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Food hygiene and safety

Course handout

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Course code according to the training framework

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Food hygiene and safety are fundamental disciplines in food science and technology, aiming to ensure the safety of food products and protect consumer health. With the increasing complexity of food production, processing, storage, and distribution systems, mastering food hygiene principles and food safety management tools has become an essential competency for future professionals in the agri-food sector.

This course handbook has been prepared for third-year Bachelor's in Food Technology and Quality Control. It provides the scientific and technical foundations necessary to understand the various hazards that may affect food products and the preventive measures required to ensure their safety throughout the food chain. Upon successful completion of this module, students will be able to:

- Identify key principles of food hygiene and safety.
- provide principles and guidance on the application of GHPs applicable throughout the food chain to provide food that is safe and suitable for consumption.
- provide guidance on the application of HACCP principles;
- provide the basis on which sector and product-specific codes of practice can be established.
- Explain the importance of proper sanitation practices in food safety.
- Analyze hazards within the food handling process and establish control measures.
- Evaluate food safety protocols in different environments.

This handbook is designed to support students in developing the knowledge and skills required for professional practice in the fields of food technology, quality control, and food safety, while promoting a scientific and preventive approach to ensuring the safety and quality of food products.

Introduction

Hygiene and food safety are essential aspects of our daily lives. They are essential to ensure the safety and quality of the food we eat. This is because improper handling or preparation of food can lead to foodborne illnesses and endanger our health. That's why it's important to understand and apply good hygiene and food safety practices. This course explores the fundamentals of food hygiene and the preventive measures needed to preserve the health of all consumers.

Food hygiene and safety are essential aspects of our daily lives. Indeed, we are all likely to consume food at various times during the whether at home, at work or in a restaurant. This is why it is essential to ensure that these foods are prepared and handled under sanitary conditions in order to avoid any risk to our health.

Food hygiene encompasses various aspects such as the cleanliness of the premises, the equipment used (kitchen utensils) and manipulators' hands, as well as compliance with the standards of preparation, preservation and transport of food. Food security, on the other hand, aims to prevent the risk of contamination of food by the different types of hazards in implementing control measures and complying with the regulations in force.

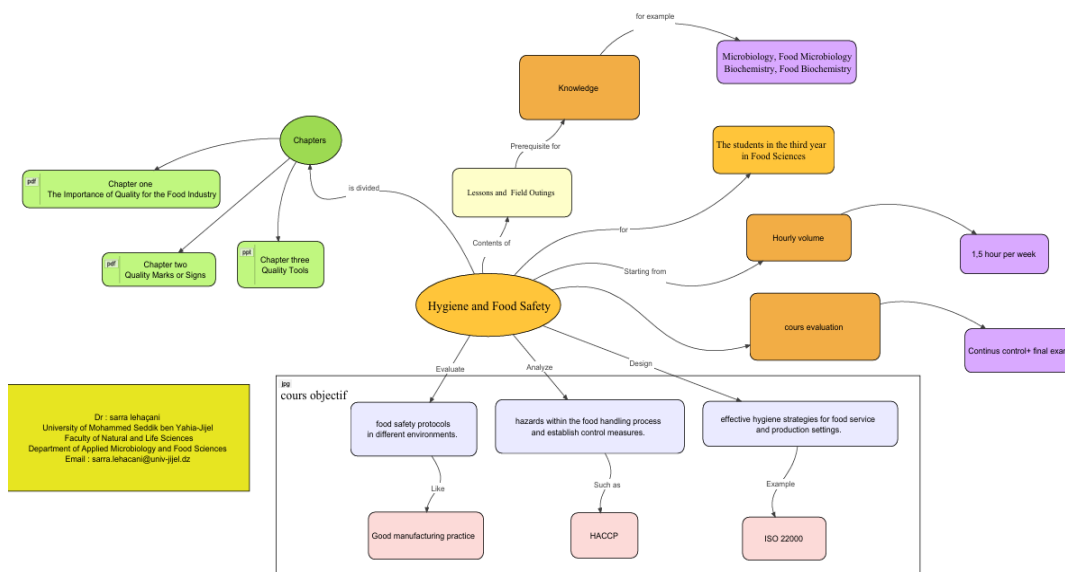


Figure 01: Conceptual map course

Chapter 1: What is called quality

Introduction

In the food sector, quality is an age-old and recurring concern that continues to be at the forefront of consumer worries. The term quality for food products encompasses different components: nutritional quality, safety, and sensory attributes (taste). Therefore, the food industry operates within these three essential dimensions of quality:

1-Nutritional quality

The nutritional quality of a food is its ability to meet the daily needs of individuals. It is important because, depending on a person's nutritional habits, it can lead to diseases such as obesity, diabetes, hypertension, and cancer. In France, the nutritional values table is mandatory on all prepackaged foods. The nutritional quality of foods can be assessed based on their content of various elements such as fats, saturated fatty acids, proteins, free sugars, fibers, vitamins, etc. To improve the nutritional quality of foods and catering, it is recommended to encourage transnational, national, and local food and catering distribution services to enhance the nutritional quality of their products.

2-Safety

Food safety is a concept that encompasses the preparation, handling, and storage of food in a way that avoids foodborne illnesses. Foodborne illnesses are caused by bacteria, viruses, parasites, or harmful chemicals present in contaminated food. Symptoms can range from diarrhea to cancer. Therefore, it is important to take measures to ensure food safety. This can be achieved through effective collaboration between governments, producers, and consumers.

3-Sensory attributes

Sensory attributes are characteristics of a product that can be perceived by the senses, such as appearance, color, flavor, texture, and taste. Sensory attributes are evaluated by trained panels

of experts who use a standardized vocabulary to describe the sensory properties of a product. Taste refers to the perception of the sensory cells in your taste buds. When food compounds activate these sensory cells, your brain detects a taste, like sweetness. Odor comes from your sense of smell.

1-What is called quality?

Quality is not just a matter of common sense, tools and techniques. It is a mindset, a change approach and a method that involves all stakeholders in the company. This requires collective awareness and a continuous evolution of the internal culture of the organism. Quality is the ability to meet customer requirements, which can be explicit or implicit.

The quality is: Process performance, operation and organization to improve productivity and more broadly drive operational excellence in private and public organizations.

Quality is therefore not what we believe to put or recognize in a product or service, but what the customer finds in it and why he is willing to pay. The excellence of products and services to satisfy increasingly demanding customers and conquer new markets (especially in export).

1-1-Full definition of Quality by AFNOR and ISO

Quality is the ability of a product to satisfy its users. The set of properties and characteristics of a product or service that enables it to meet the explicit or implicit needs of all users.

AFNOR: AFNOR stands for French Association of Standardization. Founded in 1929, the French Association of Standardization is the official organization in charge of standards in France. Since 2004 and its merger with the French Agency for Quality Improvement and Management (AFAQ), it is affiliated with the AFNOR group that operates in the fields of standardization, certification, and training.

The International Organization for Standardization (ISO): The International Organization for Standardization (ISO) is an international nongovernmental organization made up of national standards bodies; it develops and publishes a wide range of proprietary, industrial, and commercial standards and is comprised of representatives from various national standards organizations.

2-Strong challenges for companies and organizations

Beyond the price, the quality of the products and the services that accompany them are the real criteria for competitive differentiation. Quality, cost, timing, three constraints that must mobilize any organization around three inseparable issues:

1. **Commercial:** satisfaction of customers;
2. **Human:** Motivate all employees towards the same goal.
3. **Economic:** economic performance of the organization.

The European system is one of the strictest in the world in terms of health, consumers are increasingly demanding the quality of health products. the progression of the prevalence of obesity and overweight has strengthened consumer demands on nutritional aspects and on taste! This is the main criterion for consumers to make purchases.

Today, in the food sector, quality is therefore an essential and a determining element of consumer choices.

3- Quality of food

For millennia, and still now in many countries, the goal of farmers and livestock farmers was to produce as much as possible: In the event of shortage or famine, the target was quantity. But in Europe and North America, agriculture has been so “successful” that the supply is

overwhelming: too much is produced. Producers and processors, therefore, aim for the quality, demanded by consumers.

3-1-Components of Quality

The concept of quality is characterized by:

1. Its subjectivity: Quality is appreciated differently by individuals.
2. Relativity: Customer's use of the product determines its quality.
3. Its measurability: Quality has multidimensional characteristics that remain measurable.

There are three (03) approaches: The quality control, the quality assurance and total Quality Management (TQM).

The following components must be observed: Eight components of food quality

4 S + 2 R + T + E \longrightarrow **SSSS RR T E**

The Four S: Safety (Hygienic), Safety (nutritional), Savor (organoleptic) and Service (usage).

2R: Regularity and reverie

T: technology and **E:** Ethics

3-1-1- Safety (hygienic quality) they want less danger

We don't want food to bring "bad things," it makes us sick.

What can make a person sick in food? Microbes (e.g. salmonella, hepatitis viruses) or their toxins, toxic substances (eg: heavy metals, pesticides), normal components in excess (eg : salt, lipid), normal component unsuited to a particular consumer (e.: lactose intolerant, peanut allergic). The control of food safety, hygienic quality is the subject of all courses of hygiene (e.g. HACCP and hygiene in food industry).

For many years, agri-food industries have implemented various tools to ensure:

- the market release of products with optimal hygienic quality:
- raw material inspections upon receipt,
- in-process production checks,
- finished product assessments,
- supplier audits,
- HACCP (Hazard Analysis and Critical Control Points) systems, good hygiene practices,
- increasingly efficient traceability systems, and so on.

3-1-2- Health (Nutritional Quality) they want more benefits

We want food to provide "goodness," to be nutritious, and to maintain and improve our health. This primarily concerns major nutrients (lipids, carbohydrates, proteins) and minor nutrients (vitamins and minerals).

New demands have emerged regarding useful non-nutrients (fibers, omega-3 fatty acids, polyphenols, trace elements) or substances presumed to be beneficial (probiotics, "functional foods"...). Nutritional balance comes from the overall diet, meaning all foods consumed over an extended period. The nutritional quality of a single food item doesn't convey much on its own. There is no ideal food; the ideal is to vary the foods we consume.

The first two components of quality, safety, and health are invisible. They involve invisible aspects such as the absence of contaminants, harmful microbes, or toxins in food (safety) as well as the nutritional benefits and long-term health impact (health). These components require rigorous checks and strict standards from regulatory authorities and producers to ensure the safety and quality of the food products that consumers purchase and consume.

The consumer must "trust" the seller, and the seller, in turn, must trust the producer. That's why distributors enforce sanitary (safety= hygienic quality) quality standards. It's also why the law intervenes to ensure consumer protection: the hygienic quality of food is mandatory for the agri-food industry (under the regulations of the Hygiene Package).

The next two components, Savor, and service are aspects that the consumer can perceive directly.

3-1-3- Savor (organoleptical quality) we want to enjoy the taste

We aim to satisfy all five senses (not just taste!). This quality often influences the first two components: sometimes we intoxicate ourselves because we enjoy it (e.g., alcohol); we disrupt our diet due to excess or lack of taste (e.g., excessive fats and sugary drinks).

Organoleptic quality has a significant sensory component, measurable through sensory analysis (appearance, color, flavor, texture, and taste.) (objectified by a panel of experts), but it also has a psychological and social component (the Reverie).

3-3-4- Service (usability quality= Quality of Use) we want it to be convenient

(comfortable)

A healthy, complete, and delicious food item won't sell if it's too expensive, hard to find, difficult to prepare, or impossible to store (e.g., certain exotic fruits).

Therefore, consumers want foods that: Have a long shelf life before and after purchase, and after opening (e.g., UHT milk). Are easy to use: easy storage, opening/closing, and preparation.

Today, a significant portion of added value to food by agri-food industries focuses on this usability and service value (e.g., sophisticated packaging, ready-made meals).

Are affordable: not overly expensive and available everywhere. Price is a determining factor for some people (low-income individuals) but also gives an impression of quality.

There is a confusion between "It's better, so it's normal that it's more expensive" and "It's more expensive, so it must be better." Consumers often refer to the quality/price ratio.

In addition to these "Four S," there are four other qualities that are less apparent and tangible but essential for consumers. These qualities also require significant resources from agri-food industries.

3-1-5- Regularity (quality is constant =absence of unexpected elements) i don't want a surprise

We do not want surprises, the quality "does not pay" only if it is not reproducible (e.g. a juice that is only good in one bottle in two does not meet the expectations of the consumer).

Quality control, quality assurance, attach to this regularity to give a consistent product. We don't want a surprise, even a good one! The consumer loses what was the charm of food: their variability.

3-1-6- Reverie (transferred qualities) we want to get away from it all

Some consumers seek natural products ("organic"), traditional ones (e.g. advertising with a "mamma" or a painting from the 16th century, attractive from the countryside), These are known as transferred characteristics, where imagination and symbolism make the consumer "dream" (for example: my grandmother's jam is surely better).

This transferred quality is reinforced by advertising, the style of the point of sale (such as events in large supermarkets, store decoration), but also by proximity (networks, family). This dream-like quality significantly enhances organoleptic qualities (it tastes better in attractive (simple) packaging or during a festive meal).

3-1-7- Technology

The consumer is not the only user of food. Quality means satisfaction for all users: processors, craftsmen, and manufacturers, as well as distributors, stores, and supermarkets, all expect specific product characteristics too.

These are the Technological qualities: the ability to be processed and distributed. (For example: the baking quality of flour, water retention in meat for salting, suitability for storage in a truck, shelf life of yogurt in a supermarket, etc.)

3-1-8- Ethics

Ability to meet consumers' moral requirements with explicit consideration of other needs: these others can include, for example,

1. Future generations (sustainable production, organic (bio)),
2. Local producers (short supply chains),
3. Producers in poor countries (fair trade),
4. Animals and their well-being (eggs from hens marked 1 or 3).

4. Quality actions in the Food Industry Sector and instruments implemented

In the food sector, quality is an old and recurring concern that remains at the heart of consumer concerns. The term quality for food products groups together different components: nutritional, sanitary and organoleptic quality (taste). The food sector therefore acts on these three essential dimensions of quality.

4.1. Nutritional Optimization of Foods

By reducing sugar, salt, fats, trans fatty acids, saturated fatty acids, etc. The reformulation of existing products is a gradual process to habituate consumers progressively. Nowadays, the "nutrition" aspect is considered in all new product designs. Many sectors have voluntarily

engaged in the Observatory for Food Quality hosted by (AFSSA French Food Safety Agency) and INRA (National Institute for Agricultural Research) to monitor the long-term evolution of the nutritional quality of foods.

4.2. Consumer Information and Education

Notable examples include the almost systematic implementation of nutritional labeling on packages to enhance consumer information, as well as programs like "Eat Move" stemming from the commitment charter "to promote nutrition and physical activity conducive to health in television programs and advertisements."

4.3. Best Practices in Communication and Marketing

This includes adherence to codes of ethics and the cessation of food advertising on television screens aimed at children.

4.4. Support for Research

Many industrial entities fund research programs on nutrition and diet. These programs aim to promote healthy eating behaviors and balanced lifestyles. These initiatives reflect a multi-faceted approach by the agri-food industry:

- to promote nutritional awareness,
- provide transparent information to consumers,
- maintain ethical communication,
- support scientific research for healthier dietary choices and lifestyles.

Case study

A company producing extra virgin olive oil received several consumer complaints about an unusual taste and lower viscosity of its product. There were also suspicions of fraud.

Laboratory analysis later revealed that the oil had been mixed with cheaper vegetable oils.

Therefore, the product labeled as “100% extra virgin olive oil” was not authentic. by using the component of food quality explain this problem.

Chapter 2: component of quality

I. The signs of quality

The company that produces "quality" wants it to be officially recognized (certified) and wants to make it known (to consumers). On large surfaces, the buyer spends an average of 1 second choosing a food: therefore, the quality must "spring in the eye". The company may use its own trademark or an official warranty such as the red label, the conformity certificate, or the controlled designation of origin.

Quality signs are logos, labels, brands, or other identifiers that allow consumers to recognize products that have an official label indicating their quality and origin. There are five official quality and origin signs, four of which are European and one is national. The official signs of quality and origin are: Protected Designation of Origin/Controlled Designation of Origin (AOP/AOC), Protected Geographical Indication (IGP), Traditional Specialty Guaranteed (STG), Organic Farming (FO), and the Red Label.

In France and in Europe, official logos allow consumers to recognize products that have an official sign indicating their quality and origin.

1. A collective and voluntary initiative originating from producers or a producers' group.
2. Strict production conditions validated by the state.
3. Regular checks carried out by independent organizations approved by the state.
4. An official guarantee for consumers:
 - Guarantee of origin (AOC and AOP; IGP)

- Guarantee of superior quality (Red Label)
- Guarantee of a traditional recipe (STG)
- Guarantee of environmental respect (Organic Farming).

I.1. Trademark

The company can practice a "brand policy", by building a "branding image" that distinguishes it from its competitors (Danone, Nestlé,...)

Its only trademark name, registered with INPI: National Institute of Industrial Property (requirement for registration: priority), applied to the product, gives consumer confidence. Large companies take care of their brand image, comfort through communication and advertising, and constant efforts for quality and regularity. The capital that constitutes the brand requires the company to maintain the quality of its products. Larger companies use the trust inspired by their brand to strengthen all brands in their group (e.g. Nestlé).

More broadly, a group of companies too small to have an isolated brand policy can register a collective brand, to make themselves known and promote. A priori, no official quality requirement, the collective brand is just a "label".

Many companies, newer or smaller, do not have this capital of a recognized brand. They will therefore use more widely recognised collective "brands", the official guarantees of quality (the large companies also).

I. 2. Official quality guarantees

Official quality guarantees are: Appellations of origin, labels, certifications, organic farming (AOC, LR, CC, et FO).

I.2.1. AOC: Controlled Appellation of Origin

AOC is a place name, used to designate a product that comes from that place, and whose qualities are mainly due to the geographical environment (natural and human factors). AOCs are issued by INAO, the National Institute of Appellations of Origin. The AOC product is thus linked to a terroir (climate, soil, traditions), and must have an originality linked instead (product impossible elsewhere).

I.2.2. LR: Red Label

Label Rouge (Red Label) is a sign of quality assurance in France as defined by Law No. 2006-11 (5 January 2006). Products eligible for the Label Rouge are food items (including seafood) and non-food and unprocessed agricultural products such as flowers. According to the French Ministry of Agriculture: "The Red Label certifies that a product has a specific set of characteristics establishing a superior level to that of a similar current product"

The label certifies that a product has pre-defined specific characteristics, establishing a higher level of quality than other similar products. The red label is national, the other agricultural labels are regional, and each "cover" many products.

Five conditions are required to establish a label :

1. independent certification body of the producer
2. written technical description of the superior quality of the product
3. specification control plan
4. products information labelling
5. sufficient volume placed on the market

The label is not definitive but may be challenged if the conditions are no longer met.



Figure 2: Logo of official quality signs (Bosseaux, 2020)

I.2.3. OF: Organic farming: Act of 04/07/1980

National regulation is replaced on 01/01/2009 by European Regulation No: 834/2007, supplemented by the French Decree of 05/01/2010: specifications of the method of organic production of livestock.

OF is defined for means of production (not the product) no synthetic products used except positive list) environmentally and animal-friendly methods: recycled organic material, crop rotation, no GMOs, organic control, low inputs: feed produced on the farm, animals not confined, allopathic treatment/year (France avant 2009). Compound foods: more than 95% of the components derived from OF.

1. The OF passes through four conditions the same as the first four of the labels)
2. Independence between managing and producing bodies
3. very precise specifications on means of production
4. Specification control plan, with sanctions.
5. Official labelling and logo

Six certification bodies can certify, the OF, two to five visits per year: material control. A farmer must comply with the FO specification for 3 years before being able to market 'bio' products.

The significance of AB lies in its "ecological" aspect (promoting sustainable agriculture) and its social impact (lower productivity but higher prices, which helps maintain rural communities). There is no scientific evidence to suggest that "organic" foods are inherently healthier.

I.2.4. European Quality Labels : PDO, PGI, TSG

AOP (Appellation d'Origine Protégée) stands for "Protected Designation of Origin" in English. It denotes products that are closely linked to their place of origin and have specific characteristics due to that origin. It seems like you've listed various food items such as cheeses (Queso Manchego, Feta), charcuterie (cured meats), olive oils, fruits, and vegetables.

IGP (Indication Géographique Protégée) translates to "Protected Geographical Indication." This label is used for products that have a strong association with a specific geographic area, influencing their qualities or reputation.

STG (Spécialité Traditionnelle Garantie) means "Traditional Specialty Guaranteed." It designates products that have traditional production methods, ingredients, or composition, ensuring their unique and traditional nature.

I.2.5. CC (Certificate of Conformity):

Certify that a product complies with a set of specifications or requirements. Characteristics or rules related to manufacturing, processing, packaging, or origin. These characteristics must be measurable and documented in a specification sheet (public) or in a standard (as elaborated by AFNOR after consultation with all parties, in which case it may be marked as "NF").

CC does NOT guarantee superior quality but merely conformity to a reference standard.

II. Quality tools

There are numerous tools available for identifying and conducting a root cause analysis to provide a suitable response and solution to the identified problem. These primary tools are valuable as they follow a strict process in which everyone participates, and the role of a quality manager requires skills in facilitation and communication.

II. 1. The Ishikawa diagram

The Ishikawa diagram (also known as the fishbone diagram) is the result of Kaoru Ishikawa's work in quality management. Kaoru Ishikawa is considered by many researchers to be the founder and first promoter of the 'Fishbone' diagram for root cause analysis and the concept of Quality Control (QC) circles. The shape of the diagram looks like the skeleton of a fish to identify quality problems based on their degree of importance.

Ishikawa diagram is a visualization tool for categorizing the potential causes of a problem in order to identify its root causes. As you can see in the diagram. You can try out this method by simply using this diagram as a template.

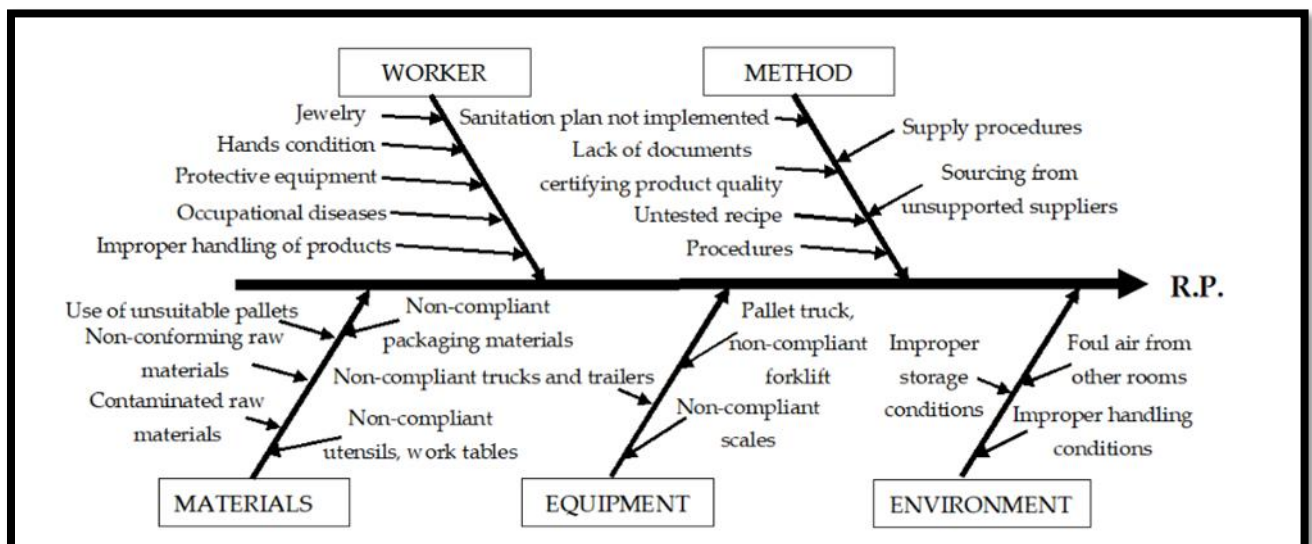


Figure 3: Ishikawa diagram—recommendations to determine the risk-generating causes of manufacturing stages. (Glevitzky et al ., 2025)

The definition of the Ishikawa diagram, also known as the cause-and-effect diagram, is very simple: it is a graphical representation of the relationships between various causes and the effects or results that stem from them. It is often used in the problem-solving process.

The cause and effect diagram is a problem-solving tool that investigates and analyzes systematically all the potential or real causes that result in a single effect.

The generic categories of the cause and effect diagram are usually six elements (causes) such as environment, materials, machine, man, and method, as indicated in Figure 3. Furthermore, “potential causes” can be indicated by arrows entering the main cause arrow.

II.1.2. The 5Ms in the Ishikawa diagram

The 5Ms in the Ishikawa diagram, often used to represent potential causes, are as follows:

II.1.2.1. Manpower

This category encompasses all causes related to employees and human intervention in general. Issues such as a lack of qualifications or knowledge, different personal attitudes, and team conflicts fall under this domain.

II.1.2.2. Materials

This pertains to the materials used in the production of goods. This aspect may not be relevant in every business or project, particularly in the case of digital services. It focuses on the quality of raw and auxiliary materials used.

II.1.2.3. Machine

If various machines are required for production, this domain becomes important. Questions arise about whether the machines are functioning correctly, whether they produce products of the desired quality, and how often repairs are necessary.

II.1.2.4. Method

Methodology is crucial in nearly every business. This aspect relates to the processes by which various things are managed. It can involve operating procedures, workflow management, or the choice of project management methods.

II. 1.2.5. Environment

This category encompasses external factors that can influence the process and, consequently, the problem, even though they occur outside the company itself. Examples include environmental influences like temperature or high humidity. However, competition, government regulations, and broader industry trends also fall within this domain.

In project management, it's possible to add "Management" and "Moyens financiers (Financial Resources)" to create the 6Ms or 7Ms, depending on the chosen framework. The choice of which factors to include in your diagram depends on the specific problem and your unique situation.

II.1.3. How we use the Ishikawa Method?

II.1.3.1. Identify the Problem

In the next step, it is important to name the problem. What is precisely the problem or the objective? Describe it in a factual manner, without attempting to analyze or interpret it. Then, write it at the head of the fishbone diagram.

II.1.3.2. Define the Causes

Now, it's time to analyze each branch, which means each individual category. Try to identify as many potential causes of the problem as possible. To do this, you'll need to work with a team of individuals who are familiar with the situation.

You can involve your team in a meeting or a brainstorming session. This way, you can examine the problem and all possible causes from different perspectives, leading to a more comprehensive list.

It can also be very useful at this stage to establish connections between the various causes.

Let's illustrate this with a simple Ishikawa diagram example:

During your brainstorming session, you've concluded that one possible cause of the problem is a lack of financial resources. You note this under the "Financial Resources" branch.

The reason for this financial shortage is that the machines have worn out more quickly in recent months, and you note this under the "Machines" category.

You would like to perform the necessary repairs to get the machines functioning correctly again, but you're not receiving the necessary support from upper management. They don't consider the repairs as a priority and are not providing the required financial resources. You can note this in both the "Management" and "Financial Resources" categories.

As you can see, the different causes can be strongly interconnected. Recording these connections in the Ishikawa diagram can be very helpful in gaining a better understanding of the overall situation.

II.1.3.3. Prioritize the Causes

The next step involves evaluating the various causes based on their impact. Different creativity techniques can be used for this purpose, such as the ABC analysis. Category A signifies a strong influence, while category C indicates very weak influence. This can help you prioritize and focus on the most influential factors. Alternatively, you can simply assign numerical values from 1 to 5, with the key being to rank the causes.

II.1.3.4. Verify Completeness

The Ishikawa diagram can only function correctly if all the causes have been noted. To ensure this, it's helpful to take a second look at the Ishikawa diagram, perhaps even a few days later, to check for completeness.

II.1.4. Why Use the Ishikawa Method?

You have now completed the creation of the Ishikawa diagram. You have found all the necessary causes and have visualized them on the diagram. The next step is to use this diagram to find a solution to the problem.

You have already weighted the causes based on their relevance and can now examine the causes more closely. Use the knowledge and input from the diagram and the entire team to deduce measures.

These measures focus on the most significant causes of the problem. This way, you have a high chance of successfully resolving the problem.

II.2. The QOOCCP (WWWWHHW) method

Who does? what? Where? When? How? How much? What for?

Empirical method based on systematic questioning. The Goal is to collect the necessary and sufficient data to analyze and report on a situation, a problem, a process, It's a checklist that allows you to be exhaustive and not forget anything.

These 5 QOOQC questions can be supplemented by 2 others: Why? and how much?

- Who? (people or categories of people concerned)
- What? (actions to be performed)
- Where? (areas affected by the project, locations)
- When? (time-based programming)

- How? (means, methods, etc.)
- How much? (quantities, budget)
- Why? (Reasons and Objectives)

These 5 QOOQC questions can be supplemented by Fundamental questions and Follow-up questions

Example: Resolving a quality decline issue on a production line.

Who:

- ✓ Who is responsible for quality at each stage?
- ✓ Who are the operators or supervisors directly involved in this problem?
- ✓ Who needs to be trained or made aware to resolve this situation?

What:

- ✓ What types of defects are appearing in the products?
- ✓ Is this a one-time issue or a recurring problem?
- ✓ Is it specific to certain types of production?

Where:

- ✓ On which production line do the defects mainly occur?

When:

- ✓ Since when have the quality issues been noticed?
- ✓ Is there a particular time of year or specific period when this problem occurs more frequently?
- ✓ At what stage of the manufacturing process do the defects appear?

How:

- ✓ How do these defects manifest in the products?
- ✓ How does the current quality control process handle these issues?
- ✓ How does the staff respond to these defects?

Why:

- ✓ Why is there a recent decline in quality? Possible causes: changes in work methods, machine reliability, or supplier quality?
- ✓ Why do the current quality control systems fail to prevent these defects?
- ✓ Why was this problem not addressed earlier?

II.3. 5S Method: Less Waste, More Efficiency

The 5S method makes it possible to continuously optimize working conditions and working time by ensuring the organization, cleanliness and safety of a work surface.

The 5S method is of Japanese origin. It was created for the production of Toyota factories.

The 5S method is a management technique that is part of the quality approach.

5S is defined as a methodology that results in a workplace that is clean, safe, and well organized to help reduce waste and optimize productivity. It's designed to help build a quality work environment, both physically and mentally. The 5S philosophy applies in any work area suited for visual control and lean production. (Waste-free management) The 5S condition of a work area is critical to employees and is the basis of customers' first impressions.

The 5S quality tool is derived from five Japanese terms beginning with the letter "S" used to create a workplace suited for visual control and lean production. The pillars of 5S are simple to learn and important to implement:

- ✓ **Seiri:** To separate needed tools, parts, and instructions from unneeded materials and to remove the unneeded ones.
- ✓ **Seiton:** To neatly arrange and identify parts and tools for ease of use.
- ✓ **Seiso:** To conduct a cleanup campaign.
- ✓ **Seiketsu:** To conduct seiri, seiton, and seiso daily to maintain a workplace in perfect condition.
- ✓ **Shitsuke:** To form the habit of always following the first four S's.

II.3.1. the 5S Program Benefits

Benefits to be derived from implementing a lean 5S program include:

- ✓ Improved safety
- ✓ Higher equipment availability
- ✓ Lower defect rates
- ✓ Reduced costs
- ✓ Increased production
- ✓ Improved employee morale
- ✓ Enhanced enterprise image to customers, suppliers, employees, and management

II.4. PDCA (Plan Do Check Act) method or cycle

is a quality management system in the industrial sector such as manufacturing, services, offshore, project areas, organizations, etc., which was popularized by Dr. Edwards Deming, an American quality management expert in the field of 1950.

The PDCA method is useful to make continuous improvements without stopping which in principle is more future-oriented flexible, logical and reasonable to do and contains a description of all elements of the plan drawn up.

This method for controlling and improving the management process supply chain or the company's habits consists of repeating four steps. In other words, there are 4 phases used in this method to pay attention and adjust the deviations that might occur with the main goal of being better in business processes.

The PDCA process ends with the Planning, Conducting, Testing, and Implementation steps also known as the Deming Phase. Deming developed the plan do check action cycle as a four-stage repetitive problem solving.

The Plan-do-check-act cycle (Figure 4) is a four-step model for carrying out change. Just as a circle has no end, the PDCA cycle should be repeated again and again for continuous improvement. The PDCA cycle is considered a project planning tool.



Figure 4: The PDCA cycle (Taufik, 2020)

II.4.1. The Plan-do-check-act Procedure

- ✓ **Plan:** Recognize an opportunity and plan a change.
- ✓ **Do:** Test the change. Carry out a small-scale study.
- ✓ **Check:** Review the test, analyze the results, and identify what you've learned.
- ✓ **Act:** Take action based on what you learned in the study step. If the change did not work, go through the cycle again with a different plan. If you were successful, incorporate what you learned from the test into wider changes. Use what you learned to plan new improvements, beginning the cycle again.

In general PDCA's in the manufacturing industry are applied to reduce waste (waiting time, failure, defects, etc.)

II.4.2. When to use PDCA cycle

Use the PDCA cycle when:

- ✓ Starting a new improvement project
- ✓ Developing a new or improved design of a process, product, or service
- ✓ Defining a repetitive work process
- ✓ Planning data collection and analysis in order to verify and prioritize problems or root causes
- ✓ Implementing any change
- ✓ Working toward continuous improvement

II.5. The 5 Whys

The 5 Whys is a technique that can help you to find the root cause of a problem.

It's a fact of life and business that sometimes things go wrong. Software fails, equipment breaks, communication is misunderstood, and the master plan you've spent the last month putting together falls apart after five minutes.

To prevent these types of problems from reoccurring you usually need more than just a quick fix. The 5 Whys can be a useful tool in helping you to get to the root of what went wrong. By understanding the root cause of the problem, you can solve it in such a way that it doesn't reoccur.

When something goes wrong, it can be tempting to leap into "crisis" mode, trying to immediately fix the issue and find someone on whom to pin the blame. A better way to react is to see the problem as a learning opportunity.

Immediately after our initial fix is in place, the 5 Whys Technique can help us identify all the causes of the problem, so that we eliminate the problem for good.

The technique works by asking why five times to find the root cause of your problem.

III. Good Hygiene Practices (GHPs)

The development, implementation, and maintenance of GHPs provide the conditions and activities that are necessary to support the production of safe and suitable food at all stages of the food chain from primary production through to handling of the final product. Applied generally, they assist in controlling hazards in food products.

Knowledge of the food and its production process is essential for the effective implementation of GHPs. This section provides guidance for effective implementation of GHPs, including appropriate location, layout, design, construction and maintenance of premises and facilities, and should be applied in conjunction with sector and product-specific codes.

GHPs manage many sources of food hazards which could contaminate food products, e.g. persons who handle food at harvest, during manufacturing, and during preparation; raw materials and other ingredients purchased from suppliers; cleaning and maintaining the work environment; storage and display.

After consideration of the conditions and activities in the business, it may be determined that GHPs alone may be sufficient to manage the hazards. However, it may also be determined that it is necessary to place greater attention on some GHPs that are particularly important for food safety (e.g. increased stringency of cleaning of a mincer for producing minced meat for raw or lightly cooked consumption compared to equipment used for producing meat to be cooked prior to consumption; increased monitoring and/or verification of disinfection of food contact surfaces).

Hazards that occur or are present at levels such that GHP procedures are not sufficient to provide safe food should be managed by an appropriate combination of control measures that are capable of preventing occurrence of hazards or eliminating or reducing them to an acceptable level. The control measures can be identified in one or more steps throughout the production process. Where significant hazards are identified that need to be controlled after the implementation of GHPs, it will be necessary to develop and implement a HACCP system. This method can also help in memorizing good hygiene and sanitation practices. It focuses on a set of points to master that are related to one of the following elements:

III.1. Primary production

Primary production should be managed in a way that ensures that food is safe and suitable for its intended use. The types of activities involved in primary production may make eliminating or reducing some hazards difficult. However, by applying prerequisite programmes such as good agricultural practices (GAPs) and/or GHPs, steps can be taken to minimize the occurrence and levels of hazards in the food chain, e.g. at milking for dairy production, steps taken in the hygienic production of eggs, or the controls on irrigation water used for growing salad crops. Not all provisions apply for all primary production situations and consideration will need to be given by the Food business operators on the appropriateness of the measures to be taken.

III.1.1. Environmental control

Potential sources of contamination from the environment should be identified. In particular, primary production should not be carried out in areas where the presence of contaminants would lead to an unacceptable level of such contaminants in food, e.g. using polluted areas,³ locating near facilities emitting toxic or offensive odours which could taint foodstuffs or near sources of contaminated water such as discharge of wastewater from industrial production or runoff from agricultural land with high faecal material or chemical residues, unless there is a measure to reduce or prevent the contamination of food.

III.1.2. Hygienic production

The potential effects of primary production activities on the safety and suitability of food should be considered at all times. In particular, this includes identifying any specific points in such activities where a high probability of contamination may exist and taking specific measures to minimize and, if possible, eliminate that probability.

Producers should as far as practicable, implement measures to:

- ✓ Control contamination from soil, water, feedstuffs, fertilizers (including natural fertilizers), pesticides, veterinary drugs or any other agent used in primary production;
- ✓ Protect food sources from faecal and other contamination (e.g. zoonotic foodborne agents);
- ✓ Control plant and animal health so that it does not pose a threat to human health through food consumption, or adversely affect the suitability of the product (e.g. observe the withdrawal period of veterinary drugs and pesticides, keeping records where applicable); and
- ✓ Manage waste and store harmful substances appropriately.

III.1.3. Handling, storage and transport

Procedures should be in place to:

- ✓ sort food to remove material which should not be used for human consumption;
- ✓ dispose of any rejected material in a hygienic manner; and
- ✓ protect food from contamination by pests, or by chemical, physical or microbiological contaminants or other objectionable substances during handling (e.g. sorting, grading, washing), storage and transport. Care should be taken to prevent deterioration and spoilage through appropriate measures which may include controlling temperature, humidity, and/or other controls.

III.1.4. Cleaning, maintenance and personnel hygiene

Appropriate facilities and procedures should be in place to ensure that:

- ✓ Cleaning and maintenance are carried out effectively and do not compromise food safety (e.g. ensuring equipment used in harvest is not a source of contamination); and
- ✓ An appropriate degree of personal hygiene is maintained to ensure personnel are not a source of contamination (e.g. by human faeces).

III.2. Establishment – design of facilities and equipment

III.2.1. Location and structure

Food establishments should not be located where there is a threat to food safety or suitability and hazards cannot be controlled by reasonable measures. The location of an establishment, including temporary/mobile establishments, should not introduce any hazards from the environment that cannot be controlled. In particular, unless sufficient safeguards are provided, establishments should normally be located away from:

environmentally polluted areas and industrial activities which are reasonably likely to contaminate food;

- ✓ Areas subject to flooding;
- ✓ Areas prone to infestations of pests; and
- ✓ Areas where waste, either solid or liquid, cannot be removed effectively.

The design and layout of food establishments should permit adequate maintenance and cleaning. The layout of premises and the flow of operations, including the movements of personnel and material within the buildings, should be such that cross-contamination is minimized or prevented.

Areas having different levels of hygiene control (e.g. the raw material and finished product areas) should be separated to minimize cross-contamination through measures such as physical separation (e.g. walls, partitions) and/or location (e.g. distance), traffic flow (e.g. one-directional production flow), airflow, or separation in time, with suitable cleaning and disinfection between uses.

Structures within food establishments should be soundly built of durable materials, which are easy to maintain, clean and, where appropriate, easy to disinfect. They should be constructed of non-toxic and inert materials according to intended use and normal operating conditions. In particular, the following specific conditions should be satisfied, where necessary, to protect the safety and suitability of food:

- ✓ the surfaces of walls, partitions and floors should be made of impervious materials that are easy to clean and, where necessary, disinfect;
- ✓ walls and partitions should have a smooth surface up to a height appropriate to the operation;
- ✓ floors should be constructed to allow adequate drainage and cleaning;

- ✓ ceilings and overhead fixtures (e.g. lighting) should be constructed to be shatter proof where appropriate, and finished to minimize the build-up of dirt and condensation and the shedding of particles;
- ✓ windows should be easy to clean, be constructed to minimize the build-up of dirt and, where necessary, be fitted with removable and cleanable insect-proof screens; and
- ✓ doors should have smooth, non-absorbent surfaces, be easy to clean and, where necessary, disinfect.

Work surfaces that come into direct contact with food should be in sound condition, durable, and easy to clean, maintain and disinfect. They should be made of smooth, non-absorbent materials, and inert to the food, to detergents and to disinfectants under normal operating conditions.

Establishments and structures covered here include market stalls, street vending vehicles, vending machines and temporary premises such as tents and marquees. Such premises and structures should be located, designed, and constructed to avoid, as far as reasonably practicable, the contamination of food and the harbouring of pests. Adequate facilities for toileting and washing hands should be provided, where appropriate.

III.2.2. Facilities

Adequate drainage and waste disposal systems and facilities should be provided and well maintained. They should be designed and constructed so that the likelihood of contaminating food or the water supply is avoided. For plumbing, steps should be taken to prevent backflow, cross-connections, and backup of sewer gases. It is important that drainage does not flow from highly contaminated areas (such as toilets or raw production areas) to areas where finished food is exposed to the environment.

Waste should be collected, disposed of by trained personnel and, where appropriate, disposal records maintained. The waste disposal site should be located away from the food establishment to prevent pest infestation. Containers for waste, by products and inedible or hazardous substances should be specifically identifiable, suitably constructed and, where appropriate, made of impervious material.

Containers used to hold hazardous substances prior to disposal should be identified and where appropriate, be lockable to prevent intentional or accidental contamination of food.

Adequate, suitably designated facilities should be provided for cleaning utensils and equipment. Such facilities should have an adequate supply of hot and/or cold water, where required. A separate cleaning area should be provided for tools and equipment from highly contaminated areas like toilets, drainage and waste disposal areas. Where appropriate, facilities for washing food should be separate from facilities for cleaning utensils and equipment, and separate sinks should be available for hand washing and food washing.

Adequate washing and toilet facilities should be available so that an appropriate degree of personal hygiene can be maintained and to avoid personnel contaminating food.

Such facilities should be suitably located and should not be used for other purposes such as storage of food or items that contact food. They should include:

- ✓ adequate means of washing and drying hands, including soap (preferably liquid soap), wash basins and, where appropriate, a supply of hot and cold (or suitably temperature controlled) water;

- ✓ hand washing basins of an appropriate hygienic design, ideally with taps not operated by hands; where this is not possible, appropriate measures to minimize contamination from the taps should be in place; and
- ✓ suitable changing facilities for personnel, if needed.

Handwashing basins should not be used for washing food or utensils.

Depending on the nature of the food operations undertaken, adequate facilities should be available for heating, cooling, cooking, refrigerating and freezing food, for storing refrigerated or frozen foods, and, when necessary, controlling ambient temperatures to ensure the safety and suitability of food.

Adequate means of natural or mechanical ventilation should be provided, in particular to:

- ✓ minimize airborne contamination of food, for example, from aerosols and condensation droplets;
- ✓ help control ambient temperatures;
- ✓ control odours which might affect the suitability of food; and control humidity to ensure the safety and suitability of food (e.g. to prevent an increase in moisture of dried foods that would allow growth of microorganisms and production of toxic metabolites).

Ventilation systems should be designed and constructed so that air does not flow from contaminated areas to clean areas; the systems should be easy to maintain and clean.

Adequate natural or artificial lighting should be provided to enable the food business to operate in a hygienic manner. Lighting should be such that it does not adversely impact the ability to detect defects of, or contaminants in, food or the examination of facilities and equipment for cleanliness. The intensity should be adequate to the nature of the operation.

Light fittings should, where appropriate, be protected to ensure that food is not contaminated by breakages of lighting elements.

Adequate and, where necessary, separate facilities for the safe and hygienic storage of food products, food ingredients, food packaging materials and non food chemicals (including cleaning materials, lubricants, fuels), should be provided. Storage should allow for segregation of raw and cooked foods or allergenic and non-allergenic food.

Food storage facilities should be designed and constructed to:

- ✓ facilitate adequate maintenance and cleaning;
- ✓ avoid pest access and harbourage;
- ✓ enable food to be effectively protected from contamination, including allergen cross-contact, during storage; and
- ✓ where necessary, provide an environment which minimizes the deterioration of food (such as by temperature and humidity control).

The type of storage facilities required will depend on the nature of the food. Separate, secure, storage facilities for cleaning materials and hazardous substances should be provided.

III.2.3. Equipment

Equipment and containers coming into contact with food should be suitable for food contact; designed, constructed and located to ensure that they can be adequately cleaned (other than containers which are single use only); disinfected (where necessary); and maintained or discarded as necessary to avoid the contamination of food, according to hygienic design principles. Equipment and containers should be made of materials that are non-toxic according to intended use. Where necessary, equipment should be durable and movable or capable of being disassembled to allow for maintenance, cleaning, disinfection and to facilitate inspection for pests.

Equipment used to cook, heat, cool, store or freeze food should be designed to achieve the required food temperatures as rapidly as necessary in the interests of food safety and suitability, and to maintain food temperatures effectively. Such equipment should also be designed to allow temperatures to be monitored, where necessary, and controlled. Where appropriate, monitoring equipment should be calibrated to ensure that temperatures of food processes are accurate. Where necessary, such equipment should have effective means of controlling and monitoring humidity, airflow and any other characteristics likely to have an effect on the safety or suitability of food.

III.3. Training and competence

Food hygiene training is fundamentally important to the food business. All personnel should be aware of their role and responsibility in protecting food from contamination or deterioration. Personnel should have the knowledge and skills necessary to enable them to handle food hygienically. Those who handle cleaning chemicals or other potentially hazardous chemicals should be instructed in proper use to prevent contamination of food.

Elements to take into account in determining the extent of training required include:

- ✓ The nature of hazards associated with the food, e.g. its ability to sustain growth of pathogenic or spoilage microorganisms, the existence of potential physical contaminants or known allergens;
- ✓ The manner in which the food is produced, processed, handled and packed, including the likelihood of contamination;
- ✓ The extent and nature of processing or further preparation before consumption of the food;
- ✓ The conditions under which the food will be stored;
- ✓ The expected length of time before consumption of the food; and

- ✓ The use and maintenance of instruments and equipment associated with food.

Training programmes should also consider the knowledge and skill levels of the personnel being trained. Topics to be considered for training programmes could include the following, as appropriate to a person's duties:

- ✓ The principles of food hygiene applicable to the food business;
- ✓ The measures relevant to the food business that are used to prevent contaminants in food;
- ✓ The importance of good personal hygiene, including proper hand washing and wearing, when needed, appropriate clothing, for food safety;
- ✓ The GHPs applicable to the food business; and
- ✓ Appropriate actions to take when food hygiene problems are observed.

In addition, for retail and food service operations, whether personnel have direct customer interaction is a factor in training, since it may be necessary to convey certain information about products (such as allergens) to customers.

III.4. Establishment maintenance, cleaning and disinfection and pest control

Establishments and equipment should be maintained in an appropriate condition to:

- ✓ facilitate all cleaning and disinfection procedures;
- ✓ function as intended; and
- ✓ prevent contamination of food, such as from pests, metal shards, flaking plaster, debris, chemicals, wood, plastic, glass, paper.

Cleaning should remove food residue and dirt which may be a source of contamination, including allergens. The cleaning methods and materials necessary will depend on the nature

of the food business, the food type and the surface to be cleaned. Disinfection may be necessary after cleaning, especially for food contact surfaces.

Attention should be paid to hygiene during cleaning and maintenance operations so as not to compromise food safety and suitability. Cleaning products suitable for food contact surfaces should be used in food preparation and storage areas.

Cleaning and disinfection chemicals should be handled and used carefully and in accordance with manufacturers' instructions, for example, using the correct dilutions and contact times, and stored, where necessary, separate from food, in clearly identified containers to avoid contamination of food.

Separate cleaning equipment and utensils, suitably designated, should be used for different hygiene zones e.g. food and non-food contact surfaces. Cleaning equipment should be stored in an appropriate place and in such a manner to prevent contamination. Cleaning equipment should be kept clean, maintained, and replaced periodically so as not to become a source for cross-contamination of surfaces or food

Cleaning can be carried out by the separate or the combined use of physical methods, such as heat, scrubbing, turbulent flow, and vacuum cleaning (or other methods that avoid the use of water), and chemical methods using solutions of detergents, alkalis, or acids. Dry cleaning or other appropriate methods for removing and collecting residues and debris may be needed in some operations and/or food processing areas where water increases the likelihood of microbiological contamination. Care should be taken to ensure cleaning procedures do not lead to contamination of food, e.g. spray from pressure washing can spread contamination from dirty areas, such as floors and drains, over a wide area and contaminate food contact surfaces or exposed food.

Wet cleaning procedures will involve, where appropriate:

- ✓ removing gross visible debris from surfaces;
- ✓ applying an appropriate detergent solution to loosen soil; and
- ✓ rinsing with water (hot water where appropriate) to remove loosened material and residues of detergent.

Where necessary, cleaning should be followed by chemical disinfection with subsequent rinsing unless the manufacturer's instructions indicate that, on a scientific basis, rinsing is not required. Concentrations and application time of chemicals used for disinfection should be appropriate for use and applied according to manufacturers' instructions for optimal effectiveness. If cleaning is not done effectively to remove soil to permit the disinfectant to contact microorganisms or if sub-lethal concentrations of the disinfectant are used, the microorganisms may persist.

Cleaning and disinfection procedures should ensure that all parts of the establishment are appropriately clean. Where appropriate, programmes should be drawn up in consultation with relevant experts.

effectiveness and periodically verified by means such as visual inspections and audits to ensure the procedures have been applied properly. The type of monitoring will depend on the nature of the procedures, but could include pH, water temperature, conductivity, cleaning agent concentration, disinfectant concentration, and other parameters important to ensure the cleaning and disinfection programme is being implemented as designed and verify its effectiveness. Microorganisms can sometimes become tolerant to disinfecting agents over time. Cleaning and disinfection procedures should follow the manufacturers' instructions. Periodic review with disinfectant manufacturers/suppliers, where feasible, should be conducted to help ensure the disinfectants used are effective and appropriate. Rotation of the disinfectants could be considered to ensure inactivation of different types of microorganisms (e.g. bacteria and fungi).

Pests (e.g. birds, rodents, insects, etc.) pose a major threat to the safety and suitability of food. Pest infestations can occur where there are breeding sites and a supply of food. GHPs should be employed to avoid creating an environment conducive to pests. Good building design, layout, maintenance, and location, along with cleaning, inspection of incoming materials and effective monitoring, can minimize the likelihood of infestation and thereby limit the need for pesticides. Establishments should be kept in good repair and condition to prevent pest access and to eliminate potential breeding sites. Holes, drains and other places where pests are likely to gain access should be covered. Roll up doors should close tightly against the floor. Wire mesh screens, for example on open windows, doors, and ventilators, will reduce the problem of pest entry. Animals should, wherever possible, be excluded from the grounds of food-processing establishments.

Pest infestations should be addressed immediately by a qualified person or company and appropriate corrective action taken. Treatment with chemical, physical, or biological agents should be carried out without posing a threat to the safety or suitability of food. The cause of infestation should be identified, and corrective action taken to prevent a problem from reoccurring. Records should be kept of infestation, monitoring and eradication.

Suitable provision should be made for the removal and storage of waste. Waste should, as far as possible, be collected and stored in covered containers and should not be allowed to accumulate and overflow in food handling, food storage, and other working areas or the adjoining environment in a manner that compromises food safety and suitability. Personnel responsible for waste removal (including hazardous waste) should be properly trained so they do not become a source of cross-contamination. Waste storage areas should be easily identifiable, be kept appropriately clean, and be resistant to pest infestation. They should also be located away from processing areas.

III.5. Personal hygiene

Personnel known or suspected to be ill or carrying a disease likely to be transmitted through food should not enter any food handling area if there is a likelihood of them contaminating food. Any person so affected should immediately report illness or symptoms of illness to the management.

It may be appropriate for personnel to be excluded for a specific time after symptoms resolve or, for some illnesses, to get medical clearance before returning to work. Some symptoms of illnesses that should be reported to management so that the need for possible exclusion from food handling and/or medical examination can be considered include: jaundice; diarrhoea; vomiting; fever; sore throat with fever; visibly infected skin lesions (boils, cuts, etc.); and discharges from the ear, eye, or nose.

Personnel with cuts and wounds should, where necessary, be assigned to work in areas where they will have no direct contact with food. Where personnel are permitted to continue working, cuts and wounds should be covered by suitable waterproof plasters and, where appropriate, gloves. Appropriate measures should be applied to ensure plasters do not become a source of contamination (e.g. plasters of contrasting colour compared to the food and/or detectable using a metal detector or X-ray detector)

Personnel should maintain a high degree of personal cleanliness and, where appropriate, wear suitable protective clothing, head and beard covering, and footwear. Measures should be implemented to prevent cross-contamination by personnel through adequate hand washing and, where necessary, the wearing of gloves. If gloves are worn, appropriate measures should be applied to ensure the gloves do not become a source of contamination.

In order not to contaminate food, personnel should wash hands with soap and water and rinse and dry them in a manner that does not recontaminate the hands. Hand sanitizers should not replace hand washing and should be used only after hands have been washed.

Visitors to food businesses, including maintenance workers, in particular to food manufacturing, processing or handling areas, should, where appropriate, be instructed and supervised, wear protective clothing and adhere to the other personal hygiene provisions for personnel. Visitors should be guided through a hygiene policy of the business prior to visits and encouraged to report any type of illness/injury that may pose cross-contamination issues.

IV. Hazard Analysis Critical Control Points (HACCP)

Definition: "Any process that helps eliminate contamination in our food and beverages is a positive sign," Adam Berman

HACCP (Hazard Analysis and Critical Control Point) is a systematic approach in identifying, evaluating and controlling food safety hazards.

Food safety hazards are biological, chemical or physical agents that are reasonably likely to cause illness or injury in the absence of their control.

A HACCP system is a preventive system of hazard control rather than a reactive one.

HACCP systems are designed to prevent the occurrence of potential food safety problems.

This is achieved by assessing the inherent hazards attributable to a product or a process, determining the necessary steps that will control the identified hazards, and implementing active managerial control practices to ensure that the hazards are eliminated or minimized.

Essentially, HACCP is a system that identifies and monitors specific foodborne hazards biological, chemical, or physical properties – that can adversely affect the safety of the food product.

This hazard analysis serves as the basis for establishing critical control points (CCPs). CCPs identify those points in the process that must be controlled to ensure the safety of the food.

Further, critical limits are established that document the appropriate parameters that must be met at each CCP.

Monitoring and verification steps are included in the system, again, to ensure that potential hazards are controlled.

The hazard analysis, critical control points, critical limits, and monitoring and verification steps are documented in a HACCP plan.

Seven principles have been developed which provide guidance on the development of an effective HACCP plan.

IV. 2. Seven principles of HACCP

IV.2.1. Conduct a hazard analysis

Identify the potential hazard(s) associated with food production at all stages, from primary production, processing, manufacture and distribution until the point of consumption. Assess the likelihood of occurrence of the hazard(s) and identify the measures for their control.

IV.2.2. Determine the Critical Control Points (CCPs)

Determine the points, procedures or operational steps that can be controlled to eliminate the hazard(s) or minimize its (their) likelihood of occurrence. A "step" means any stage in food production and/or manufacture including the receipt and/or production of raw materials, harvesting, transport, formulation, processing, storage, etc.

IV.2.3. Establish critical limit(s)

Optical limits must be specified and validated if possible for each Critical Control Point. In some cases more than one critical limit will be elaborated at a particular step. Criteria often used include measurements of temperature, time, moisture level, pH, Aw, available chlorine and sensory parameters such as visual appearance and texture.

IV. 2.4. Establish monitoring procedures

Monitoring is the scheduled measurement or observation of a CCP relative to its critical limits. Monitoring should ideally provide this information in time to make adjustments to ensure control of the process to prevent violating the critical limits. Where possible, process adjustments should be made when monitoring results indicate a trend towards loss of control at a CCP. The adjustments should be taken before a deviation occurs. Data derived from monitoring must be evaluated by a designated person with knowledge and authority to carryout corrective actions when indicated. If monitoring is not continuous, then the amount or frequency of monitoring must be sufficient to guarantee the CCP in control.

IV.2.5. Establish corrective actions

Specific corrective actions must be developed for each CCP in the HACCP system in order to deal with deviations when they occur. The actions must ensure that the CCP has been brought under control, Actions taken must also include proper disposition of the affected product. Deviation and product disposition procedures must be documented in the HACCP record keeping.

IV.2.6. Establish verification procedures

Verification and auditing methods, procedures and tests, including random sampling and analysis, can be used to determine if the HACCP system is working correctly. The frequency of verification should be sufficient to confirm that the HACCP system is working effectively. Examples of verification activities include:

- ✓ Review of the HACCP system and its records;
- ✓ Review of deviations and product dispositions;
- ✓ Confirmation that CCPs are kept under control.

Where possible, validation activities should include actions to confirm the efficacy of all elements of the HACCP plan.

IV.2.7. Establish record-keeping and documentation procedures.

Efficient and accurate record keeping is essential to the application of an HACCP system. HACCP procedures should be documented. Documentation and record keeping should be appropriate to the nature and size of the operation.

Documentation examples are:

- ✓ Hazard analysis;
- ✓ CCP determination;
- ✓ Critical limit determination.

Record examples are:

- ✓ CCP monitoring activities;
- ✓ Deviations and associated corrective reactions;
- ✓ Modifications to the HACCP system.

Table 1: CCP control plan related to the process of obