Botulinum Exotoxin Neurotoxin Anaerobic Gram+	Soil, fish, vegetables and dust	Usually 12-96	Death, or slow recovery over 6-8 months	Double vision Paralysis of cranial nerves	Under-processing Anaerobic conditions Smoked fish	Strict control of canning of vegetables and fish Strict control of smoking Temperature control
Bacillus Cereus Exotoxin or Endotoxin Enterotoxin Aerobic Gram+	Cereals Dehydrated food Dust Soil	Exotoxin 1-5 Endotoxin 8-18	12-46 Hours	Abdominal pain Diarrhoea Vomiting	Poor handling Incorrect storage	Care with handling (esp. rice and dehydrated foods) Correct refrigeration Good hygiene Heat at 121°c for 3 minutes
Escherichia Coli Infection or toxin (E-coli 157) 'Traveller's diarrhoea' Enterotoxin Aerobe	Human sewage Water Raw meat	12-24	1-5 Days	Abdominal pain Diarrhoea Vomiting	Uncooked meat	High standards of hygiene Thorough cooking Avoidance of cross-contamination Correct temperature storage Safe sewage disposal Water chlorination

Food-borne diseases

Illness	Causative Agent	Sources	Incubation Period	Symptoms	Transmission	Prevention / Control
E-Coli (also a food poisoning bacterium)	Escherichia Coli 0157	Beef burgers Dairy products Raw meat Water Faeces	1-14 Days	Pain Bloody diarrhoea Nausea Haemolytic Uraemic Syndrome (HUS) Kidney damage Kidney failure	Very low infective dose Cross-contamination Person-to-person Contact with farm animals Contaminated water	High standards of hygiene Thorough cooking Avoidance of cross-contamination Correct temperature storage Safe sewage disposal
Bacillary Dysentery	Shigella Sonnei or Shigella Flexneri	Faeces of infected people	1-7 Days Usually 4	Diarrhoea Fever Abdominal pain Possible vomiting Blood in stools	Faecal-oral route Infected person Contaminated food	Can be a major problem in schools High standard of personal hygiene Disinfection Cleaning Satisfactory sewage disposal
Campylobacter Enteritis Micro-aerobic Spirochete Gram- o.g.t 43°c	Campylobacter jejuni or C.Coli	Raw meat Poultry Animals Untreated water	2-11 Days	Headache Nausea Abdominal pain	Water, Raw Milk, Raw meat Chickens , cats and dogs Person-to-person or to food very unlikely	Water chlorination Milk heat treatment Pet hygiene Destroyed by heating food at 60°c for 15 minutes
Listeriosis Aerobic	Listeria Monocytogenes	Environment general Human faeces Animal faeces Foods, including cook/chill delicatessen products	Up to 70 Days	Meningitis or Septicaemia Flu-like illness in pregnant women Possible abortion Still birth Premature delivery Neonatal sepsis in new-born	Widely distributed in the environment, but food playing an increasing role Immune system compromised	Thorough cooking Easily killed by heat Limited refrigeration storage Avoidance of suspect foods Covered food
Typhoid **Paratyphoid**	Salmonella Typhoid Salmonella Paratyphoid	Faeces of infected people	1-3 Weeks	Fever, malaise, rose spots on trunk, constipation or severe diarrhoea (Paratyphoid is less severe)	Milk, water, cooked meat, shellfish contaminated by polluted water. 2-5% persons become permanent carriers. Hence reservoir is usually man	Similar to dysentery. Affected food handlers to produce 12 negative specimens over 6 months. Chlorination of water. Heat treatment of milk and milk products. Cleaning of shellfish from polluted waters. Identification and exclusion of carriers

Cases of food poisoning

Confirmed laboratory reports by pathogen for the UK from 2009 to 2018.

(Thomas et al., 2018)

Pathogen	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Bacteria										
Campylobacter	65,164	70,329	72,249	72,577	66,584	68,471	61,588	59,253	64,227	69,636
Clostridium perfringens	389	110	46	43	43	39	130	91	117	108
E. coli O157	1,337	1,108	1,503	1,301	888	1,186	1,083	965	785	864
Listeria monocytogenes	248	191	174	195	162	188	173	195	162	172
Salmonella	10,083	9,374	9,456	8,804	8,461	9,074	8,630	9,253	10,061	10,124
Shigella	1,590	2,020	2,071	2,021	2,076	2,496	1,879	1,847	2,064	2,812
Protozoa										
Cryptosporidium	5,507	4,605	3,557	6,653	4,274	4,430	5,543	6,734	5,131	6,039
Giardia	3,571	4,037	3,942	4,128	3,838	4,227	4,073	4,742	5,256	6,216
Viruses										
Astrovirus	111	222	135	343	381	327	314	423	486	472
Norovirus	10,329	15,528	10,661	14,526	9,716	7,880	6,562	10,164	6,897	8,573
Rotavirus	17,495	18,446	18,068	17,136	16,958	5,011	4,721	3,061	4,400	2,651

Source: Public Health England, PH Wales, Health Protection Scotland, PH Agency for Northern Ireland.

Cooking top tips

- Always follow cooking temperature guidelines according to the recipe or packet instructions carefully
- Check that food is cooked completely before serving - use visual cues, such as making sure the food is steaming hot
- Consider using a food thermometer to verify the correct temperature
- Practice good hygiene when preparing and cooking your food - have a read of our cleaning and cross-contamination pages for more info
- Look to store leftovers correctly to keep food safe and avoid food waste - our chilling page has tips and advice that can help.
- Remember to take extra care when reheating leftovers - you can find our guidance in the 'using your leftovers' section on this page

Source: Food Standards Agency

Non-bacterial food poisoning

Chemicals and metals

Potential chemical hazards in food manufacturing:

Aluminium: Unconfirmed concerns regarding dementia.

Anatomy: Pans with chipped enamel should not be used.

Cadmium: Used in the fittings of cookers and fridges. These fittings may be attached by acid if the two come into direct contact.

Copper: Can initiate rancidity in milk products.

Lead: Acute food poisoning could come from glazing in some containers (and so should be avoided). Chronic 'illnesses (rather than food poisoning) could come from water-pipes, etc.

Tin or Iron: Present in cans. Occasionally, prolonged storage of acidic food may result in food poisoning.

Zinc: Used in galvanising. Such equipment should not be used with acid foods.

Acute symptoms

Occurs within one hour. Vomiting is the first symptom, followed by abdominal pain and diarrhoea.

Chronic symptoms

Some chemicals have a cumulative effect on the body; for example, nitrates and nitrites (carcinogens) added to some bacon and ham. Some chemical affect bodily functions, causing slow deterioration. For example, **the Italian wine scandal in 1986**, and the **Spanish cooking oil scandal (Articles 2 and 3).**

Metallic poisoning

Problems mainly with acidic food:

Copper	Old utensils.
Brass	Copper/Zinc alloy; problems with taps in slush ice machines 1986. Replace with plastic fittings.
Lead	Glaze on pottery. Lead in Milk November 1989: Cattle fed on contaminated meat.
Tin/Iron	Tin Cans, if lacquer damaged food interacts with the can.

Poisonous plants

Deadly Nightshade	Inadvertently mixed with comfrey leaves used for herbal tea. 1983 recall.
Potatoes	Green surface under the skin is 'Solanine'.
Leaves of rhubarb	'Oxalic acid in the leaves. Later on in the season the oxalic acid transfers down into the stem.
Red kidney beans	Poisonous if eaten raw or under-cooked, which causes haemagglutin. Pre-soaking for 5 hours and boiling for 10minutes destroys the poison.

Poisonous fish

The fish mentioned below all produce toxins that are *not* destroyed by heat:

Fugu (Puffer) Fish	The ovaries, intestines and occasionally musculature poisonous. A delicacy in Japan.
Scombrotoxin	Associated with 'fatty' Scombroid fish such as mackerel, sardines, pilchards, whitebait and tuna. High levels of histamine found when toxin is present. Occurs in fish that have started to deteriorate. Can be a problem in canned fish as well as fresh fish. Food poisoning symptoms develop between 15 minutes and 3 hours and include vomiting, diarrhoea, rash, hot flush and burning mouth.
Ciguatera	Caribbean fish (Barracuda, Seabass, Grouper, Eel) which feed on smaller fish that have fed on dinoflagellates (part of plankton). Symptoms developed between 4-8 hours and includes numbness of the mouth and tongue, and respiratory failure. 'Paralytic Shellfish Poisoning' (PSP) and 'Paralytic Shellfish Poisoning' (DSP) is similar to ciguatera poisoning.
Paralytic shellfish poisoning	Caused by mussels and shellfish that have ingested, large amount of dinoflagellates. Symptoms developed between 30 minutes and 3 hours and include numbness of the mouth and neck, fingertips and toes. Followed by repertory paralysis and possible death. Controlled by sampling and the prohibition of harvesting where necessary.

Article 2- Fraudulent winemaker

In 1986 a **fraudulent winemaker in Italy mixed methanol into his wine**, with tragic results. Twenty-three people died and over 90 were hospitalised after being poisoned with the wood alcohol, which was used to increase the alcohol content in what had been a rather thin product. Eight people died initially and 30 were hospitalised apparently from one batch, but the scandal spread with another hospitalisation when a woman drank from a bottle of […the wine…], which was tainted with methyl alcohol.

The culprits […] were charged with multiple accounts of manslaughter. 12 growers were arrested on charges of manslaughter, grievous bodily harm or illegal adulteration of food.

Italian wine was seized in France and West Germany and destroyed. Denmark enforced a ban on all Italian-made drinks after discovering that a large consignment of vermouth was similarly tainted. The Italian industry used the episode to enforce much stricter control measures.

Original source unknown

Article 3 Poisoned cooking oil

Twenty years ago, 1,000 people died in an epidemic that spread across Spain. Poisoned cooking oil was blamed, an explanation that suited government and giant chemical corporations. Woffinden B, 2001

It is increasingly understood that scientific research is now hardly ever conducted in a spirit of disinterested inquiry. Usually, it is funded by global companies whose concerns are anything but disinterested. Even when research is financed by government agencies, those, too, will want to call the tune. According to a survey […] one in three scientists working for government quangos or newly privatised laboratories has been asked to adjust conclusions to suit the sponsor.

Twenty years ago, the Spanish 'cooking oil' disaster began as a mystery illness. Years later, the toll was put at more than 1,000 deaths and more than 25,000 seriously injured, many of whom were permanently disabled. It was the most devastating food poisoning in modern European history.

The disaster is historically important not just because of its scale and the number of victims. It was the prototype contemporary scientific fraud. It marked the first time that multinational interests successfully contrived a major cover-up in international science. **For the one thing that is certain about the Spanish 'cooking oil' disaster is that it had nothing to do with cooking oil.**

The epidemic is officially deemed to have started on May 1 1981 when an eight-year-old boy […] suddenly fell ill and died in his mother's arms on the way to […] hospital in Madrid. Learning that his five brothers and sisters were also ill, doctors had them all brought in and put one of the girls into intensive care. The other four children were transferred to the Hospital del Rey, Madrid's prestigious clinic for infectious diseases, where doctors began treating them for 'atypical pneumonia'.

When the director […] arrived at work the following morning, he was alarmed to be told that these new patients were being treated for pneumonia. He gave his staff a dressing-down; it was out of the question medically for six members of a family to be suffering the same symptoms of pneumonia at the same time.

The […] family proved merely the first of many. It seemed to be mainly women and children who were affected. The initial symptoms were flu-like: fever and breathing difficulties, vomiting and nausea, although patients soon developed a pulmonary oedema (the build-up of fluid in the lungs), skin rashes and muscle pain. The epidemic was national news. After a few days […it was…] believed it was due to food poisoning, adding that the foodstuff was marketed 'via an alternative route'. He was certain of this because the casualties were all coming from the apartment blocks of the communities and towns surrounding the capital; almost no one from Madrid itself appeared to be affected. […]

[…] The head of the endocrinology department at […the…] hospital, pointed out in a newspaper article that the symptoms of the illness were best explained by 'poisoning by organo-phosphates'. The following day, he received a telephone call from the health ministry, ordering him to say nothing about the epidemic, and certainly nothing about organo-phosphorous poisoning. […The hospital Director…] was suddenly informed that he was relieved of his duties. […] His dismissal at least enabled him to carry out his own first-hand investigations. He patrolled the mercadillos and noticed the popularity and cheapness of large, unlabelled plastic containers of cooking oil.

Immediately, he and his colleagues, […], went to the houses of affected families and removed the containers of oil that they had been using when they fell ill. They carefully labelled them, sent samples of each to the government's main laboratory at Majadahonda, just outside Madrid, and awaited the results. […]. After, it seems, some initial hesitation, the government accepted his theory. On June 10, an official announcement was made on late-night television, informing the public that the epidemic was caused by contaminated cooking oil. Almost immediately, the panic subsided. The hospitals remained full of victims, but new admissions dropped sharply. The situation seemed, at least, under control.

Yet the government's announcement had been watched with stunned disbelief […]. Only the previous day, on June 9, […] results of the tests on their own, precise oil samples […] showed that, although none was the pure olive oil that the vendor had no doubt claimed it to be, almost all the oils had different constituents. Such a variety of oils obviously could not account for one specific illness.

The cooking oil theory was superficially persuasive. To protect its native olive oil industry, the Spanish government tried to prevent imports of the much cheaper rapeseed oil, then being put to widespread use throughout the European Community (which Spain did not join until 1986). Imports of rapeseed oil were allowed only for industrial use; the oil first had to be made inedible through the addition of aniline.

Streetwise entrepreneurs simply imported the cheaper oil anyway. The more scrupulous among them then removed the aniline; the others didn't bother. The illness was therefore attributed to aniline poisoning. It became colloquially known as la colza, (which is Spanish for 'rapeseed').

A number of the more high-profile oil merchants were arrested. Three weeks after the television announcement, the health ministry allowed families to hand in their supposedly contaminated oil and replaced it with pure olive oil. This belated exchange programme was hopelessly mishandled, with few authentic records kept of who was exchanging what or (and this should have been the key point) whether the oil came from affected or unaffected households.

As olive oil was guaranteed in return, many people simply handed in any oil they could find, even motor oil. Most of the oil that supposedly caused the epidemic was never available for subsequent scientific analysis. The instinctive reaction of most families, upon hearing that it was to blame for the illness, had simply been to throw it away.

In order to demonstrate that the oil had caused the illness, government scientists needed to be able to show, for example, that families who had bought the oil were affected, whereas those who hadn't were not; that the aniline in the oil was indeed poisonous and that the victims were suffering from aniline poisoning; and, bearing in mind that such commercial cooking oil fraud had been widespread for years, just what had changed in the manufacturing process to cause the oil suddenly to become so poisonous. To this day, none of these basic conditions has been met.

In 1983, however, an international conference was convened in Madrid under the auspices of the World Health Organisation (WHO). Despite the reservations of many scientists present, the epidemic was then officially named toxic oil syndrome (TOS). In 1985, the opinion of […an…] internationally respected British epidemiologist […] was sought. He was cautious, saying, 'If it could be shown that even one person who developed the disease could not have had exposure to [the oil], that would provide good grounds for exculpating the oil altogether.' The trial of the oil merchants began in March 1987. Four months later […the epidemiologist…] just before giving his evidence, announced that, on the basis of fresh epidemiological reports given to him, he now believed that the oil was the cause of the outbreak. […]

After years of one-track media reports, the notion of the 'cooking oil' epidemic was firmly lodged in the public consciousness. It was unquestioned fact. No one doubted the official scientific conclusions, especially as they were accepted by the WHO. After the 1983 Madrid conference, when there was still widespread unease with the oil theory, the Spanish government recruited some of the country's leading epidemiologists to head a fresh commission of inquiry […]

So they set about a rigorous examination of the official information. The results shocked them. […They…] looked at the pattern of admissions to hospitals and realised that *the epidemic had peaked at the end of May*. **The incidence curve went down at least 10 days before the government's June 10 broadcast,** and **about a month before the withdrawal of the oil.** In fact, **the announcement that oil was to blame had had no effect on the course of the epidemic**.

Meanwhile, his wife had examined the patterns of distribution of the suspect oil, which had come across the border from France. She realised that **vast quantities of the oil were sold in regions (notably Catalonia) where there had not been a single case of illness**. And they subsequently learned that **the government was already fully aware of this**. […]

Through all the obfuscation, one man had simply ignored the official lines of inquiry and spent months pursuing his own. Having eliminated the cooking oil, […he…] and his colleagues turned their attention to other salad products. Speaking to market stallholders, lorry drivers and around 4,000-5,000 affected families, **they concluded that, without any doubt, the contaminated foodstuff was tomatoes, and it was the pesticides on them that were responsible for the epidemic**. The organo-phosphorous chemicals would indeed cause the range of symptoms observed by clinicians.

The tomatoes, they established, had come from Almeria, in the south-east corner of Spain. Once a desert area, this was not fit for crop-growing until the discovery of underground water in the 1970s helped to transform it into an agricultural success story. Fruit and vegetables were forced into rapid growth under long tunnels of plastic sheeting. Some farmers got three, or even four, crops a year. […]

The consequences of the cover-up were appalling. Many died unnecessarily. Thousands more, children among them, were left to endure a lifetime of pain and physical impairment that perhaps could have been avoided if they had received the care and treatment they needed as early as possible. The Spanish colza is not just one of the great tragedies of the last century, it is also one of the great scandals.

Years later, in 1989, a similar mystery illness was first diagnosed in New Mexico. Victims, 29 of whom died, fell ill with pneumonia-like symptoms. Altogether, there were about 1,500 cases across the US. The symptoms appeared identical to those suffered by the affected in Spain; yet no one in the US had had access to contaminated cooking oil. It is virtually certain that this outbreak, too, was caused by OP pesticides. […].

Preservation

The need for preservations

The animal kingdom and vegetables are part of a natural cycle of growth and decay. Human food is mostly made up of natural products within these cycles; (Genetically Modified (GM)) crops are increasingly part of the food web). Food preservation can be broadly defined as *any method of treating food which prolongs the length of time it retains its quality, appeal and acceptability*. This includes short-term domestic methods to long-term highly mechanised methods used in food processing.

Acceptability of food is dependent on individual preferences and a country's eating customs and habits. For example, populations in the Far-East have a lower tolerance to dairy produce than those in the West and as a consequence consume far less of that kind of product.

The need for preservation has its origins in the struggle for survival for early humans. Now, however, preservation is totally ingrained in the supply of food not only for survival needs but in order life-style choices can be maintained:

- Movement of food, locally and globally
- Utilisation of seasonable foods to satisfy more affluent eating habits
- Long term storage of foods such as butter, beef, etc
- Extended 'shelf-life' of common products

Methods of preservation

- **Canning**: Sealing food in airtight containers and heating them to destroy microorganisms
- **Drying**: Removing moisture from food to inhibit the growth of microorganisms
- **Fermentation**: Using beneficial bacteria or yeasts to convert sugars into acids or alcohol, which act as preservatives
- **Freezing**: Lowering the temperature to slow down the activity of bacteria, yeasts, and moulds
- **Pickling**: Using vinegar or brine to create an acidic environment that prevents spoilage
- **Salting**: Drawing out moisture through osmosis, which inhibits bacterial growth
- **Smoking**: Exposing food to smoke, which contains antimicrobial compounds
- **Vacuum sealing**: Removing air from the packaging to prevent oxidation and the growth of aerobic microorganisms

Design and construction of food premises

General factors affecting design

Good design results in easier working practices. Correct materials make cleaning and disinfection easier.

Planning permission is required before new premises can be opened. Prior contact with the local authority can prevent the requirement to make alterations of premises prior to being allowed to open. Regulation (EC) No 852/2004 on the hygiene of foodstuffs

The structure of food rooms must:

- Be capable of being kept clean.
- Not allow ingress of pests such as rodents, insects and birds
- Provide satisfactory standards of lighting and ventilation
- Provide suitable and sufficient sinks and hand-wash basins
- Provide adequate clean and constant water supply, including hot water

Correct siting and access requirements include:

- Services such as gas, potable water, drainage, electricity, refuse collection
- Space for future expansion
- Structural stability
- Suitable environment with limited pollutions
- Allocated areas (access, space, egress) for deliveries, staff, food and waste

Effective layout to:

- Prevent cross-contamination by having separate areas for dirty foods (vegetables), raw foods, high risk foods, cooked foods, de-boxing, packaging etc.
- Provide continuous 'linear workflow' by design that is multi-directional, with no back-tracking or cross-over. There should be a 'Product > Raw > Process > Finished product' flow. Flows should also be applied to staff with different functions and tasks, containers and equipment, and for refuse storage and disposal
- Provide for effective cleaning and disinfection by design
- Adequate space around equipment
- An effective layout will influence behaviour by design

Facilities required for effective layout:

- **Ancillary facilities**. Locker storage, changing facilities
- **Cleaning and disinfection**. Sinks (Hold and Cold), Convenient, adequate size and quantity, Dishwashers, Ring-main for pressure washers, CiP[6] and ClAYG[7]
- **Food preparation**. Stainless steel sinks, hot and cold water, separate sinks for different purpose
- **Hand washing and personal hygiene**. Sufficient and accessible, soap, drying facilities, nail brush (preferably non-hand operated)
- **Pest Control**. Prevent access.: For example, metal kickboards to doors, mesh to air-bricks, air curtains, trapped gullies
- **Plant room/space**. Adequate space for operation and maintenance
- **Refuse**. Designated areas, foot-operated bins, as part of the Waste Management System
- **Sanitary accommodation**. As required in WCs: Clean, efficient order, well-lit and ventilated, intervening ventilated space required between food room and WC (Regulation (EC) No 852/2004)
- **Staff welfare**. Storage for outdoor and protective clothing, canteen facilities, rest areas
- **Storage**. Designated areas for equipment and materials
- **Temperature control**. Forces air environments, temperature monitoring and controls.

[6] **CiP**. Clean-in-Place.
[7] CLAYGO. Clean-as-You-Go.

Food safety design and construction

Ceilings	Walls	Doors and Windows	Floors
Good repair	Non-permeable	Sealed (where appropriate with mesh)	Slopes to drainage
Secure lighting	Free from holes or cracks	Clear fire escapes	Tiles free from cracks
Secure attachments	Secure signage	Free from dust	'Rat Runs' clearly marked
Secure ventilation	Properly fitted sockets	Doors fitted with kick plates	
Ability to inspect behind false ceilings	Free from condensation	Free from condensation	
	Curved to the floor	Sloping sills	
	Secure piping and ducting		
	Piping and ducting 150mm from walls		
	Intact lagging		
	Capable of being cleaned (and disinfected where necessary)		

Pest Control

Definition

A pest is an organism which, in a particular environment or set of circumstances, is destructive, noxious or troublesome to man or his interests, a living creature capable of contaminating food.

Purpose of pest control

The primary purpose of pest control is to prevent the spread of disease. Birds, insects and rodents can all spread disease which can affect man and other animals. Birds, cockroaches, flies and rodents, which are common potential problems for the food industry, are all capable of transmitting food poisoning organisms.

The spread of disease

Diseases may be spread by:

- Consuming food contaminated by rodent urine and droppings
- Contact with rat urine (Which can result in Well's disease
- The consumption of under-cooked pork infected by Trichinella Cysts
- Parasites, which live on rats
- Rat bites
- Faecal contamination
- Regurgitated food
- Poor waste management and waste disposal

Bird pests

Birds that commonly gain access to food premises are sparrows and feral pigeons, although other species such as starlings occasionally cause problems. Warehouses and large factories are prime targets, although bakehouses and supermarkets are also affected. Bird pests:

- Block gutters with nests (resulting in insects and mites within the nest entering the building
- Contaminate food
- Deface buildings (with guano, which could also land on personnel, equipment, product in transit)
- Present a physical contamination due to feathers
- Spread disease

Control of bird pests

Wherever possible, the emphasis should be placed on environmental controls to reduce the risk of food contamination. The areas around food rooms should be kept clean and tidy, and all possible breading sites removed.

- **Environmental controls**. Control measures such as the elimination of perches, good house-keeping/maintenance and shielded windows and doors are most effective.

- **Physical controls**. Such controls are less common (within food safety). Traps and mist-netting are two methods, although a licence may be required. Bird-scarers are also available (against sparrows only)

- **Chemical controls**. Narcotics (such as alphachloralose) may be used; within legislative and licence requirements.

Article 4 ‘Wildlife and Countryside Act 1981’

(Internet connection required)

The trapping or killing of birds, destroying nest or the taking of eggs etc is covered in the Wildlife and Countryside Act 1981 (as amended).

The RSPB provides a summary of the Act, (with links within to devolved law).

Notes:

Cockroaches

Two species of cockroaches are established and widely distributed in the UK. These are the:

Oriental cockroach (which has a 40-week lifecycle)

German cockroach (which has a 14-week lifecycle)

Control of cockroaches

Wherever possible, the emphasis should be placed on environmental and physical controls to reduce the risk of food contamination. The areas around food rooms should be kept clean and tidy, and all possible breading sites removed.

Environmental controls. These controls include such measures as:

- Attention to drains and refuge areas
- Elimination of harbourage areas
- Good building structure and maintenance
- Storage of food (in pest-proof containers)
- Strict hygiene practices

Chemical controls. Chemical measures include repetitive treatment with residual insecticide to break the lifecycle.

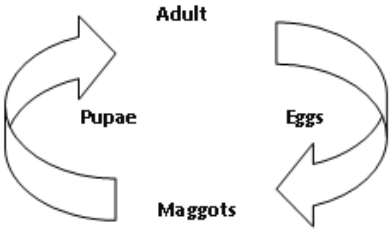
Physical controls. 'Monitoring' by way of traps is a physical control measure.

Cockroach infestation checklist

Item	Notes
Check and destroy any contaminated food	
Consider closure if ‘large’ infestation found	
Contact pest control contractor and follow recommendations	
Repeat treatments as required, (Eggs are often in inaccessible areas and may take many days to hatch)	
Lay sticky traps to determine the extent of infestation	
Clean premises and improve housekeeping to eliminate source of food	
Inspect the building structure with the pest control contractor	
Seal crevices, remove panels and ducting as necessary to facilitate treatment	
Remove food prior to the use of insecticides	
Ensure stored food is in pest-proof containers	
Establish the source of the contamination to prevent re-infestation, (The source may be from deliveries)	

Flying insects

Common flying insect problems are derived from house flies, Bluebottles, Fruit Flies, Wasps etc. The speed of development of flying insects varies with temperature and may be less than three weeks from egg to adult The following illustration shows the life cycle:



Food infection by flying insects

Flies infect food in four ways:

- During feeding, where flies regurgitate enzymes and partly digested food from the previous meal
- Flies defecate continuously
- Flies carry bacteria on the hairs on the bodies and legs
- Pupal cases, eggs and dead bodies may be found in food

Control of flying insects

Wherever possible, the emphasis should be placed on environmental and physical controls to reduce the risk of food contamination. The areas around food rooms should be kept clean and tidy, and all possible breading sites removed.

Environmental controls. Windows and other openings used to provide ventilation should be tight-fitting with cleanable flyscreens. Roof access at apexes and eaves should also be screened. Doors should be kept clean and closed (when not in use), or provided with cleanable screens or clear, heavy-duty plastic strips.

Physical controls. Two common physical controls are electronic fly- killers and sticky flypapers.

Chemical controls. Two common chemical controls are insecticides, (where care is required if deployed near food), and pheromones (attractants).

Article 5 ‘Fly Infection’

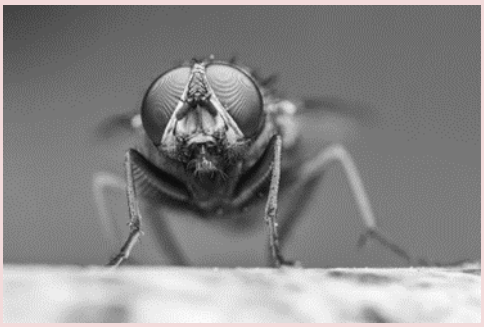
The danger to health from flies must not be underestimated. Flies have been involved in the transmission of many pathogens, including dysentery and food poisoning organisms.

How flies transmit disease in food production. Soudant A, 2020

Flies pollinate plants, kill spiders and hunt dragonflies, but they also consume decomposing bodies and eat the sludge in drainage pipes. Flies are loaded with bacteria and spread diseases that are harmful to humans.

One of the most problematic insects for food producers are flies. They carry pathogens and bacteria, contaminate food and multiply quickly. While there are thousands of fly species, some of the most common include small flies (Fruit-fly and Drain fly) and large flies (Housefly, Cluster fly, and Blow fly).

With mouthparts designed for piercing, sucking or sponging, much of the problem is what they feast on- decaying organic matter. You may not think much of these winged insects that can drop onto the side of your plate, but if that fly could talk and tell you of the journey it took, you might go running for the hills.



The basic life-cycle of a fly begins with a female laying an egg. The reproductive capacity of a female fly is enormous. Depending on the species of fly, she can lay up to a few thousand eggs during her lifetime. Flies can lay their eggs in garbage cans, compost piles, excrement and/or decaying organic matter. The egg then develops through a larva phase, a pupa phase, and finally, into an adult. All this while the growing fly continues to feed on the very garbage or decaying matter it was hatched in.

And, while they double in size, moult, double in size and moult again, not only do they eat the stuff, but they get covered in it as well. During a warm summer their life cycle, from egg to adult, can span from six to 45 days depending on environmental conditions and species of fly. By the time the fly makes its way into our homes, businesses or factories, it’s covered in decaying organic matter and disease-causing bacteria, and they can pass it on to us.

This is why it’s important to take a more serious approach and do more than just casually brush flies away.

A fly infestation for food and beverage producers can mean food poisoning and contaminated water, potentially leading to Anthrax, Cholera, Salmonella, Tuberculosis or Typhoid. While you may think that your business is exempt from such concerns, if your food processing plant produces any sort of food waste, then it's a prime candidate for these kinds of risks.

Flies enter into buildings through cracks in weather stripping, windows screens with holes, or openings left by other pests. Once in, they search for food waste and garbage sources to feed on, transmitting disease wherever they land- on dishwashers, food prep areas, and in sinks and drains.

The first sight of flies in your food production facility means it's time to implement a fly management programme. But controlling an infestation alone won't cut it. You must also include a strategy for identification and prevention, as well as methods to ensure sanitation and mitigate food safety risks. Thus, reducing fly infestations and keeping your facility audit ready.

It's equally important to know the source of the infestation, (where the female is laying her eggs), to deploy an effective elimination procedure. Once you know where they're coming from, then you can exclude the source and implement prevention measures. These measures could include insecticide, mechanical control, and sanitation. Prevention measures should also include identifying structural issues that allow easy access for flies within your facility.

A comprehensive programme with a focus on prevention can lower the risk of flies invading your facility, contaminating your food processes and potentially transmitting diseases.

Notes:

Rodents

The most common rodent problems are derived from:

The Black Rat (Rattus Rattus)

- A ship rat
- Good climber
- Omnivorous, but favours fruit and vegetables
- Wide foraging area

The Brown Rat (Rattus Norvegicus). Characteristics:

- Burrows in soil
- Common
- Found in sewers
- Omnivorous, but favours cereals
- Stays close to its nest

The House Mouse (Mus Domesticus). Characteristics:

- Limited range
- Many habitats
- Nibbles at food at many points
- Omnivorous, but prefers cereals

Signs of rodent infestation

Signs of rodent infestation include:

- Droppings (Shiny, soft droppings indicate recent infestation)
- Footprints (in spillages)
- Gnawing marks and damage
- Holes
- Rodent grease smears and rat-runs

Control of rodents

The three main methods of rodent control are:

Chemicals (Rodenticides). These chemicals are divided into two groups:

- **Chronic rodenticides**. To obtain the desired result, these chemicals need to be ingested by rodents in small doses over a few days.
- **Acute rodenticides**. These chemicals kill the rodent in a relatively short time after a single feed. However, acute rodenticides are more toxic to humans and domestic animals.

Environmental. This method of control includes measures such as:

- The **proofing** of doors (kickboards, thresholds)
- **Mesh** on vent pipes/bricks
- The proper **maintenance** of facilities

Physical controls. This method of control includes measures such as:

- **Traps**, which may be used if there is a particular risk of contaminating food.
- **Sticky boards**, which are most used to eliminate the survivor of a treatment.

Notes:

Personal Hygiene

Regulatory requirements

People are a source of food poisoning organisms and may also act as a vehicle. For example, by transporting bacteria from raw meat to High-Risk foods. Therefore, food handlers must always observe the highest standards of personal hygiene to ensure they do not contaminate food.

Regulation (EC) No 852/2004 On the Hygiene of Foodstuffs

- A person working in a food handling area must inform the proprietor of the food business if they know, suspect that they have, or are carrying, a food-borne illness. Similarly, they must report illnesses such as diarrhoea, an infected wound, skin infection, or any other condition that could result in food becoming contaminated by pathogenic, micro-organisms. Anyone who is afflicted with such illnesses or symptoms, or who is a suspected carrier, may be excluded from a food handling area.

- People working in a food handling area must maintain a high standard of personal cleanliness and must work in a hygienic manner.

- Food handlers must wear clean over-clothing and where appropriate, protective clothing.

- Food premisses must have adequate hand washing facilities with hot and cold, or appropriately mixed, running water, together with materials for cleaning and drying hands hygienically.

- Where necessary, adequate staff changing facilities must be provided.

(Link to Regulation (EC) No 852/2004 of the European parliament and of the council the Regulation)

General requirements

Unhygienic habits. Food handlers must avoid unhygienic habits such as:

- Blowing into bags (to open them)
- Blowing into cups, glasses containers etc (to free them from dust or debris)
- Biting fingernails
- Chewing pen-tips
- Linking of fingers (when sifting sheets of paper)
- Picking up cups, glasses, containers etc with fingers on the inside
- Taking hands to face (nose, or ears), or hair

Hands. Hands are principal agents for the transfer of bacteria to food. Transfer can be prevented by adherence to the following:

- Cuts should be covered with a waterproof (blue) plaster (or dressing)
- Fingernails should be kept trim and clean
- Good hand washing
- Nail varnish should not be worn
- The handling of food without the use of tools/implements should be minimised

Jewellery. Rings (other than a simple wedding band), watches, necklaces, broaches and bracelets must not be worn in food rooms because they harbour dirt and may potentially be a source of physical contamination.

Protective clothing. Clean protective clothing must be worn by all persons handling open food in order to prevent the transfer of contamination from normal clothing. Suitable protective head covering (such as a mop cap) must be donned. Where required, suitable protective beard covering (such as a beard snood) must be worn.

Mob Cap

Mob Cap and Beard

Management requirements

Managers and supervisors must maintain high standards by:

- ✓ Vetting new staff for attitude, habits and willingness to undergo training
- ✓ Establish and communicate Standards and Procedures (For example, reporting sickness, policy on the wearing of jewellery, clothing policy)
- ✓ Provision of structured Induction, Probation and Continuation training
- ✓ Leading by example
- ✓ Monitoring personal hygiene levels- visual checks, swabs etc
- ✓ Reviewing of Occupational Health (OH) questionnaire results (anonymised)
- ✓ Ensuring provision of facilities and resources
- ✓ Internal Audit (IA) of procedures (and escalation as required)

Article 6 'Personal hygiene example'

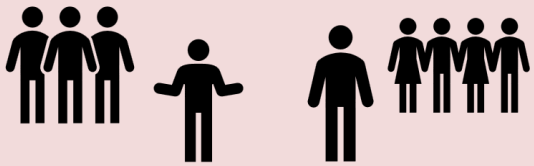
Source- Environmental Health News

Oval Caterers allowed infected staff to work

What is believed to be the largest outbreak of food poisoning in Lambeth was caused by a catering company that allowed nine of its staff to carry on working while carrying salmonella enteriditis phage type 4. At least one of them was working in the kitchen at the time.

More than 90 people are known to have been taken ill following a lunch in two executive boxes at the Oval Cricket Ground last September. Forty of the affected guests were il enough to [seek] medical help and were either tested by GPs or their own local authority. At least three people ended up in hospital and some guests claimed to have lost two stone in weight.

[…A…] Principle Food EHO […] explained that the catering company […] offered a choice of six set menus. This complicated tracing the infection to a particular food, but the investigating team, a core of seven EHOs and TOs, strongly suspect[ed] the mayonnaise.



However, what really clinched Lambeth's case was the discovery that [the company…] had no system for excluding food handlers who had been taken ill from work. 'The chef had been ill the previous week. We then checked all food handlers and found a couple still working on site who were salmonella enteriditis phage type 4 positive. We went on that basis to court and the company pleaded guilty.' The investigation and data collection took some six months and involved Lambeth in more than 240 interviews with guests and catering staff. Some 18 Local Authorities and 12 Public Health laboratories were involved; guests were spread right across the Southwest of England and one was contacted in Belgium. The Communicable Disease Surveillance Centre and the local regional health authorities were also involved.

The company, which changed its name after the outbreak, pleaded guilty to charges of the sale of unfit food [in addition to] a hygiene offence and was fined £5,600. [The company] no longer has a catering licence [for] the Oval. Whatever it calls itself, Graison now faces further prosecutions. The companies who hired boxes at the Oval are investigating the best line to take to bring prosecutions. Of the 29 [companies] involved, all but one refused to pay the bill for the function. The Director of one of the companies was among the number particularly affected by the food poisoning.

Quite a few of the guests now intend to take prosecutions. Following the success of Lambeth's case at Horseferry Road Magistrates Court, […the…] CEHO […] said, 'This is certainly the largest outbreak we have looked in to, with over 90 people poisoned. Ironically, only one of the infected guests lives in Lambeth. These fines were not as high as we would have liked, but these convictions will undoubtedly assist with the large number of private actions we know are being taken against the caterers.

Design of food equipment

Regulation (EC) No 852/2004 on the Hygiene of Foodstuffs:

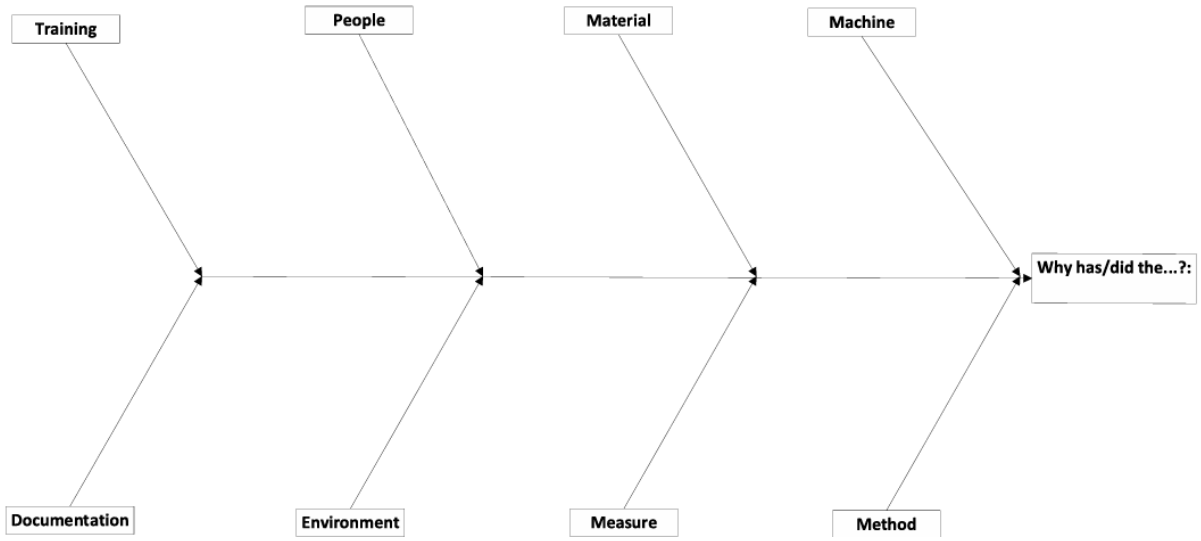
Articles, fittings and equipment that come into contact with food should be of such material and maintained so they can be kept clean and where necessary disinfected.

Main principles:

- Accessible parts
- Corrosion resistant
- Durable
- Easily dismantled and reassembled
- Easy to clean
- Free from harbourage areas
- Inert
- Minimum number of crevices (free from narrow angles)
- Non flaking
- Non-toxic
- Protect food from contamination
- Self-draining
- Smooth (free from jagged, sharp edges)
- Waterproof

Management role in maintaining equipment Standards:

- Establish and maintain Standards in accordance with User Manuals, Instructions for use, etc
- Communication of Standards, Procedures and Work Instructions
- Monitoring and Auditing framework in place
- Recording and Review framework in place
- Preventative Maintenance Schedule in place
- Establish and maintain first-line trouble-shooting capability
- Fault Reporting, RCA[8] and Response framework in place



Typical 'Root Cause Analysis' framework.

[8] **RCA**. Root Cause Analysis.

Cleaning and disinfection

Background

Even in the most efficient and well-equipped food business, soiling of equipment, fittings and infrastructure is an inevitable consequence of food production. The type and extent of such soiling varies greatly and as such cleaning and disinfection should be organised so to deal with the specific requirements of each particular business, in order to ensure that a high level of hygiene is maintained.

Definitions

- **Bactericide**. A substance which destroys bacteria.
- **Cleaning**. The process of removing soil, food residues, dirt, grease and other objectionable matter. Cleaning is the systematic removal of accumulated and unwanted matter.
- **Detergent**. Chemical, or mixture of chemicals that helps to remove dirt and grease.
- **Disinfectant**. A chemical that achieves disinfection.
- **Disinfection**. Reduction of micro-organisms to a level where they will not cause harm to food or consumers.
- **Sanitiser**. A chemical that both cleans and disinfects.
- **Sterilisation**. A process that destroys all living organisms.

Notes:

Benefits of cleaning

- Ensures a safe and pleasant work environment
- Ensures efficient use of plant and equipment
- Maintain food safety
- Promotes good public relations
- Reduces the risk of foreign matter contaminating foodstuffs
- Removes harbourages or food supplies for pests
-
- Satisfy consumer requirements
- Satisfy customer requirements
- Satisfy legal requirement

Consequence of poor cleaning

- Deterioration of facilities
- Food contamination (through taints, dirt etc)
- Food poisoning
- Food waste
- Loss of reputation
- Plant/ Equipment failure (leading to loss of availability)
- Poor quality product (through reduced shelf-life)

Guidance on use of cleaning agents

- Allow sufficient contact time
- Avoid contaminating food
- Do not mix cleaning agents
- Use appropriate implements and equipment
- Use at recommended strength
- Use in accordance with manufactures' instruction
- Use PPE[9] (as required)
- Store safely (following CoSHH[10] requirements)

Notes:

[9] **PPE**. Personal Protective Equipment.
[10] **CoSHH**. Control of Substances Hazardous to Health.

Clean-in-Place (CiP)

CiP developed out of the brewery and dairy industries because of the use of large, complex plant, equipment lengthy, sometimes narrow pipework in use. The cleaning method began to be increasingly used in the 1960s, grew rapidly and by the 1980s was considered by industry to be the routine way to clean such plant and equipment.

Factors affecting effectiveness:

- Concentration of cleaning fluid
- Contact time
- Equipment design
- Flow of cleaning fluid
- Temperature available

Monitoring considerations

- Concentration
- Flowrate
- Microbiological controls
- Rinsing
- Temperature
- Time

Assessing the effectiveness of CiP

- Sampling (of final rinse)
- Swabbing
- Testing next batch (of product)

Cleaning equipment considerations

- Colour-coded (To reduce the risk of cross-contamination)
- Specific tools/equipment for specific machinery
- Brushes- Polyester bristles or resin (Heat and (cleaning) chemical resistant)
- Maintenance and replacement framework
- Instructions for use followed

Post cleaning considerations

- Reassembly process checklist
- Parts checklist (Nuts, bolts etc)
- Disinfection of handled parts
- Guards/Rails in place
- Operating checklist
- Stored (as required)

Clean -As-You-Go (ClayGo)

'Clean-As-You-Go' is a proactive approach to maintaining cleanliness and hygiene in food preparation and production environments. This practice involves continuous cleaning and sanitising of work areas, equipment, and utensils throughout the food handling process.

Key Components

Immediate Cleanup:

- **Spills and Debris**: Any spills, food scraps, or debris should be cleaned up immediately to prevent contamination and maintain a safe working environment
- **Utensils and Equipment**: After using any utensils or equipment, they should be cleaned and sanitized before being used again

Regular Sanitization:

- **Work Surfaces**: Countertops, cutting boards, and other work surfaces should be regularly wiped down with appropriate sanitizing solutions
- **High-Touch Areas**: Handles, knobs, and switches should be frequently sanitized to reduce the risk of cross-contamination

Waste Management:

- **Proper Disposal**: Waste should be disposed of promptly and correctly to prevent the buildup of garbage and reduce the risk of pests
- **Recycling and Composting**: Implementing recycling and composting practices can help manage waste more effectively and sustainably

Personal Hygiene:

- **Hand Washing**: Food handlers should wash their hands regularly, especially after handling raw food, using the restroom, or touching their face
- **Protective Clothing**: Wearing clean uniforms, aprons, and hairnets can help maintain hygiene standards

Benefits

Food Safety:

- **Prevention of Cross-Contamination**: By cleaning as you go, the risk of cross-contamination between raw and cooked foods is minimised, reducing the likelihood of foodborne illnesses
- **Compliance with Regulations**: Adhering to clean-as-you-go practices helps ensure compliance with food safety regulations and standards

Operational Efficiency:

- **Streamlined Workflow**: A clean and organised workspace allows for more efficient food preparation and reduces downtime caused by having to clean up large messes at the end of a shift
- **Reduced Cleaning Time**: Regular cleaning throughout the day means less intensive cleaning is required at the end of the day, saving time and labour

Workplace Safety:

- **Reduced Risk of Accidents**: Keeping floors and surfaces clean and free of obstructions helps prevent slips, trips, and falls
- **Improved Employee Morale**: A clean and well-maintained work environment can boost employee morale and productivity

Customer Satisfaction:

- **Positive Impressions**: Cleanliness is a key factor in customer satisfaction, especially in open kitchens or food service areas where customers can see the food being prepared
- **Quality Assurance**: Maintaining high standards of cleanliness ensures that the food served is of the highest quality

Monitoring and Feedback:

- **Regular Inspections**: Conducting regular inspections can help identify areas that need improvement and ensure compliance with clean-as-you-go practices
- **Feedback Mechanisms**: Providing a way for staff to give feedback on cleaning procedures can help identify issues and improve practices

Energy in cleaning

To clean (remove dirt), energy has to be applied to ensure the operation is carried out efficiently. This energy is applied in three distinct forms:

- **Physical energy** (Manual labour, mechanical, machines)

  Factors affecting Physical energy include:
  - Availability of human resources
  - Ease of operation
    - Equipment required

- **Thermal energy** (Heat)

  Factors affecting Thermal energy include:
  - Costs
  - Equipment required
    - Methods of applying heat
  - Safety requirements

- **Chemical Energy** (Detergents)

  Factors affecting Chemical energy include consideration of the choice and use of chemicals to ensure effective and safe operation:
  - Is the chemical easy to use? (Automated dosage; Pump; Range of use)
    - Is the chemical safe to use? (No further preparation required, Ease of training)
    - Will the chemical remove the dirt/soil in question?
  - Will the chemical taint the food?

Selection of chemicals

The selection of a chemical method should be precluded by ensuring only established suppliers provide the products. This is to ensure the products meet industry Standards. Furthermore, any introduction of the use of chemicals into the workplace should go through a process of validation (trials), including input from stakeholders from departments such as:

- SHEQ[11]
- Technical
- Production
- Engineering
- NPD[12]
- Facilities

Disinfection in cleaning

Cleaning alone is not intended to kill micro-organisms. The process of destroying micro-organisms (disinfection) may be carried out as a separate procedure or combined with cleaning by using a sanitiser. Disinfection is not required in all situations. A disinfectant should be used where the presence of micro-organisms will have an adverse effect on the safety or quality of the food involved. Where applied, disinfection should be restricted to:

- Food-contact surfaces
- Hand-contact surfaces
- Food-handlers' hands
- Cleaning equipment

[11] **SHEQ**. Safety Health Environment Quality.
[12] **NPD**. New Product development.

Heat disinfection

Heat disinfection is a reliable and effective means of disinfection, although it may not be a practical solution. It is found in use in machines such as dishwashers, where a water temperature of 88°c is used.

Chemical disinfection

Chemical disinfection requires a careful choice to be made. Careful consideration should be given to:

- The type of surface to be cleaned
- The contact time available
- The type of organism to be destroyed
- The possibility of food tainting
- Safety factors such as toxicity, safety in use, interaction between detergent and disinfection

Standard cleaning procedure

Pre-clean. Sweeping, debris removal, soaking etc.

Main clean. Loosening the main body of dirt.

Intermediate rinse. Removal of loosened dirt.

Disinfection. Where required.

Final rinse. Removal of disinfection residue.

Airing/Drying. Removal of moisture, (a potential harbour for bacteria), by exposure to air.

Double-sink washing

- Remove loose debris/residues
- Place articles in the first sink in detergent at 55°c, clean with a brush (or clean cloth)
- Remove loosened dirt
- Place articles into second sink, rinse off detergent residues
- Soak in second sink at a high temperature
- Allow to drain and dry

Work surface cleaning (Stainless steel)

- Remove loose debris and clean with a cloth
- Wash with hot detergent solution and cloth
- Rinse with hot water and a clean cloth (to remove dirt/detergent)
- Apply disinfectant and allow sufficient contact time
- Rinse with clean, hot water and a disposable paper towel
- Allow to air-dry

Management functions

Cleaning will not be effective unless it is fully supported by management. The role of management is to define the Standards required and to communicate these to staff, usually by means of:

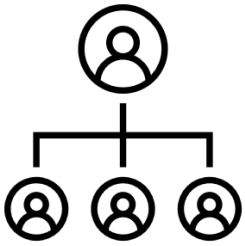
- The provision of adequate training
- Availability of suitable cleaning products (and equipment)
- Inclusion of a comprehensive cleaning schedule within normal work routines

Monitoring of cleaning is essential to ensure that Standards are met. Visual checks should be made daily in all food businesses and recorded. Larger businesses may include bacterial swabbing of surfaces. The effectiveness of cleaning systems should be reviewed regularly and any corrective action taken.

Administrative functions

Administrative functions can be summarised as:

- Safe storage of chemicals
- Effective stock control
- Adequate distribution of materials
- Financial control

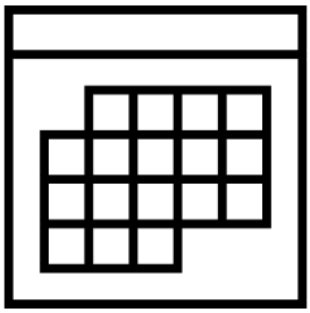


The use of cleaning schedules

Cleaning schedules are an effective and essential means of ensuring that cleaning works are carried out correctly and effectively, cleaning schedules should form an integral part of work routines in businesses concerned with food preparation (in order to ensure the activity is not over-looked).

In establishing an effective cleaning schedule, it is essential for management to analyse the overall cleaning requirements of the establishment; the specific requirements relating to each piece of equipment or part of the premises. The working pattern also needs to be considered. A cleaning schedule should be written clearly and concisely, be easy to follow and not vague or ambiguous. The cleaning schedule will specify:

- What is to be cleaned
- Who is to clean
- When cleaning is to occur
- The equipment and chemicals required
- How cleaning is to be carried out
- The safety precautions to be followed (including PPE[13])
- The time required
- Method of checking cleaning has been carried out
- Responsibility for ensuring compliance



[13] **PPE**. Personal Protective equipment.

Job card (Example)

Job Card #: 1234 ‘ …Title …’

Items	Cutting Boards Food Preparation Surfaces
Materials	Zipalong Detergent (Blue Powder) Killgerm Disinfectant (Pink Liquid) Scrubbing brush
Precautions	Always wear protective rubber gloves Use chemicals strictly in accordance with ‘Instructions for Use’

Method

Important Step	Key Points	Reasons Why
1. Remove loose material.	By scraping.	To get rid of debris and to prepare for cleaning.
2. Immerse in hot water.	With 10% Zipalong detergent X1 Scoop per sink full.	To help remove dirt and grease Sufficient amount
3. Clean	Using a scrubbing brush	
4. Drain	Until excess water is removed	
5. Immerse in hot water.	With Killgerm disinfectant (x2 cupfuls per sink)	Helps reduce micro-organisms. (Sufficient amount)
6. Drain	Thoroughly	In preparation for drying
7. Air-dry		

Manager / Supervisor Notes:

Note to reader: A ‘Reason Why’ doesn’t always have to be given. The ‘reason Why’ is provided to reinforce the ‘Key Point’.

Food labelling

Date marks help manufacturers, retailers and consumers to maintain food safety and quality.

Date labelling is applicable to most pre-packed foods. Foods should be labelled:

A ‘Use By’ date applies to highly perishable foods which, after a short time, may be a danger to health. (The inclusion of the year is optional).

A ‘Best Before’ or ‘Best Before End’ date is an indication of the length of time the food will remain in its optimum condition if properly stored, and applies to low-risk foods such as cereals, cans etc. Food may still be edible after a ‘Best Before’ or ‘Best Before End’ date. However, its appearance and the quality could suffer.

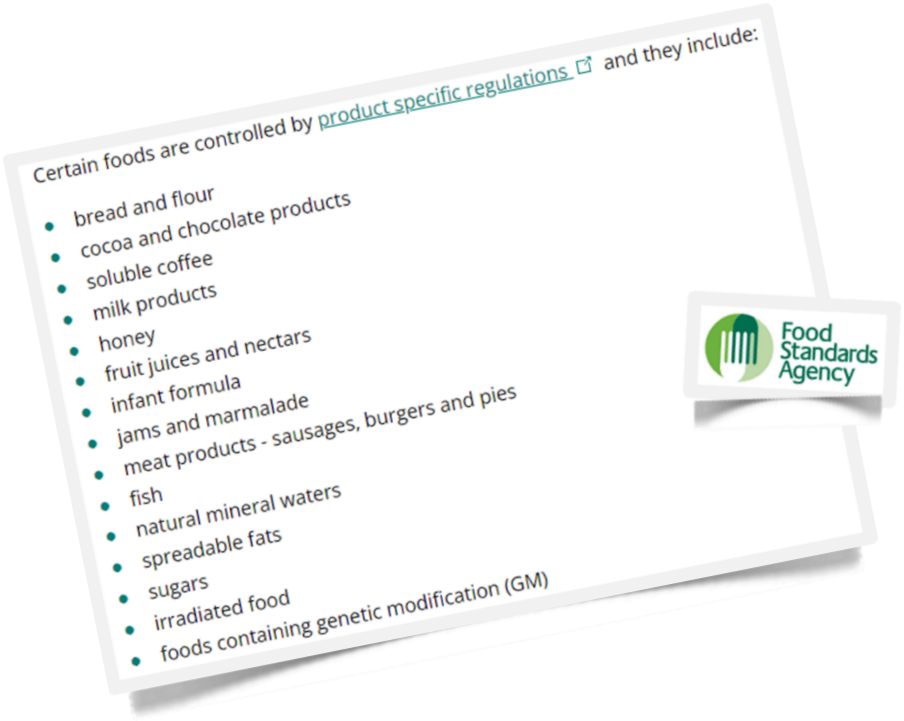
Food labelling offences

It is an offence to sell food beyond its ‘Use By’ date.

It is an offence to alter the date-mark of stock unless you are the person originally responsible for packing.

Exempt foods

Fresh fruit and vegetables, wine, alcoholic drinks with an alcoholic strength of 10% or more, soft drinks and fruit juices for catering establishments (5litres), flour, confectionary, bread, vinegar, cooking and table salt, sweets, chewing gum and ice-lollies are exempt.



https://www.food.gov.uk/business-guidance/packaging-and-labelling

Food storage and deliveries

Food storage

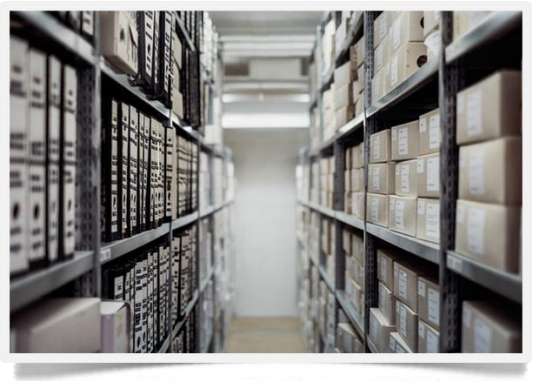
Food has to be stored ready for use in a convenient, accessible store or in bulk storage. Bulk purchasing, especially during market gluts, can normally work out cheaper so long as storage costs are not prohibitive, but the food must be maintained in suitable conditions for that product in order for benefit to be gained.

Perishable foods are best fresh, and so it is better to have these supplied daily. However, where daily supply is not possible, refrigeration or freezing can increase the storage times of such items considerably.

Storage space for raw materials must of suitable construction, repair, suitably sited for deliveries and use by personnel and have sufficient capacity.

Food must be stored in hygienic conditions taking into consideration:

- Minimising deterioration
- Maintaining quality
- Maintaining nutritional value
- Maintaining appearance and taste
- The prevention of contamination by pests
- Preventing taint (effects of odour)



Storage of dry foods

Fruit and vegetables

These goods lose moisture easily and can dry out. Therefore, they should be used as soon as possible. Fruit and vegetables should be stored in dry, well-ventilated areas, separate from other foods.

Citrus fruits and apples can taint other fruits. Checks for mould should be made and any fruit or vegetables affected, removed.

Apples and bananas are badly affected by temperatures below 3°c, turning brown and black respectively.

Bakery products

Bread, cake and pastry are generally too dry to allow bacterial growth. However, good ventilation and stock rotation is essential to avoid mould growth and staleness.

Flour and cereals

These should be stored in dry, mobile stainless steel bins with pest-proof lids. Flour and cereal present potential problems with rodents and stored product pests such; for example, psocids. Flour should not taste acidic or moist, and dampness will turn it yellow, sour and sticky.

Hydrogen swell	Hydrogen gas produced with acid fruits.
Flipper	One end bulges out slightly. Can be pushed back.
Springer	Advanced Flipper. When one end bulges and is pushed back the other end bulges.
Hard swell	Both ends bulge out.
Flat sour	No gas and the contents smell foul.
Sulphating	Purple, black stain from the food interacting with the can.

Botulism in cans refers to a serious form of food poisoning caused by the bacterium Clostridium botulinum. This bacterium produces a potent toxin that can grow and produce toxins in improperly processed or canned foods.

Characteristics of dry food stores

Requirements	Why?	How?
Dry	Moisture aids deterioration Mould, lumpiness, discolouration, liquefaction	Sound structure
Cool- Ideally approximately 10°c	Warmth aids deterioration	Natural/Mechanical ventilation North facing Away from the boiler-room
Good lighting	Safe and easy access and egress Aid to cleaning Aid to inspections (vermin etc)	Natural Artificial
Good ventilation	Maintain temperature Prevent stale odours Disperse food odours	Windows Mechanical
Clean	Prevent harbourage of bacteria, rodents, insects etc	Easily cleanable surfaces Regular cleaning routines Spillage routines
Tidy	Maintain a safe workplace Aid to stock rotation	Effective stacking system (racking); portable
Vermin proof	Prevent stock damage Prevent damage to property Prevent food contamination Prevent food complaints Prevent food poisoning	Physical barrier - E.g. wire Kick plates Vermin-proof containers Good facilities maintenance
Adequate size	Safety Effective stock rotation	Forward planning Designated areas
Accessible	Safety Reduce time Cost effective	Forward planning

Deliveries

Hazards during deliveries

Deliveries can be contaminated in a number of ways, including:

- Bacterial contamination from for example: unclean delivery personnel, vans, raw foods, pests, dust and dirt
- Bacterial multiplication due to high vehicle temperatures or off-loaded food left at ambient temperature
- Physical contamination from, for example: people, pests and vehicle debris
- Chemical contamination

Delivery checks

The type of delivery inspection will depend upon the type of food being delivered. All deliveries must be checked for:

- Damage to packets and boxes
- Rusty, brown dented cans
- Out of date stock
- Infestation or pest damage
- Dampness, spoilage
- Temperature (Especially chilled or frozen product)
- Any other contamination

Procedures for non-acceptance of sub-standard goods should be established. Goods should be labelled on receipt in order to aid stock rotation (if not already date-marked).

Organoleptic checks

Organoleptic checks refer to those made for quality, taint and spoilage using the human senses:

- Appearance: Free from signs of mould, colour changes, untypical wetness.
- Smell: Fresh, pleasant, natural, bad, unusual, musty.
- Taste: Unusual, bitter, sweet, untypical.
- Texture: Unusual sloppiness, hardness, brittleness.
- Sound: Sloppiness (of canned goods)

Delivery checklist

Potential hazards

Bacterial contamination; for example, from unclean delivery personnel, van, raw foods, pests, dust, dirt etc.

Bacterial multiplication: For example, transport temperatures above 8°c, product left out at ambient temperature once unloaded.

Physical contamination; for example, from people, pests, vehicle debris.

Chemical contamination: For example, from chemicals carried in the same vehicle.

Delivery inspection:

Cleanliness of personnel and the vehicle.

Temperature of food on delivery:
- Reject frozen product above -10°c
- Reject chilled product above 10°c

Condition of product

Condition of packaging (Cans, etc)

Presence or evidence of pests, etc

Contamination (Biological, Physical, Chemical)

Coding and Specification

Date-coding: 'Use By' or 'Best Before'

Products to specification

Storage

Stores as soon as possible

Separate any unfit product

Clearly mark any unfit or damaged product

Stock rotation

Stock rotation ensures that **stock is used in date order, preventing wastage**. Stock rotation is necessary for all forms of food storage. Daily checks should be made for chilled, high-risk foods, weekly for other food products.

Stock rotation checks will also serve to deter pest infestations because of the disturbance caused and labelling can also serve as an additional cleaning check.

Preferably, stock rotation should be a designated responsibility, where those responsible have knowledge of the shelf-life of the products, storage conditions and manufacturers' codes etc.

The general principle of stock rotation is 'First in - First out', **FiFo**.

Notes:

Storage and temperature control

General principles

Food has to be stored ready for use in a convenient, accessible store, or in bulk storage. Bulk purchasing, especially during market gluts can normally work out cheaper if storage costs are not prohibitive. However, the food must be maintained in suitable conditions for that product I order for benefit to be gained.

Perishable goods are best fresh and supplied daily. Where this is not possible, refrigeration and freezing can increase storage times of such items considerably.

Food must be stored in hygienic conditions, taking into account:

- Minimisation of deterioration
- Maintenance of quality and nutritional value
- Maintenance of taste and appearance
- Prevention of contamination by pests
- Prevention of taint

Deterioration and decomposition

Decomposition of foods begins immediately it is taken from the plant, animal or taken from the sea. The process is natural and designed to rid the earth of dead organisms. Case must be taken to arrest this process in order for the food to remain fit to eat. Decomposition occurs due to the action of bacteria, yeasts, moulds and enzymes. These are already present in the plant or animal during life and act to break down proteins, carbohydrates and fats into their basic constituents, which may taint and otherwise affect the quality of the food.

Proteins are broken down by proteolytic enzymes into amino acids. Gases such as methane, oxygen, hydrogen and ammonia may be produced resulting in odours and colour changes. The rate of enzyme activity is reduced at low temperatures and ceases above 77°c when the enzymes themselves are broken down; de-natured.

Spoilage of preserved food

The spoilage of food is brought about by:

- Physical damage
- Natural enzyme activity
- Non-enzyme changes (autoxidation)
- Microbiological action of yeasts, moulds and certain bacteria

The effects of spoilage

The effects of spoilage on food include:

- Off odours
- Off flavours
- Texture changes
- Putrefaction
- Changes in appearance

Food can become spoiled due to the process of decomposition, attack by pests, contamination by chemicals, or by physical damage; For example, bruising resulting from poor handling. Other changes such as freezer-burn and oxidation can also be a cause of spoilage.

Spoilage prevention

In order to prevent or delay enzyme spoilage, and inhibit the growth of pathogenic organisms, food may be preserved by:

- Use of low temperatures
- Use of high temperatures
- Dehydration
- Use of chemicals
- Restricted oxygen content
- Other physical methods such as smoking or irradiation

Storage of chilled food

Requirement

Food which is likely to support the growth of pathogenic micro-organisms and the formation of toxins must be kept at 8°c or below.

Variations

Food which is likely to support the growth of pathogenic micro-organisms, and the formation of toxins may be kept above 8°c if:

- It is for service or display for sale, has not previously been kept for service or display for sale and is not on service or display for sale for more than four hours
- If the exceedance of 8°c is for unavoidable reasons as to accommodate practicalities in handling during and after processing or preparation, during the defrosting of equipment or due to temporary breakdown so long as the exceedance is limited and consistent with food safety.

Exemptions from 8°c:

Exemptions from the requirement for food to be kept at 8°c or below include:

- Cooked food being displayed for sale at 63°c or more
- Food which for the duration of its shelf-life may be kept at ambient temperatures with no risk to health
- Food which has been subject to dehydration or canning
- Food which must be ripened or matured at ambient, but not after that ripening or maturation is complete
- Raw food intended for further processing before human consumption

Commercial ‘Chillers’

Products held at low temperatures within a commercial environment are held at -1°c and will remain in good condition for approximately one month. This period can be increased in a carbon dioxide enriched atmosphere.

Fresh meats, poultry, offal and raw meat products

The temperature range for storage of these products is -1°c to 1°c. When meats are delivered to the catering department or food processing unit, they are probably at the end of a long handling chain which may include periods of storage under temperatures conducive to bacterial growth. Therefore, it is difficult to give recommended times for the storage of raw meats. However, generally beef has a longer shelf-life than poultry, or fattier lamb or pork meats.

From production to consumption, if beef is stored at approximately 0°c it may last for up to six weeks. However, as a unit may be at the end of the food production chain, it should never be kept for longer than seven days at 0°c.

Lamb, ham and poultry, if fresh and at 0°c, should be kept for up to three days only from the time of purchase.

Dairy products

Milk was, until recent decades, a major vehicle for the spread of diseases such as tuberculosis, brucellosis, typhoid, paratyphoid, campylobacter, salmonella and staphylococcal food poisoning. However, thanks to heat treatment (pasteurisation and sterilisation) these problems have been reduced.

Milk should be stored within 1°c and 4°c. Most dairy products can support bacterial growth and so should be kept away from raw foods and under refrigeration. Butters and fats become rancid due to the splitting of the fats. Refrigeration slows the rate of rancidity.

It is illegal to use raw ‘Green Top’ milk within the food industry.

Vacuum packing

Psychrophilic bacteria (those with an o.g.t below 20°c) present in fish cause them to deteriorate quickly even at low temperatures. Fish must be packed in ice as soon as they are caught. Frozen fish muscle undergoes a toughening process (protein hardening) after several months. Therefore, fish should not be stored for prolonged periods. Fatty fish (Scombroid) may become rancid.

Spoilage at low temperatures

Most pathogenic organisms cease to multiply below 5°c. (However, Clostridium Botulinum Type E remains active at a slower rate).

Psychrotrophic bacteria (e.g. Listeria) can grow at temperatures as low as 0°c, but also at a slow rate.

Moulds are capable of growth, as is spoilage bacteria, and enzyme activity is only reduced.

Notes:

Storage of frozen food

Contamination may occur between goods in freezers. Cooked and raw product should be wrapped and stored separately in the freeze.

Refrigeration

General guidelines for refrigeration are:

Hot food should never be placed into a fridge (or freezer).

Cooked food should be cooled rapidly and placed into the fridge within 90 minutes.

High Risk foods should be stored in Blast-Chillers.

Refrigerators should not be over-stocked. To aid with air circulation, food should not be tightly packed or placed near cooling elements.

Refrigerated food should be checked daily for quality and to aid with rotation.

Each refrigerator should be labelled with its intended use. Raw and cooked product should be stored separately.

Food should be suitably covered; for example, with cling film, in containers, foil, grease-proof paper.

Refrigerated goods should be checked on delivery to ensure the temperature is within specification. Once accepted, the goods must be date-coded where necessary to aid with stock rotation.

Each refrigerator should have its own thermometer. The correct operating temperature should be indicated on the refrigerator: Generally 1°c to 4°c. The preferred temperature for raw meat, poultry and fish is +1°c to -1°c.

Refrigerator temperatures should be checked at least three times a day.

Refrigerator doors should remain open for as short a time as possible.

Refrigerator door seals should be checked regularly.

Refrigerators should be de-frosted and cleaned at least weekly. The unit should be switched off and un-plugged, and stock moved to an alternative unit.

General guidelines for freezers

- Deliveries of frozen food must be checked to ensure it is at the correct temperature.
- Delivered food more than 5°c above the recommended storage temperature must not be accepted (i.e. above -13°c).
- Delivered food should be transferred to a freezer as soon as possible.
- Frozen food must be stored below -18°c, and the freezer temperature checked at least daily. Each freezer should have its own thermometer. The correct operating temperature should be indicated on the freezer.
- Frozen food must be covered to avoid freezer burn.
- Frozen goods must be date-coded where necessary to aid with stock rotation; with stock checked at east weekly.
- Freezer lids and door seals should be checked regularly.
- Freezers may be tightly packed as air does not have to circulate.
- Freezers with automatic defrost cycles should be defrosted and cleaned thoroughly at least every three months. Shelves may be removed and cleaned on a more regular (weekly) basis.
- Freezers without automatic defrost cycles should be defrosted and cleaned thoroughly weekly.
- Cooked and raw foods should be stored apart.
- Freezing does not kill bacteria; it just stops them from multiplying. Spores and toxins are unaffected by freezing.

Notes:

Types of freezing

Effective preparation of some types of product is necessary prior to freezing; for example, it might be necessary to blanch vegetables (for one minute) in order to inactivate the oxidising enzymes. Blanching also reduces bacterial load, removes trapped air and pre-shrinks the product.

Rapid freezing

'Rapid Freeze' product is frozen to -23°c for domestic freezing, and -33°c for commercial freezing. This type of freezing produces small ice crystals; whereas slow freezing produces large crystals resulting in **high drip** on thawing and gives a spongy texture to the product.

Storage periods depend on the type of product and packaging. Prolonged storage results in loss of texture, flavour, tenderness and nutritional quality. Rancidity results in fatty foods. Correct 'Hold' temperatures are:

Domestic: -18°c

Commercial: -29°c

Commercial quick freezing

Method of Freezing	Characteristics
Fluidized Bed	Insulated tunnel with up-drafts of intensely cold air Aids separation (E.g. peas, sweetcorn) Freezes quickly Temperature/Time: -40°c for 3-8min; or -25°c for 8-15min
Air Blast	Food passes through a tunnel of cold air at -30°c to -40°c for approximately two hours.
Cryogenic	Liquid nitrogen at -192°c is applied to the product (spray or dip) Freezes instantly Food retains shape and appearance (e.g. prawns, sausages)
Plate	Packed product is held between cold metal surfaces at -33°c for 2-3 hours The metal surfaces are cooled by freezing brine

Frozen meats

Meats can be frozen for long periods (up to two years) at temperatures below -23°c. Meats can suffer from freezer burn caused by the loss of moisture from their surface. Therefore, meats should be well wrapped and frozen quickly to prevent freezer burn.

Some parasites found in meats are destroyed by freezing, and the total number of bacteria is reduced. However, many bacteria do survive, as do spores and most toxins. On thawing, the bacteria can start to multiply again and reach previous levels.

Ice Cream

Ice cream should be stored at below -1°c, or at -12°c for a maximum of one week. Ice cream should be stored separately whenever possible; and never stored with raw meats.

Ice cream that has risen to -2°c must be reprocessed before it is used. Thawed ice cream should be disposed of, and never re-frozen.

Cleaning Refrigerators

Refrigerators should be cleaned at least weekly and whenever stock is reasonably low. General steps in the process include:

Switch off and **unplug** (Note. The automatic defrost programme may be altered and so may need to be reset)

Transfer stock- Preferably to an alternative unit

Remove spillages, wrapping, rubbish etc

Remove shelves for cleaning

Clean internal surfaces- Warm water and mild detergent or bicarbinate of soda. Do not use abrasives or perfumed cleaning materials.

Scrub rails and runners

Disinfect- With a Food Safe product

Dry all surfaces- A clean disposable cloth may be used if there is insufficient time to allow air-drying

Clean external surfaces- Using warm water and a mild detergent, (ensure seals are cleaned)

Replace shelves

Plug in and **switch on**

Ensure the correct working temperature is achieved

Restock- In Rotation

Spoilage at freezing temperatures

Enzymes remain active at -2°c, and spores and toxins are unaffected. The majority of enzymes are destroyed during processing (such as blanching).

Even though the amount of water available is reduced by freezing, some bacteria will survive and multiply, and will compensate on thawing for those bacteria destroyed during freezing.

Parasites, such as Trichinella in pork, are destroyed through freezing.

Freezer or chiller failure

Freezer or Chiller failure may occur as a result of a number of factors, including loss of power or compressor shutdown. The products stored within the unit may be at risk if temperatures conducive to bacterial growth are reached.

Actions to be taken on Freezer or Chiller failure:

Check. Immediately check the temperature of the stored products, and record.

Limits. If the temperature is within limits, it may be moved to an alternative unit. The limits are:

Frozen product	**-13°c**
Chilled	**+10°c**

Frozen. The frozen product must be used within one week.

Thaw. The state of frozen product will dictate actions:

Completely thawed food must be disposed of.

Partly thawed product may be completely thawed, cooked and used immediately.

Chilled. Chilled product must be used within 24 hours.

High temperatures

Cooking

Heat is used to destroy both spoilage and pathogenic organisms. Once cooked, care should be taken to avoid cross-contamination, and refrigerated storage is necessary to inhibit microbiological growth.

The death of bacteria in heat treated food follows a logarithmic course in which equal numbers of surviving cells die in each successive unit of time. I.e. increasing the temperature or extending the cooking time results in the death of more bacteria. This rate is called **Thermal Death Time** (TDT) and is used extensively in the canning process.

However, it has to be remembered that spores and some toxins are very heat resistant; for example, Clostridium Botulinum.

Pasteurisation

This process requires time/temperature ratio **71.7°c for 15 seconds**. The process is used for delicately structured food such as milk and shellfish etc. That temperature must be sufficient to destroy vegetative pathogens and most spoilage micro-organisms.

Pasteurisation has a minimal effect on flavour and nutritional value.

Bacteria destroyed by pasteurisation include Salmonella, Campylobacter, Tuberculosis, Brucella Abortus (and others). However, spores and toxins remain unaffected.

Clean packing and adequate refrigeration storage is essential.

Sterilisation

Sterilisation temperatures normally **exceed 100°c (for 20 minutes)** and usually involve steam under pressure; which is less damaging to food. Sterilisation involves the destruction of all living organisms, which is difficult to achieve. In food manufacturing a heat treatment sufficient to kill all viable organisms is used, referred to **commercial sterility**.

The **advantages** of sterilisation are that it kills all pathogens, kills all viable spoilage organisms and prolongs shelf-life at ambient temperatures. The **disadvantages** are that flavour is affected and nutritional value is reduced.

Milk is **sterilised when it is taken to 110°c for 30 minutes** then cooled rapidly to 10°c. **UHT (Ultra High Temperature) milk is taken to 132°c** .

Canning

Canning is by far the most important method of food preservation in terms of tonnage; variety of food preserved and improved shelf-life. Canning is a form of heat treatment; with most foods treated by being sealed in a can and subjected to a **temperature of 121°c** for a time to ensure that every particulate of food is subjected to the prescribed treatment for **at least 3 minutes**. With large cans of dense food this may mean heating the can for 45 minutes for the heat to penetrate to the centre. This process is known as '**Botulinum Cook'**, is **sufficient to destroy Clostridium Botulinum**, considered to be the most heat-resistant bacteria. Other combinations of time and temperature can be used to give the same effect.

All canned foods given such treatment have very long shelf-lives, limited only by slow physical or chemical changes that may take place.

High acid foods. If the food is sufficiently acidic (ph 4.4 or less) the temperature of the heat process may be reduced as Clostridium Botulinum is more easily destroyed in an acidic environment.

Low acid foods. These foods (such as vegetables and meats) need to be sterilised under pressure to achieve the correct temperature to destroy Clostridium Botulinum but retain the texture of the food in an acceptable form.

Cured foods. The effectiveness of the heat treatment is enhanced by the presence of curing salts. However, cured meats, such as ham, is subjected only to pasteurising temperatures in order to retain the structure of the meat; making it less shelf-stable. Such meats should not be stored above 5°c.

Advantages of canning:

Applicable to a wide range of foods

No special storage conditions required

Longer shelf-life

Disadvantages of canning:

Heat treatment impairs flavour

Weight of cans

Dehydration

Micro-organism require water in order to survive. Dehydration dries the food through the removal of water. Dried foods normally contain less than 25% water with an Aw (Available Water) of **0.6Aw** (most bacteria require 0.99-0.95Aw). Pure water is 1Aw. Foods, such as dried egg and dried fruit are shelf-stable and not easily attacked by bacteria.

Some bacteria survive dehydration through the formation of spores. The spores can germinate on re-hydration; for example, Bacillus Cereus.

Spoilage can occur from moulds growing on food which is too dry to support bacterial growth.

Sun Drying

Drying food by means of the heat from the sun is the oldest method of natural removal of water, and is used for raisons, prunes, figs tomatoes etc.

Modified Atmospheric Packaging (MAP)

Items such as boxes, foil sachets and plastic sachets are vacuum sealed with nitrogen (or CO2) flushed to reduce oxidisation. Sulphur Dioxide may be added as a preservative in some products.

MAP involves the modification of the normal ratio of atmospheric gases (O2, N2, CO2) at the onset of storage to reduce spoilage, oxidisation and enzyme activity. MAP uses the same gases as are used for controlled atmospheric storage.

The main methods of MAP are:

- Gas packing
- Vacuum packing

Food that is dehydrated using MAP has a longer shelf-life if stored at low levels of humidity and not opened to the atmosphere. Little storage space is needed in comparison to other preserved products. MAP also involves lower costs and is easier to transport.

There is, however, a risk of spore germination on rehydration. Therefore, care is needed to ensure rehydration occurs properly. Furthermore, the quality of the food may not meet customer expectations on rehydration; due to the proteins having denatured excessively, toughening of cellulose and a quicker spoilage rate than fresh products.

Commercial dehydration

Sufficient heat is needed to evaporate the water content: 85°c to 101°c. The removal of water can cause changes in tissue structure, with a resultant loss of shape, colour, texture and nutrients. Dried convenience foods are a direct result of improved technology in the dehydration processes, all of which are preceded by the blanching process, making oxidising enzymes inactive.

Commercial dehydration processes

Hot air tunnel and fluidised bed drying. (e.g Pulses) Warm air is passed through food in motion; speeds drying; Particles separate.

Spray and roller drying. (e.g Milk, Soup) Food dispersed as droplets and dried or spread over a heated roller and dried.

Heated vacuum drying. Drying under reduced pressure; requires a lower level of heat. There is a lower oxygen level, which reduces the risk of oxidisation changes (i.e. browning of foods and rancidity).

Accelerated freeze drying (Sublimation). (e.g Coffee). Food is frozen and heated under vacuum. Ice turns straight into water vapour, missing out the liquid water stage; Less damage to cells; Better reconstitution.

Notes:

Chemical preservation

Micro-organisms cannot tolerate high concentrations of chemicals. Therefore, it is no surprise that chemicals have been used to preserve food for centuries by way of salt, sugar, vinegar and natural antioxidants (for example, spices and traditional preservatives). Chemical dehydration reduces the amount of available water, leaving insufficient water for bacterial growth.

Salt

When added to food, salt withdraws water not only from the food but from any micro-organism within the food, with the result that the micro-organisms dehydrate and die. Preservation, in part, is due to osmosis and effectiveness depends on a number of factors:

Water content of the food

pH level

Microbial contamination

Salt tolerance is decreased by reducing temperature or pH. **Halophilic** organisms are those that are able to grow in high salt concentrations. **Haloduric** organisms survive in high salt concentrations but do not reproduce, until the salt is removed.

Staphylococci are fairly resistant to salt concentrations, hence its association with semi-preserved, salted food poisoning outbreaks.

Curing involves the use of salt and other chemicals for food preservation. **Brining** involves the use of salt to enhance colour and flavour.

Sugar

Sucrose has an action similar to that of salt but concentrations need to be higher. Moulds are less susceptible to sugar concentrations, they can withstand up to 60°c sugar concentration.

In order to be effective, jams and preserves have a 65% sugar concentration and heated during the process at a temperature of 105°c.

Acetic Acid (Vinegar)

Acetic acid preserves food by lowering the pH below the normal growth range of most micro-organisms, although some yeasts and moulds may be unaffected. The process is referred to as ‘pickling’ and examples include eggs, onions and cabbage.

Smoking

The preservative qualities of smoking is brought about by the anti-microbial substances in the smoke (acids, phenols and aldehydes) which act on the bacteria in the food. Some dehydration also occurs. Clostridium Botulinum usually survives and so smoked food needs to be refrigerated.

'Hot' and 'Cold' smoking methods is commonly used for products such as fish and bacon.

Research has shown that the smoking process may carcinogens in the food.

Preservatives

The use of preservatives (such as **Sodium Nitrates** and **Nitrites**) is strictly controlled by legislation, with maximum permitted levels specified.

Sodium Nitrates and Nitrites are used during curing to reduce spoilage, and reacts with haemoglobin in the blood of animals bringing about a deeper red colour change. The curing effect is also controlled by pH, temperature and type of micro-organism present.

Nitrites develop colour more effectively than Nitrates but can have toxic properties. Research is being undertaken with the aim of discovering which Nitrite inhibits **Clostridium Botulinum**, and the minimum amount needed.

Nitrates and Nitrites gradually disappear during storage and heating.

Food irradiation

Micro-organisms are destroyed by exposure to gamma radiation emanating from radioactive sources, such as Cobolt 60. Rays penetrate packaging, therefore food can be packaged prior to treatment.

Food irradiation differs for frozen and fresh foods.

Ultra-violet (UV)

This method of preserving food is used in the UK.

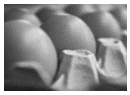
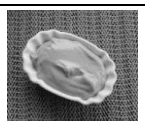
UV treatment reduces the number of pathogens in shellfish.

Allergens

Types of allergens

Allergens include **celery**, **cereals containing gluten** (such as barley and oats), **crustaceans** (such as prawns, crabs and lobsters), **eggs**, **fish**, **lupin**, **milk**, **molluscs** (such as mussels and oysters), **mustard**, **peanuts**, **sesame**, **soybeans**, **sulphur dioxide** and **sulphites** (at a concentration of more than ten parts per million) and **tree nuts** (such as almonds, hazelnuts, walnuts, Brazil nuts, cashews, pecans, pistachios and macadamia nuts).

(Source- Food Standards Agency)

				
Celery	**Cereals containing gluten**	**Crustaceans**	**Eggs**	**Fish**
				
Lupin	**Milk**	**Mollusc**	**Mustard**	**Nuts**
				**14 Most common food allergens**
Peanuts	**Sesame Seeds**	**Soybeans**	**Sulphur dioxide- Sulphites**	

Article 7 'Key Facts'

Access to sufficient amounts of safe and nutritious food is key to sustaining life and promoting good health.

Unsafe food containing harmful bacteria, viruses, parasites or chemical substances, causes more than 200 diseases – ranging from diarrhoea to cancers.

An estimated 600 million – almost 1 in 10 people in the world – fall ill after eating contaminated food and 420,000 die every year, resulting in the loss of 33 million healthy life years (DALYs).

Children under 5 years of age carry 40% of the foodborne disease burden, with 125,000 deaths every year.

Diarrhoeal diseases are the most common illnesses resulting from the consumption of contaminated food, causing 550 million people to fall ill and 230,000 deaths every year.

Food safety, nutrition and food security are inextricably linked. Unsafe food creates a vicious cycle of disease and malnutrition, particularly affecting infants, young children, elderly and the sick.

Foodborne diseases impede socioeconomic development by straining health care systems, and harming national economies, tourism and trade.

Food supply chains cross multiple national borders. Good collaboration between governments, producers and consumers helps ensure food safety.

Source: WHO (2015) Fact Sheet No399

Notes:

Food Preparation

Thawing raw meat and poultry

It is necessary to thaw joints of meat and poultry thoroughly before cooking as the liquid from thawing meat, especially poultry, may contain large numbers of food poisoning bacteria. Therefore, great care must be taken when thawing to prevent the liquid contaminating work surfaces or other food.

Thawing should be carried out in a specially designed rapid thawing cabinet, a refrigerator or in a kitchen; and preferably in impervious, lidded food trays used for only for the purposes of thawing such products.

The following is a suitable procedure for thawing:

Performance	Conditions	Standards
Remove the product from the freezer	With sufficient time for the product to thaw thoroughly	IAW temperature controls and monitoring procedures
Position for thawing	Separate from other products, works surfaces or equipment Without allowing cross-contamination	
Thaw thoroughly	Using a thermometer to check the centre Until the product is flexible and ice crystals have melted	
Remove giblets (Poultry)	Completely removed	
Return the product to the refrigerator (if thawed at room temperature		
Cook within 12 hours	Any stuffing cooked separately	

Once thawed, frozen food should never be re-frozen.

Cook-chill

To ‘Cook-Chill’ is to cook food, then rapidly chill it to 3°c or less within 90 minutes, and to keep the food at that temperature until reheated.

There are eight stages:

Bulk storage

Preparation

Cooking

Portioning: including packaging and labelling.

Blast-chilling: including packaging and labelling.

Storage at or below 3°c

Distribution at or below 3°c

Reheating

The benefits of Cook-chill are:

Accommodates bulk purchasing

Accurate portioning

Reduced energy consumption through good planning

Less space needed (so lower costs)

Planned workload

Better quality than food kept above 63°c (for prolonged periods)

Safety

Chilling and reheating should be carefully controlled.

Spores survive the process and could multiply.

Sous vide

Food may be raw or partially cooked then vacuum sealed. Sous-vide requires strict temperature control in order to maintain food safety.

Sous vide is a precise cooking technique that ensures perfectly cooked food without the risk of overcooking. **Methods of Sous vide include**:

Vacuum Sealing: Food is sealed in a plastic pouch or glass jar to prevent moisture loss and maintain flavour.

Water Bath: The sealed food is immersed in a water bath heated to a specific temperature using an immersion circulator. This device maintains precise temperature control.

Characteristics of Sous vide are:

Consistent Cooking: The water temperature remains constant, ensuring that the food reaches the same, desired.

No Overcooking: Unlike traditional methods, Sous vide eliminates the risk of overcooking. Water efficiently conducts heat, preventing the food from exceeding the desired temperature.

Core temperatures

Chilled deliveries	8°c or below
Frozen deliveries	-18°c or below
Fridge/**Cold Hold**	8°c or below (Ideally 1-5°c)
Freezer	-18°c to -20°c
Cook temperature	70°c for two minutes
Cook temperature	75°c for 30 second
Hot Hold (once cooked)	Above 63°c
Danger zone	5-63°c
Hand-washing temperature	45-50°c
Water temperature	82°c

‘Cold Hold’ and ‘Hot Hold’

Food Hygiene (England) Regulations 2006

Effective 01 January 2006 and replaced the Food Safety (Temperature Control) Regulations 1995. (At time of writing).

These regulations set the standards for food which is likely to support the growth of pathogenic micro-organisms or the formation of toxins (I.e. **High-Risk** food). Generally, food should be held either:

Food which is cooked or reheated and on service or display for sale must be kept at 63°c or higher, providing it has not previously been on service or display for sale and so long as the service or display for sale does not exceed two hours. Alternatively, the food may be kept at below 8°c.

‘Chill Hold’ exemptions

Food temperature may be above 8°c where food is displayed for sale for not more than 4 hours. Also, food temperature may rise for a limited period consistent with food safety for an unavoidable reason such as:

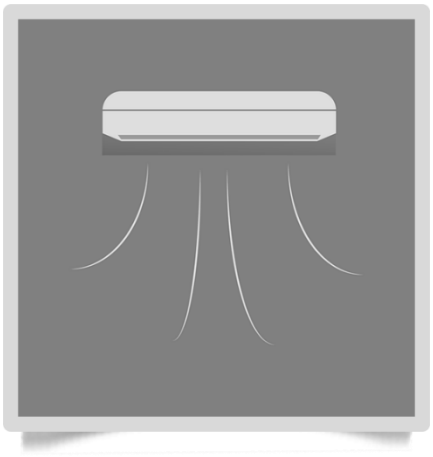
- During unloading
- Equipment breakdown
- Defrosting

Cooling

Food should be cooled as quickly as possible after its final heat treatment.

‘Hot Hold’ defence

The food has been kept below 63°c for less than two hours.



Refrigeration breakdown

In case of breakdown:

Fridge: Foods may be put into another fridge if the temperature of the food has not risen above 10°c, and should be used within 24°c. If the temperature of the food has risen to above 10°c it must be disposed of.

Freezer: If the food has remained below -12°c it may be retained but must be used within one week. Thawed or partially thawed food must be disposed of.

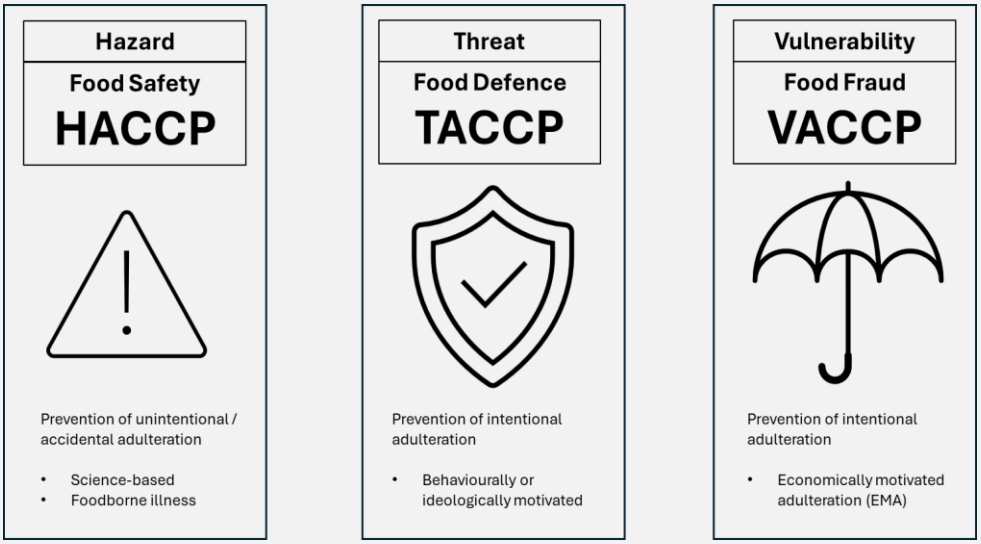
Decomposition

The decomposition of food begins immediately it is taken from the plant, sea or animal. The process is natural and designed to rid the earth of dead organisms. Care must be taken to arrest this process in order that food remains fit to eat. Decomposition occurs due to the action of bacteria, yeast, moulds and enzymes already. These act to break down proteins, carbohydrates and fats into their basic constituents, which may taint and otherwise adversely affect the food; rendering it unfit for (human) consumption.

Proteins are broken down into amino acids by proteolytic enzymes. Gases, (for example, methane, oxygen, hydrogen and ammonia) may be produced, resulting in odours and colour changes. The rate of enzyme activity is slowed own at low temperatures, and ceases above 77°c when the enzymes themselves are broken down (de-natured).

Bacterial food decomposition and enzyme decomposition are reduced by refrigeration and freezing. Some spoilage bacteria, however, do still multiply at lower temperatures, and spoilage may still occur in refrigerators. Therefore, the life of the food is limited. Moulds will grow below freezing (for example, -8°c to -2°c) hence freezer temperatures are often well below this at -18°c to -23°c.

CCP Model



Hazard > Food Safety

HACCP is a proactive, science-based approach that safeguards food from farm to fork.

Threat > Food Defence

TACCP is concerned with food defence and with a focus on food tampering, intentional adulteration or contamination of food.

Vulnerability > Food Fraud

VACCP is a risk assessment that helps identify and control vulnerabilities in the food supply chain that can be exposed to economically motivated food fraud.

Hazard Analysis and Critical Control Points

HACCP context

HACCP is a proactive, science-based approach that safeguards food from farm to fork. By focusing on prevention, it empowers food producers to deliver safe, high-quality products. The method emerged in the 1960s as a collaborative effort between NASA, the Pillsbury Company, and the U.S. Army. Initially designed for space missions, it soon found its way into the food industry. Today, HACCP serves as a globally recognised framework for preventing foodborne illnesses and ensuring product safety.

Significance of HACCP

1. **Preventing Foodborne Illnesses**:
    - HACCP reduces the risk of pathogens (e.g., Salmonella, E. coli) reaching consumers
    - It prevents outbreaks and protects public health
2. **Enhancing Product Quality**:
    - Proper control at CCPs ensures consistent product quality
    - Consumers trust safe and reliable food products
3. **Compliance with Regulations**:
    - Many countries mandate HACCP for food businesses
    - Compliance demonstrates commitment to safety.

Model documents

The Food Standards agency provides model HACCP documents.

Prerequisites

Prerequisites (may be understood as pre-requirements) are standard working practices and routines that must be in place before a HACCP plan can be effective. The prerequisites must be the 'normal' way activities are carried out around the work environment. They are the foundations and set standards and expectations, for example:

- Allergen policy (and segregation)
- Brittle, Hard Plastics and Ceramics policy
- Approved suppliers
- Brittle, Hard Plastics and Ceramics policy
- Cleaning schedules
- Control of Substances Hazardous to Health (CoSHH)
- Labelling
- Maintenance programme
- Pest management policy (Pest control)
- Personal hygiene policy (Hygiene standards)
- Potable water supply
- Preventative Measures / Corrective Actions on suspected food poisoning
- Staff and management training
- Recall procedures
- Stock rotation
- Temperature control
- Traceability (Ingredients/Products)

Seven Principles of HACCP

Hazard Analysis and Critical Control Point (HACCP) is based on seven key principles that help ensure food safety. These principles are essential for any food business:

1. **Conduct a Hazard Analysis**: Identify potential hazards associated with the food production process.

2. **Determine Critical Control Points (CCPs)**: Pinpoint specific stages where control measures can prevent, reduce, or eliminate hazards.

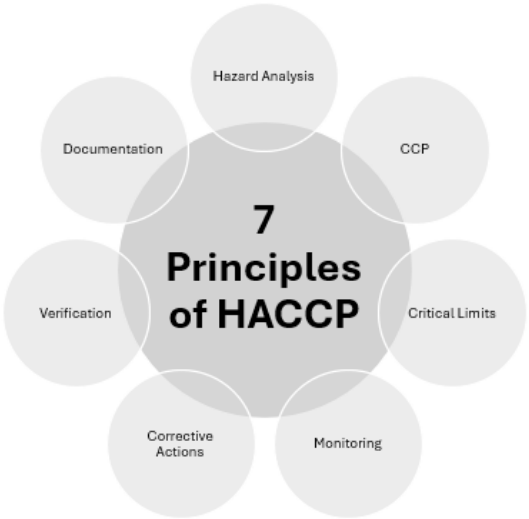
3. **Establish Critical Limits**: Set target levels for parameters (e.g., temperature) at CCPs.

4. **Establish Monitoring Procedures**: Regularly monitor CCPs to maintain control.

5. **Establish Corrective Actions**: Address deviations promptly if CCPs go out of control.

6. **Establish Verification Procedures**: Independently validate the effectiveness of the HACCP plan.

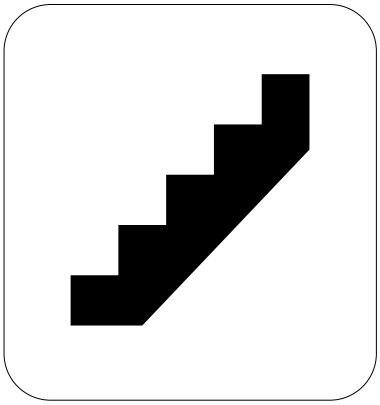
7. **Establish Documentation**: Maintain accurate records of each stage in the process



The 12 Steps of implementing the HACCP

The Seven Principles are implemented into the system through 12 Steps:

1. Assemble the HACCP team. Form a HACCP team with expertise in microbiology, food science, engineering, and quality assurance.



2. Describe the product.

3. Identify the intended use.

4. Create a flow diagram (Business Process Map).

5. Verify the flow diagram: Ensure the flow diagram accurately represents the entire process by reviewing it on-site with the production team

6. List all potential hazards associated with each step, conduct a Hazard Analysis and consider any measures [necessary] to control identified hazards (Principle 1).

7. Determine Critical Control Points (Principle 2).

8. Establish Critical Limits for each CCP (Principle 3). Define acceptable ranges (e.g., minimum cooking temperature). Consider scientific evidence, regulations, and industry standards.

9. Establish a monitoring system for each CCP (Principle 4).

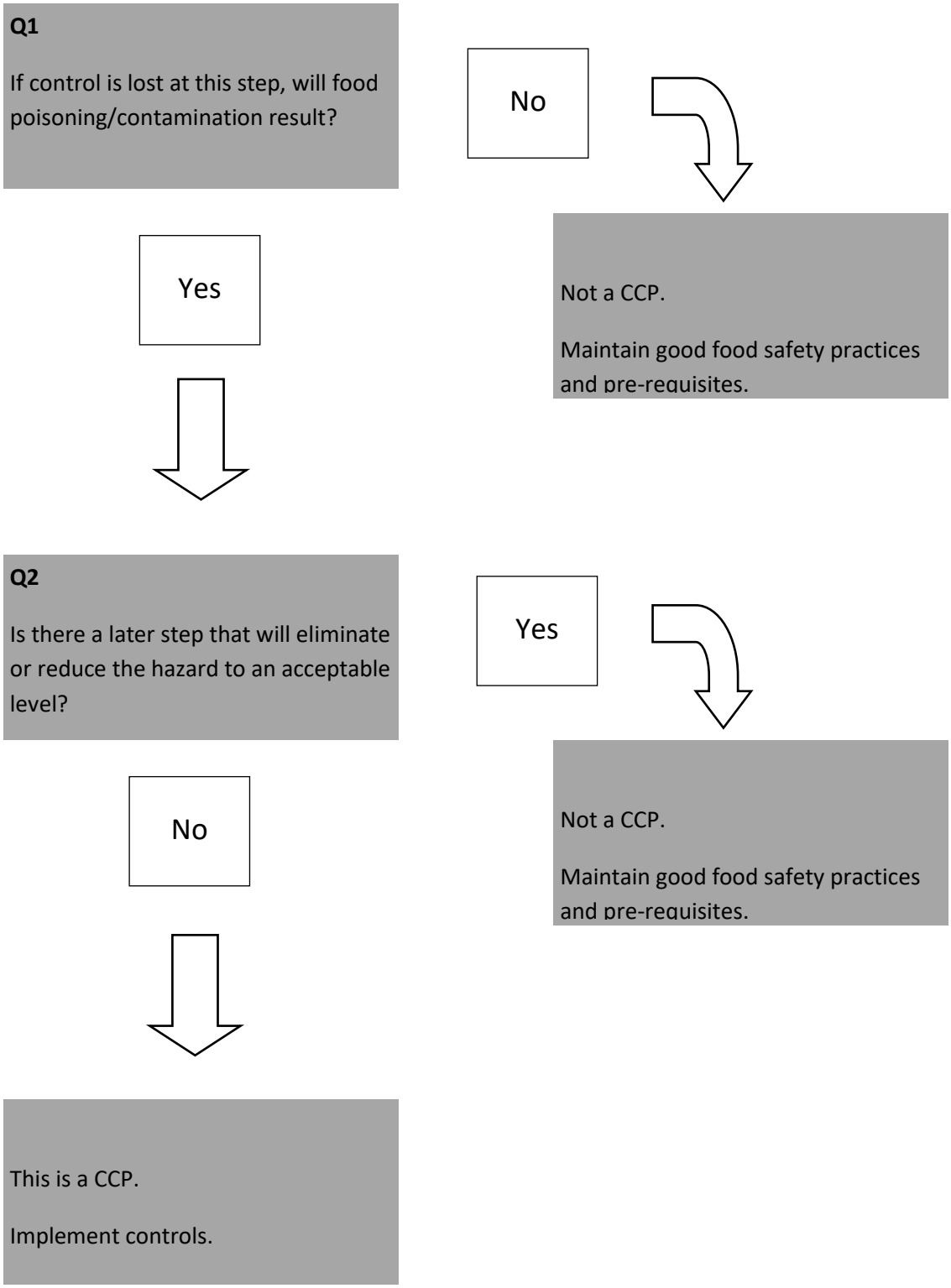
10. Establish Corrective Actions (Principle 5).

11. Establish verification procedures (Principle 6).

12. Establish Documentation and Record Keeping (Principle 7).

Simplified Decision Tree

A HACCP Decision Tree consists of a set of questions designed to arrive at conclusions of whether a step is a CCP or not. The questions involved in a HACCP decision tree are always answerable by a yes or no answer. However, if in doubt over the answer to a question, always assume the worst situation until you have evidence to say otherwise.



Threat Assessment and Critical Control Points

TACCP context

TACCP is concerned with food defence and with a focus on food tampering, intentional adulteration or contamination of food. TACCP builds upon the existing processes of HACCP in ensuring the safety of food products. HACCP is about managing food safety hazards in the food chain; TACCP aims to protect food products from deliberate contamination with the intention to cause harm. TACCP can be categorised under behavioural or ideological motivations.

TACCP implementation involves thinking like a potential attacker and examines vulnerability, likelihood, opportunities and an appreciation that intentional contamination requires human intervention. TACCP helps to proactively identify and manage control points in the supply chain that can be at risk of intentional contamination.

Aims of TACCP:

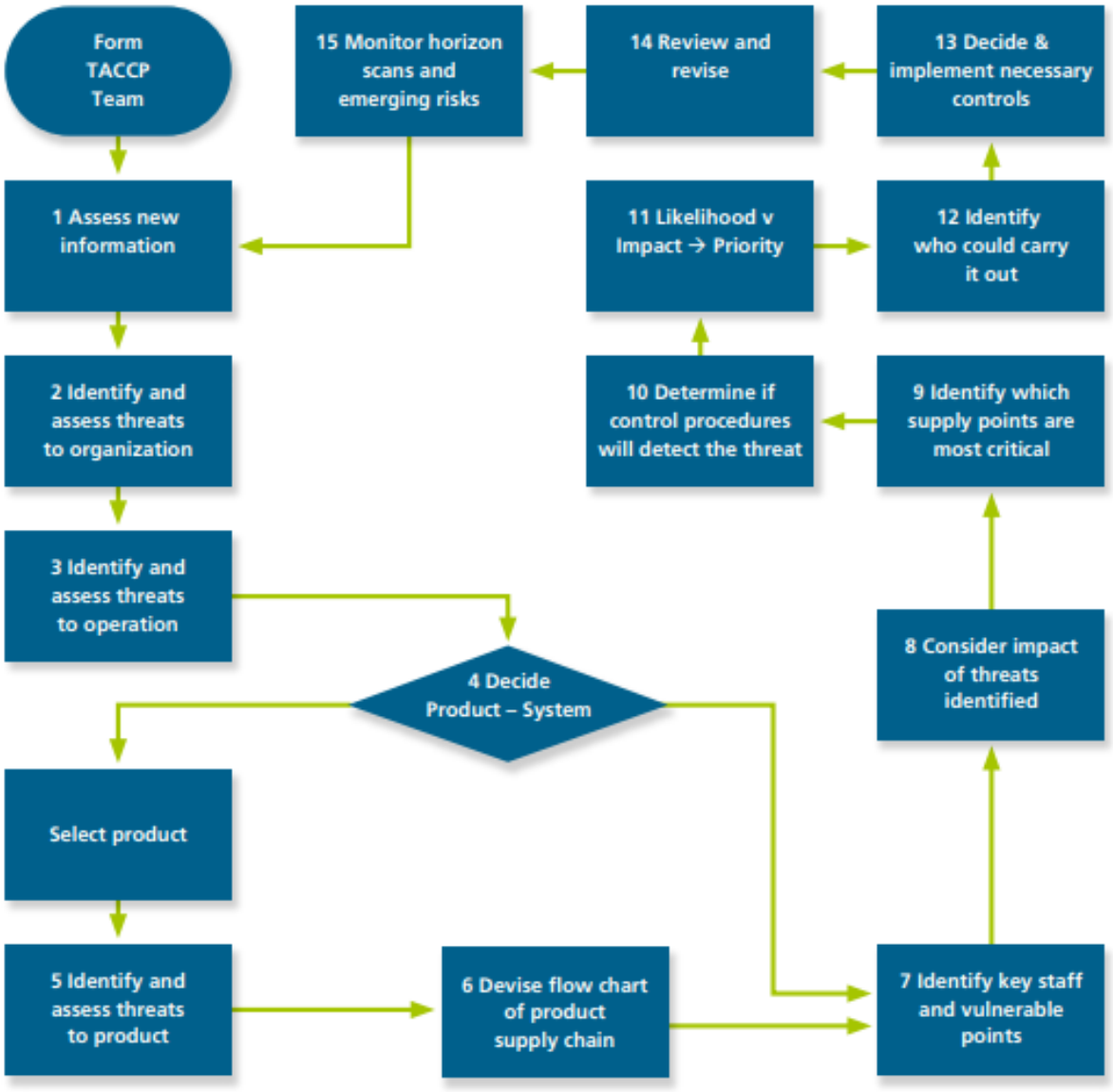
- Reduce the likelihood (chance) of a deliberate attack
- Reduce the consequences (impact) of an attack
- Protect organisational reputation
- Reassure customers, press and the public that proportionate steps are in place to protect food
- Satisfy international expectations and support the work of trading partners
- Demonstrate that reasonable precautions are taken and due diligence is exercised in protecting food

TACCP process

In most cases TACCP should be a team activity, as that is the best way to bring skills, especially people management skills, together. The TACCP team can and should modify the TACCP process to best meet its needs and adapt it to other threats as necessary to deal with four underlining questions:

- Who might want to attack us?
- How might they do it?
- Where are we vulnerable?
- How can we stop them?

Illustration of the TACCP process



Source: PAS 96/2017

Types of threat

Economically motivated adulteration (EMA)

EMA is intentional actions taken with food products to deceive consumers or gain economic advantage.

Article 8 'EMA Beef scandal'

Agriland
Phelan, 2017

Spanish police have arrested and charged 14 people with fraud, and breaching consumer rights, following accusations that a Spanish meat company has been selling low-quality beef burgers with incorrect labelling. Some burgers were found with under 25% beef content according to the authorities.

The meat processing plant, based in Burgos, Spain, labelled the products as containing a certain percentage of beef. In reality, the products had less beef content than was claimed, with pork, bread, fats or soy substituted instead, according to the Guardia Civil.

Evidence going back at least to 2002 was acquired by authorities that suggests quick-frozen beef products were being made by the company that sometimes contained under 25% actual beef.

The Guardia Civil, one of Spain's police forces, described the case as a major example of food fraud on a national level.

The police investigation into the fraud began in December 2015, when the Guardia Civil 'became aware' of potentially fraudulent activity on the part of the company, whose name has not been disclosed.

As part of the investigation, 3,000 documents were examined by authorities, and meat samples from multiple facilities of the company in question were analysed in laboratories.

The results of these tests showed that, contrary to labels showing beef as the main ingredient, a high percentage of burgers contained substitute ingredients.

The firm at the centre of the matter reportedly produces 'white-label' goods for other firms – for example, supermarkets, to distribute under their own branding. The police stated: 'The scope of marketing appears to be very high as the company manufactured white-label products that were distributed in the domestic market'.

The nature of the processed products (hamburgers, meatballs and so on) prevented the discovery of the deception prior to the operation, as analysis in a specialized laboratory would be needed to identify the fraud, the Guardia Civil said in a statement.

Considerable differences in price for beef and prices for the substituted materials purportedly gave an 'important economic benefit' to the company in question.

Malicious contamination

The intentional and illegal alteration or adulteration of products. For example, it can involve deliberately contaminating raw materials before they arrive on-site. It is a form of attack in which a product is contaminated deliberately with the intention of causing damage to a business, or harm to the consumer through illness or death.

Article 9 'Malicious attacks on food'

Safe to eat? Attacks on food and drink products
Croner-1, 2018

In 2005, a major British bakery reported that several customers had found glass fragments and sewing needles inside the wrappers of loaves of bread.

In 1984, the Rajneeshee sect in Oregon attempted to affect the result of a local election by contaminating food in 10 different salad bars, resulting in 751 people being affected by salmonella food poisoning.

In 2013, a major soft drinks supplier was forced to withdraw the product from a key market when it was sent a bottle which had had its contents replaced with mineral acid. The attackers included a note indicating that more would be distributed to the public if the company did not comply with their demands.

In 1990, a former police officer was convicted of extortion after contaminating baby food with glass and demanding money from the multinational manufacturer.

In 2008, a former tax inspector was jailed in Britain after being convicted of threatening to bomb the supermarket giant Tesco and contaminate its products.

In 2014, the Kenya Dairy Board warned that hawkers were putting lives at risk by adding preservatives (formalin and hydrogen peroxide) in a (probably futile) attempt to extend the shelf life of milk.

Extortion

The term extortion refers to the crime of obtaining money or property by using threats of harm against the victim, or against his property or family. Extortion might involve threats of damage to the victim's reputation, or to his financial wellbeing.

Article 10 'Extortion over baby food'

Farmer jailed for 14 years for blackmail and contaminating baby food

Living Magazines, 2020

A 45-year-old sheep farmer was yesterday (October 12) jailed for 14 years after being convicted of blackmail and contaminating specific ranges of baby food.

[…The farmer…] was unanimously convicted by a jury following a nine-day trial at London's Old Bailey on August 20. The court had heard how he selected jars of Heinz baby food from Tesco supermarket shelves, took them home and set about contaminating them with metal shards. He then returned a small number of the contaminated jars to stores and threatened that babies would be seriously or fatally injured unless he was paid £1.5m.

His blackmail plot involved three victim companies – Tesco, Heinz and Cow & Gate.

The jury heard that two mothers discovered metal shards in the baby food they were giving their little ones. Thankfully no babies were injured.

During the investigation products were urgently recalled and in total 42,000 jars of baby food were recovered. There was no evidence that further jars had been tampered with.

[…He…] was found guilty of three counts of blackmail and two counts of product contamination. He was also convicted of an unrelated offence of blackmail linked to a traffic dispute. The court heard how he tracked down a man he had been in a road rage incident with and sent him a threatening letter attempting to blackmail him into handing over £150,000 worth of Bitcoin.

During the trial Wright attempted to convince the jury that he had been forced to carry out the baby food blackmail plot by travellers who were threatening him but he was unable to provide any evidence to support his elaborate lie.

Jailing him His Honour Justice […described the farmer's…] action as 'repulsive' and said his threats were 'of a blood curdling nature'. He described his motive as 'grubby financial gain'.

He added: 'You were remorseless and revelling in the process.'

The Justice […] described […the farmer…] as being full of self-pity but lacking in empathy.

'The greatest mitigation you could have given was a guilty plea, instead you put forward an absurd and untenable case that fell apart under scrutiny,' he said.

‘You were prepared to and did put vulnerable children at risk of serious injury. The offending caused shock, distress and expense, but mercifully did not cause injury but that was down to luck rather than good judgement.’

For the blackmail and contamination offences relating to Tesco, Heinz and Cow & Gate, […the farmer… was jailed for a total of 11 years. For the separate blackmail offence relating to a road rage incident, […he…] was jailed for three years to run consecutively. He must serve at least half of his sentence in custody before being released on licence.

His Honour Justice [….] also commended the work of the legal teams, the patience and care taken by the jury and praised the work of the investigative teams.

[…]

Stretching across the country, the investigation – Operation Hancock – was the largest blackmail inquiry ever conducted in the UK and was also supported by specialist government departments – The Food Standards Agency, Food Standards Scotland, Public Health England, Public Health Scotland and Police Scotland.

Deputy Senior Investigating Officer […] from the Bedfordshire, Cambridgeshire and Hertfordshire Major Crime Unit said: ‘Throughout this investigation our primary focus was always to protect public from harm and bring the person responsible to justice.

‘’the farmer…] is a dangerous offender who gave no thought to the babies he could have harmed during his callous pursuit of money. He concocted an elaborate tale to try and cover his tracks, claiming he was being forced to carry out his crimes. The jury saw through his lies and found him guilty of all charges. […] now faces a long time in prison where he can think about what he has done.’

‘The contamination of baby food products resulted in a comprehensive, whole-system response from UK law enforcement; partners from across local, regional and national policing collaborated to identify and arrest Wright. The investigation was led by the Major Crime Unit and supported closely by teams from across the NCA. […]

Hertfordshire Assistant Chief Constable […], who led the inquiry, added: ‘I hope that the lengthy sentence handed down to […the farmer…] today acts as a deterrent to anyone who thinks blackmail is a viable criminal option. The police investigation was supported by a range of specialist government departments as well as the victim companies, who were highly responsive and operationally supportive. The resources available to law enforcement to respond to threats of this nature are significant and such crimes will simply not be tolerated.

Espionage

The activity of obtaining lawfully protected information about a company's business secrets through unlawful means.

Article 11 'Espionage, with design to steal corn technology'

Chinese woman charged in plot to steal U.S. corn technology

Gillam C, 2014 (Reuters)

A Chinese woman has been arrested and charged with trying to steal patented U.S. seed technology as part of a plot to smuggle types of specialised corn from farm fields in the U.S. Midwest for use in China, authorities said on Wednesday. The woman […] is married to the founder and chairman of a Chinese conglomerate that runs a corn seed subsidiary. She and her brother […] worked together and with others to steal the valuable corn seed from Iowa and Illinois, according to law enforcement officials. […]

[…]The others involved in the conspiracy include employees at U.S. seed companies who provided locations where experiments with the genetically altered seeds took place; or they provided gene sequencing information for the bio-engineered seeds, according to documents filed in U.S. District Court in the Southern District of Iowa.

[…] Two of the world's largest agricultural seed companies, have said they are cooperating with federal authorities in the ongoing probe. Both […companys…] develop and sell genetically altered seeds that are coveted by many farmers because they help farmers fight insect and weed problems, and can yield more in adverse growing conditions. But the seed technology is patented, and the seeds are higher priced than conventional seeds. The investigation began after […a company…] security staff detected suspicious activity in fields where the company was testing new types of seed and notified authorities.

Counterfeiting

The activity of making illegal copies of an item (or service)

Article 12 'Counterfeit vodka'

Counterfeit Glen's Vodka found in several locations across the UK

Gwynn S, 2015 (The Grocer)

Counterfeit bottles of […] Vodka have been on sale in several locations around the UK, the FSA has warned. The bottles, which were sold by independent retailers in London, the Midlands and north Scotland, can be identified by two mistakes on the labelling. The front label reads 'Produced and bottled in Scotland' while the rear label gives the Drinkaware website as 'DRINKAWARE.CO.UK'.

Similar bottles were seized in Luton in December. 'The Food Standards Agency continues to work with enforcement agencies across the UK to stamp out the trade in counterfeit alcohol,' said […] director of the FSA in Scotland.

[…], business development director at […the company…] said: 'In this instance, they seem to be focusing on […this company…], but it's an industry issue. Many brands are getting counterfeited, including our competitors.'

'We are working constantly with the FSA and the local councils on this,' he added. 'Every time we're alerted we cooperate with them on testing and so forth. As part of our general brand development, we are also updating our brands with bespoke bottles and embossing, which will help consumers clearly identify what is fake and what isn't.'

According to the Independent, […the…] Vodka was one of the brands found being produced as part of a major counterfeit vodka operation in Derbyshire last week, which was broken up by police as part of a Europe-wide operation. Officers discovered more than 20,000 empty bottles ready for filling, as well as a complex system to distil antifreeze for use in the counterfeit spirits.

In 2011, a man was convicted of using methylated spirits to formulate counterfeit Glen's Vodka. Shoppers who consume fake vodka are at risk of blindness and serious illness.

Cyber crime

A criminal activity that involves the targeting or use of a computer, a computer network or a networked device.

Article 13 ‘Food for fraud’

[…] Customers billed for unordered food

BBC, 2016

Customers of takeaway food app […] have had their accounts hacked and run up bills for food that they did not order, according to an investigation by the BBC's Watchdog programme. One user said that £200 was spent on burgers delivered to several addresses.
The firm said the hacks were carried out using passwords stolen in previous data breaches on other companies. One expert warned that the firm must improve security.

[…The company…] was launched in 2013 as a takeaway app, offering to find all nearby locations for users wanting to order food. It rapidly expanded to dozens of towns and cities across the UK.

[…A…] user […], from Reading, told Watchdog: ‘I noticed that I had a 'thank you' email from […the company…] for a burger joint in Chiswick. I thought that was really odd so I went on to my account and had a look and there had been four orders that afternoon to a couple of addresses in London.’

[…Another…] was charged £113.70 for chicken, waffles and chips that she did not order while […yest another…] was charged £98 for a delivery from TGI Friday which was 86 miles away from his home. All of them had their money refunded.

[…The company…] denied that any financial information had been stolen. ‘Customer security is crucial to us and instances of fraud on our system are rare, but where customers have encountered a problem, we take it very seriously,’ it said in a statement. It added: We are aware of these cases raised by Watchdog they involve stolen food, not credit card numbers. These issues occur when criminals use a password stolen from another service unrelated to our company in a major data breach.’

It urged customers to use ‘strong and unique passwords for every service they use’. But […a…] technology expert […] told Watchdog that Deliveroo could do more. ‘When we buy things online, the more hoops we have to jump through to complete that purchase, the more likely we are to go away and do something else instead.

‘[…The company…] realises that - so tries to remove as many of the hoops as possible. However, some of the hoops that […the company…] are removing are there specifically for security purposes. So while it may be making it easier for us to place orders, it is also making it easier for us to be defrauded.’

Threat Assessment Part 1- **Access**

Category	Criteria	Relevant? Y/N	What is the threat? (Brief Description)	Risk Rating (Likelihood x Severity)[14]
Premises	(A1) Access to people on business only			
	(A2) Vehicle parking outside perimeter			
	(A3) Premises zoned to restrict access to those with a business need			
	(A4) Visible and comprehensive perimeter fencing			
	(A5) Perimeter alarm system			
	(A6) CCTV monitoring/recording of perimeter vulnerabilities			
Vehicles	(A7) Monitored access points			
	(A8) Approach roads traffic calmed			
	(A9) Scheduled deliveries			
	(A10) Documentation checked before admittance			
	(A11) Missed deliveries investigated			

[14] **Risk Rating**. Values derived from own scoring matrix. See Appendix B 'Risk Rating'.

Category	Criteria	Relevant? Y/N	What is the threat? (Brief Description)	Risk Rating (Likelihood x Severity)[14]
People	(A12) Chip & PIN access control			
	(A13) Changing facilities, separate personal clothing from work wear			
Electronic systems	(A14) Routine monitoring and implementation of NCSC guidance			
	(A15) Penetration testing by external professionals			
	(A16) Routine training in cyber security principles (e.g. Cyber Essentials [29] or BS ISO 27000 series)			
Visitor screening	(A17) By appointment only			
	(A18) Proof of identity required			
	(A19) Accompanied throughout			
	(A20) Positive identification of staff and visitors			
	(A21) CCTV monitoring/recording of sensitive areas			

Category	Criteria	Relevant? Y/N	What is the threat? (Brief Description)	Risk Rating (Likelihood x Severity)[14]
Other aspects	(A22) Secure handling of mail			
	(A23) Restrictions on portable electronic and camera equipment			
	(A24) Limitations on access to mains services			

Notes:

Threat Assessment Part 2- **Tamper**

Category	Criteria	Relevant? Y/N	What is the threat? (Brief Description)	Risk Rating Likelihood x Severity)[15]
Detection	(T1) Numbered seals on bulk storage silos			
	(T2) Numbered seals on stores of labels and labelled packs			
	(T3) Effective seals on retail packs			
	(T4) Numbered seals on hazardous materials			
	(T5) Close stock control of key materials			
	(T6) Recording of seal numbers on delivery vehicles			
	(T7) Secure usernames and passwords for electronic access			
	(T8) Reporting of unauthorized access by cyber systems			

[15] **Risk Rating**. Values derived from own scoring matrix.

Category	Criteria	Relevant? Y/N	What is the threat? (Brief Description)	Risk Rating Likelihood x Severity)[15]
Pre-employment checks	(T9) Proof of identity			
	(T10) Proof of qualifications			
	(T11) Verification of contractors			
	(T12) More sensitive roles identified with appropriate recruitment			
Ongoing personal security	(T13) Staff in critical roles motivated and monitored			
	(T14) Whistleblowing arrangements			
	(T15) Temporary staff supervised			
	(T16) Individuals able to work alone			
	(T17) Favourable security culture			
End of contract arrangements	(T18) Access and ID cards and keys recovered			
	(T19) Computer accounts closed or suspended			
	(T20) Termination interview assesses security implications			

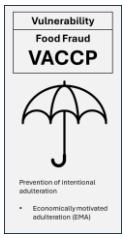
Category	Criteria	Relevant? Y/N	What is the threat? (Brief Description)	Risk Rating Likelihood x Severity)[15]
Other parties	(T21) Loss of internet			
	(T22) Hactivists DDOS attack			
	(T23) Phishing- Loss of commercially confidential information			
	(T24) Phishing- Leading to extortion			
	(T25) Theft of IP- Unauthorised access to company MIS			
	(T26) Activists- Attack on premises (Theft/Damage)			
	(T27) Activists- Attack on vehicles (Theft/Damage)			
	(T28) Activists- Attack on livestock (Harm/Theft)			
	(T29) Criminals- Attack on premises (Theft/Damage)			
	(T30) Criminals- Attack on vehicles (Theft/Damage)			
	(T31) Criminals- Attack on livestock (Harm/Theft)			

Threat Register

Threat # (RAG)[16]	**What is the threat?** (Brief Description)	**Defensive Action**	**Owner**	**Comment** (Update/Date Completed)

[16] **RAG**. Colour code: Red, Amber, green.

Vulnerability Assessment and Critical Control Points



VACCP context

VACCP is a risk assessment that helps identify and control vulnerabilities in the food supply chain that can be exposed to economically motivated food fraud. Unlike HACCP, which identifies all the potential hazards that can enter food unintentionally, VACCP is concerned with preventing food fraud, which is the intentional contamination of food during its production; usually carried out for economically motivated reasons.

Types of food fraud

Although there are many kinds of food fraud the two main types are:

The sale of food which is unfit and potentially harmful, such as:

- Recycling of animal by-products back into the food web
- Packing and selling of beef and poultry with an unknown origin
- Knowingly selling goods which are past their ‘use by’ date

The deliberate misdescription of food, such as:

- Products substituted with a cheaper alternative. For example, farmed salmon sold as wild, and basmati rice adulterated with cheaper varieties
- Making false statements about the source of ingredients, i.e. their geographic, plant or animal origin

How to spot the signs of food fraud

There are things that you need to look out for which could be an indication of food crime. It is important that all those working in a food business are made aware of these potential signs of food crime, and how to report any concerns.

- Increase in customer complaints such as a decline in the quality of products or a change in the taste.
- Products or ingredients you have purchased from suppliers do not match their description.
- Suppliers are not able to provide a traceability record for products.
- Testing that you have carried out indicates that there is an issue around the authenticity, origin, or quality of products that you have received.
- Inaccuracies in paperwork you have received regarding products that you have purchased. For example, the information provided on an invoice not matching the label on a product. This could be an indication of document fraud.
- A potential new customer or supplier using poor grammar and spelling across all business documentation such as emails, invoices, and the business website.
- Claims from suppliers which go against your own horizon scanning/knowledge of your sector and supply chains. For example, if a supplier has a large amount of an ingredient available for sale at a low price when your own research suggests that that ingredient is currently in short supply or commanding a higher price than usual.
- Prices that appear too good to be true could be an indication of fraud. For example, exclusive offers and discounts on products that are currently hard to get hold of or hold a higher price.
- Staff within the businesses acting in a defensive manner and not willing to share duties or information or attempting to maintain sole control over systems.
- Unusual cash transactions within the business.

Source: Food Standards Agency

Article 14 ‘Beef falsely labelled’

Food fraud probe into beef falsely labelled as British

Jordan and Simpson, 2023 (BBC)

The National Food Crime Unit (NFCU) is investigating potential food fraud involving pre-packed sliced beef which was labelled as British but came from South America and Europe.

A supermarket in the UK has been forced to remove products from its shelves.

The unit has declined to name the retailer or the supplier of the meat.

[…] The deputy chief of the NFCU, said it was not a food safety issue but a matter of food fraud, which it takes very seriously.

The products include pre-packed sliced beef and deli products.

[…He…]: ‘The retailer was notified on the same day that we took action against the food business suspected of the fraud and immediately removed all affected products from their shelves.

‘The retailer continues to work closely and cooperatively with the NFCU investigation to progress the case against the supplier. This is not a food safety issue but a matter of food fraud.’

The BBC has contacted UK supermarkets for comment. […Major supermarkets have…] said they are not the retailer that had been supplied with the beef.

[…One…] commercial director, said: ‘We know each and every farmer that produces our […company…] beef. At […the company…], higher welfare means higher welfare and British means British. These standards are fundamental to our make-up and this will never change.’

The investigation - codenamed ‘Operation Hawk’ - was made public in December by the Food Standards Agency, which is the parent body of the NFCU.

At the time it said it was looking into the directors of a company which sold large volumes of pre-packed meat to UK supermarket retailer ‘who pride themselves on only selling British products’.

However, it did not disclose details of the probe, including what type of meat was in question.

Some trade associations told Farmers Weekly magazine, external, which revealed that beef was at the centre of the investigation, they were disappointed that it had taken until now for some facts to be released.

A spokesman for the Association of Independent Meat Suppliers, said: ‘It is only today that we have found the product concerned is beef, and it is our belief, given the popularity of sliced cooked beef across all trade channels, that its sale by food fraudsters will not have been limited to a single supermarket.

‘The NFCU's current play book has the potential to damage UK overseas trade simply by their policy of a lack of transparency and industry engagement.’

The NFCU's […spokesperson…] said: ‘Any fraud investigations of this nature take time to go through evidence and bring to any outcome, including any potential prosecution.

‘We take food fraud very seriously and are acting urgently to protect the consumer.’

Notes:

Article 15 ‘Falsified Salmonella testing certificates’

FSA’s National Food Crime Unit investigation results in a £50,000 fine for food business which faked disease certificates

Food Standards Agency, 2024

A food business owner has been fined following a successful prosecution by the Food Standards Agency (FSA). An investigation by the FSA’s National Food Crime Unit, working with Heart of the Southwest Trading Standards, found evidence he had falsified Salmonella testing certificates.

[A] poultry farmer [...] received a substantial fine […] after pleading guilty to various offences under The Food Safety and Hygiene (England) Regulations 2013 and the Animal Health Act 1981.

The FSA, working with partners including Avon and Somerset police, Environmental Health and Trading Standards, executed a search warrant at the poultry farm and abattoir in November 2023 and found evidence of traceability concerns and that [the company] had falsified Salmonella testing certificates. This meant birds had been slaughtered for the food web without proof they were free from disease.

The Animal and Plant Health Agency supported the investigations, monitoring the welfare of the poultry on site and collecting official Salmonella samples. The FSA acted to manage the potential food safety risk by ensuring products with traceability concerns were removed from the market.

An alert was also issued to industry by the FSA’s NFCU to ask food businesses to check the traceability of their suppliers to help ensure legitimate businesses maintain the integrity and safety of their food webs and protect their customers.

[…The company…] was sentenced to a fine of £5000 for each FSA offence, £3500 for each local authority offence, costs amounting to £21,810.75, plus a victim surcharge of £2000, which came to a total of £50,830.75.

Vulnerability Assessment

Document #: **Version**:	**Ingredient**:		
Issue Date:	**Review Date:**	**Owner:**	**Authorised**:

Create a separate VACCP for each ingredient.

Topic	Criteria	Yes / No	Comments / Actions
Supplier	(V1) Did you put the supplier through an approval process? Do they have robust precautions and traceability measures in place?		
	(V2) Do you have a good partnership with them? How long have you been using them for?		
	(V3) Are they trusted within the industry?		
	(V4) Have there been any past incidents of food fraud in relation to this supplier?		
	(V5) Consider the company's current business situation. Are they experiencing any financial difficulties?		
Ingredients	(V6) Has the ingredient been previously frauded? (counterfeiting)		
	(V7) Is it considered valuable or have a high profit margin?		
	(V8) Has it been processed? E.g. into a different form such as a powder.		
	(V9) Does the ingredient's physical state increase its vulnerability?		
	(V10) Has the ingredient been previously substituted?		
Industry Pressures and External Influences	(V11) Is the ingredient in high demand?		
	(V12) Is the ingredient used in several different products and businesses?		
	(V13) Has the market price of the ingredient suddenly increased?		
	(V14) Does demand exceed supply?		
	(V15) Has there been a considerably poor harvest due to weather etc.?		

Vulnerability Register

Vulnerability # (RAG)[17]	**What is the Vulnerability?** (Brief Description)	**Preventative Action**	**Owner**	**Comment** (Update/Date Completed)

[17] **RAG**. Colour code: Red, Amber, green.

Food Safety Legislation

Examples of food crime

Theft. Examples may include the theft of livestock or goods in transit. Although theft is a matter for the police, the National Food Crime Unit do hold an interest in how stolen food products enter the food supply chain.

Unlawful processing. Examples of unlawful processing may include the slaughter of stolen livestock in a warehouse or private residence. The slaughter of animals and processing of products of animal origin must be carried out at an approved premises, in an approved manner and by an individual with the correct license. This is to ensure that animal welfare and food safety standards are met and that there is a full record of traceability.

Waste diversion. Food products that have been, for whatever reason, marked for disposal then entering the legitimate food web. This may include the diversion of animal by products into the supply chain or consignments of food that have been rejected and deemed unfit for human consumption entering the supply chain.

Adulteration. Examples may include adding water to fruit juice or peanut powder to almond powder without informing customers. Forms of adulteration may also include the addition of non-food items to ingredients.

Substitution. Examples may include replacing lamb with goat or authentic vanilla with synthetic vanillin.

Misrepresentation. Examples may include saying that something is organic, free range, Halal, Kosher or produced in the UK when it is imported from overseas.

Document fraud. Examples may include a document which falsely states the movement of livestock, traceability of a food product, forged import documents or a fake certificate attempting to prove any claims such as organic certification.

Source: Food Standards Agency

Types of legislation

EU legislation has been included due to it remaining relevant (in the UK) since the UK's departure from the EU.

- **Act**. a legal text that creates a new law or modifies an existing one. Once it has successfully gone through established processes, an Act is passed by the Parliament.

- **Regulation**. Delegated powers, made by an appropriate Minister under a specific Act; usually provides greater detail.

- **Local Act/Bylaw Orders**. Adopted/made by a Local Authority and only applicable in the Local Authority's own area.

- **Code of Practice**. Not legally binding but may be considered when arriving at a decision.

- **Industry Guides to Good Practice**. Sector-specific guidance on operations.

- **Enforcement Codes of Practice**. Guidance for enforcement officers. Produces uniform standards of enforcement.

- **EU Directives**. A legal act adopted by the EU institutions and addressed to the EU Member States. It sets out a specific objective to be achieved, but unlike a regulation, it does not apply directly at the national level. Instead, each member state must transpose the directive into its own national law within a specified deadline.

- **EU Regulation**. A legal act defined on the Functioning of the European Union. Regulations have general application, are binding in their entirety, and are directly applicable in EU Member States. Unlike directives, which require transposition into national law, regulations become immediately enforceable as law across all member states simultaneously.

- **Case Law**. Refers to the body of law established through judicial decisions in previous cases. Rather than being based on constitutions, statutes, or regulations, Case Law relies on precedents- detailed facts and outcomes from legal cases resolved by courts or similar tribunals.

Food safety regulations

Up-to-date information on legislation and regulations surrounding Food Safety can be found at the following links (Internet required).

Food Standards Agency- Key Regulations

The Food Safety and Hygiene (England) regulations 2013 (as Amended)

The Food Hygiene (England) Regulations 2006

Food Safety- Your Responsibilities

Registration of a food business

Most food businesses need to register if operating more than five days in five consecutive weeks. The business must register with the Local Authority. Registration is free and not refused.

Some businesses will need approval. These include businesses concerned with:

- Meat and meat products
- Eggs
- Milk and dairy products
- Fish and fish products

Food law offences

- **Summary offence**. Dealt with by Magistrates Courts. Punishment is a fine or up to six months imprisonment, or both.
- **Indictable offence**. Reserved for serious crimes. Usually tried by a Judge and Jury and stiffer punishments may be awarded- a fine or up to two years imprisonment or both.

Environmental Health Officers

Environmental Health Officers (EHOs) play a crucial role in safeguarding public health. Their primary aim is to protect people from health, safety, and environmental risks. EHOs can be employed by both the public and private sectors, including local councils, the NHS, and the armed forces. Their responsibilities include:

- **Inspections**. EHOs inspect various premises to ensure they operate safely, maintain hygiene standards, and comply with relevant legislation. They focus on areas such as food safety, health and safety, and the environment.
- **Food Safety**. Most EHO roles are food-based. EHOs prevent harm from poor hygiene and food safety risks, such as food poisoning.
- **Complaints and Investigations**. EHOs follow up on complaints related to foodborne illness, infectious diseases, pest infestations, pollution, and housing standards.
- **Powers**. EHOs issue 'Notices'. The Courts issue 'Orders'.
- **HIN**. Hygiene Improvement Notice.
- **HEPN**. Hygiene Emergency Prohibition Notice.
- **Court Order**. Hygiene Prohibition Order.
- **Collaboration**. They work with colleagues, business owners, employees, and external stakeholders to address health and safety concerns.
- **Administrative Work**: EHOs write reports and carry out administrative tasks.

The role of the EHO in food poisoning investigations

The role of the Environmental Health Officer (EHO) in food poisoning outbreaks is to:

- Obtain samples of suspect food
- Trace the origin of the contaminated food
- Check procedures and management systems
- Investigate the premises
- Swab work surfaces
- Check the condition of equipment
- Check the storage of chemicals
- Ascertain the organism responsible for the outbreak
- Establish if the illness is food poisoning[18] or food-borne[19]
- Interview staff to determine if they have had symptoms, what their role is and their involvement in the preparation of food (including the method)
- Obtain faecal specimens
- Isolate affected staff (to ensure the illness cannot be passed on
- Trace persons who may have consumed the suspect food
- Obtain specimens from persons who have consumed the suspect food
- Make recommendations to prevent recurrence
- Take legal action as necessary

A food-borne illness refers to any disease or infection caused by consuming contaminated food or beverages. These illnesses can result from bacteria, viruses, parasites, or chemical substances present in the food. Common examples include salmonella, E. coli, norovirus, and listeria. Proper food handling, storage, and hygiene are essential to prevent such illnesses.

[18] **Food Poisoning.** Refers specifically to an acute illness caused by consuming contaminated food.

[19] **Food-Borne Illness.** A broad term that encompasses any disease resulting from consuming contaminated food or beverages; Usually caused by bacteria. Includes not only acute poisoning but also infections caused by parasites (e.g., Giardia) or chemical contaminants (e.g., heavy metals).

Article 16 ‘The cost of food crime’

The Cost of Food Crime
Food Standards Agency, 2020

Background

The Food Standards Agency (FSA) has a statutory duty to protect public health from risks which may arise in connection with the production, supply and consumption of food. Our strategic ambitions– against which we measure our impact – include that ‘food is safe’ and is ‘what it says it is’. Food crime is defined as ‘serious fraud and related criminality within food supply chains that impacts the safety or the authenticity of food, drink or animal feed. It can be seriously harmful to consumers, food businesses and the wider food industry.’ Protecting consumers from food crime is a priority in achieving the FSA's goals and therefore, a solid evidence base to track progression is vital.

The main issue with existing estimates of the cost of food crime is the disparity in what should and should not be included in the calculations. This project aims to bring clarity to this confusion by building a framework to calculate the cost of food crime that aligns with the FSA's definition of food crime.

[…]

Results

An economic framework was developed for estimating the economic cost of food crime which uses:

> **Victim costs**: Direct economic losses suffered by crime victims, including medical care costs and lost earnings.
>
> **Criminal justice system costs**: Costs of anti-food crime activities, legal and adjudication services, and corrections programs including incarceration.
>
> **Crime career costs**: Opportunity costs associated with the criminal’s choice to engage in illegal rather than legal and productive activities.
>
> Intangible costs: Indirect losses suffered by crime victims, including pain and suffering, decreased quality of life, and psychological distress.
>
> **Market costs**: Loss of profits for genuine firms.

[…]

Source: Food Standards Agency ‘The cost of food crime’.

Glossary

Allergic response. An individual immunological reaction to certain substances. With symptoms usually unlike bacterial food poisoning symptoms, but occasional similar.

ATP. An acronym used to refer to the general equation for aerobic respiration.

Aw (Available Water). Water that is not bound to another property.

Bactericide. A substance which destroys bacteria.

Cleaning. The process of removing soil, food residues, dirt, grease and other objectionable matter. Cleaning is the systematic removal of accumulated and unwanted matter.

Contamination. The occurrence of any objectionable matter in the product. Types of contamination include physical, biological, chemical.

Controls. Measures put in place to reduce or eliminate a hazard.

Corrective Action. Any procedure applied when a Critical Limit is exceeded (during food production). The Critical Limits represent the acceptable levels of identified food safety hazards at specific Critical Control Points (CCPs). When deviations occur, Corrective Actions are taken promptly to address the Root Cause and bring parameters back within acceptable limits.

Cyber Security. Protection of devices, services and networks and the information on them, from theft or damage.

Critical Control Point (CCP). A point or step in the process at which a hazard, if uncontrolled, may result in harm to the customer.

Critical Limit (CL). A specific range of maximum and minimum values used as a reference for controlling a Critical Control Point (CCP).

Cross-contamination. The transfer of harmful micro-organisms or allergens from one surface or food product to another.

Detergent. Chemical, or mixture of chemicals that helps to remove dirt and grease.

Disinfectant. A chemical that achieves disinfection.

Disinfection. Reduction of micro-organisms to a level where they will not cause harm to food or consumers.

Food Defence. Procedures adopted to assure the security of food and drink and their supply chains from malicious and ideologically motivated attack leading to contamination or supply disruption.

Food Fraud. Dishonest act or omission, relating to the production or supply of food, which is intended for personal gain or to cause loss to another party.

Food Hygiene. All measures necessary to ensure the safety and wholesomeness of food through all stages of the food-chain. This includes initial preparation, processing, storage, transportation, distribution and offering for sale to the customer.

Food-borne illness. The general term for illness linked to food. Such illnesses may be caused by ingestion of poisonous foods such as plants, fungi, fish and food contamination.

Food-borne disease. An illness caused by micro-organisms such as bacteria and viruses, which use food as a vehicle to move to humans where they can multiply and produce symptoms.

Food Contamination. Food can be contaminated in a number of different ways:

Pathogenic bacteria, or their toxins

Chemical, including metals

Viruses

Micro-toxins

Other agents; for example, protozoa and parasites

Food poisoning. An acute illness caused by the consumption of food contaminated by bacteria, other microbes such as viruses, or chemical contaminants, resulting in abdominal pain with or without diarrhoea.

Flow diagram. A schematic representation of a process, structure, organisation etc.

Gastro-enteritis. Inflammation of the stomach and intestine, which could cause vomiting, abdominal pain and diarrhoea.

HACCP. Hazard Analysis and Critical Control Point. A formalised and documented food safety system. HACCP is a systematic preventive approach to food safety that addresses biological, chemical, and physical hazards in production processes.

Hazard. Any biological, chemical or physical agent, (found in food), that has the potential to cause harm, injury or illness.

Healthy carriers. People who apparently have not been ill but excrete specific pathogenic organisms which may contaminate food. Can be detected by faecal specimens. Especially dangerous in food handlers.

High Risk Foods. Foods which provide favourable conditions for the multiplication of pathogenic bacteria and are intended for consumption without further cooking etc. Usually proteinaceous. For example, cooked meat or poultry, milk and milk products, cooked eggs, shellfish, cooked rice, mayonnaise. Storage under refrigeration required.

Mycotoxins. Toxic compounds produced by certain types of Molds (fungi) that can contaminate food and pose serious health risks to humans and animals. Here are some key points about mycotoxins

Onset / Incubation period. The period between infection (consumption of food) and the first signs or symptoms of the illness. 'Onset' normally refers to toxic food-borne illnesses, while 'incubation' normally refers to infective food-borne illnesses.

PAS. Publicly available Specification.

Pathogen. Disease producing organism

Risk. The likelihood of a hazard being realised.

Risk Assessment. A formalised and documented method of estimating the likelihood of a hazard occurring and the severity of the event.

Root Cause Analysis (RCA). A method of (structured) problem-solving that helps identify and understand the true cause of an event.

Routes. The path along which bacteria are transferred to high-risk food.

Sanitiser. A chemical that both cleans and disinfects.

Source. Where the bacteria (including food poisoning bacteria) are usually found. People: Hands, nose, mouth, skin, boils, cuts, intestines; Raw food, especially meat; Fish, shellfish, eggs, milk, water supplies; Fruit and vegetables; Dust and soil; Insects, rodents, animals and birds.

Sterilisation. A process that destroys all living organisms.

Surfactancy. The ability of a substance to reduce the surface tension between two phases, such as two liquids, a liquid and a gas, or a liquid and a solid.

TACCP. Threat Assessment and Critical Control Points. TACCP is a focus on food defence, specifically addressing intentional tampering, adulteration, or contamination of food.

Toxin. Poison produced by pathogens.

VACCP. Vulnerability Assessment and Critical Control Points. A food safety programme that helps identify and control vulnerabilities in the food supply chain, specifically related to economically motivated food fraud

Vehicle. Something that transfers bacteria from the source to high-risk food; for example, hands, cloth and equipment, hand-contact surfaces, food-contact surfaces.

Appendix A 'Toolbox Talk' template

TBT #	**Title**		
Date/Time	**Time**	**Location**	**Department**
Equipment/Stores			
Safety/Health/Environment/Quality Factors			
Food Safety Factors			
Outcome (What will be achieved after the session)			
Key Learning Points (KLPs) (Enablers of the Outcome)			
Topic 1 (Delivery content)			
Topic 2			
Topic 3			

Facilitator:_____**Initials**:_____**Date**:_____

Appendix B 'Risk Rating' template

Risk Rating Matrix

Impact → Likelihood ↓	Insignificant 1	Minor 2	Moderate 3	Major 4	Severe 5
Almost Certain 5	5 Moderate[20]	10 Moderate	15 High	20 High	25 Critical
Likely 4	4 Low	8 Moderate	12 High	16 High	20 High
Possible 3	3 Low	6 Moderate	9 Moderate	12 High	15 High
Unlikely 2	2 Low	4 Low	6 Moderate	8 Moderate	10 Moderate
Rare 1	1 Low	2 Low	3 Low	4 Low	5 Moderate

Definitions:

1. **Impact**:

    - **Insignificant (1)**: No significant impact on operations
    - **Minor (2)**: Small impact, easily managed
    - **Moderate (3)**: Noticeable disruption
    - **Major (4)**: Significant impact, possible harm
    - **Severe (5)**: Critical impact, possibly catastrophic

2. **Likelihood**:

    - **Rare (1)**: May happen once in 10 years
    - **Unlikely (2)**: Could happen once in 5 years
    - **Possible (3)**: May happen once in 2-3 years
    - **Likely (4)**: Could happen annually
    - **Almost Certain (5)**: Likely to occur multiple times a year

Risk Levels:

- **Low (1–4)**: Acceptable risk, minimal action required
- **Moderate (5–10)**: Requires monitoring and possibly mitigation
- **High (11–20)**: Immediate action to reduce risk
- **Critical (21–25)**: Requires urgent and significant action

[20] 'Almost Certain' and 'Insignificant' are potential timewasters that may adversely affect the operation and so should be anticipated and mitigated for.

Notes: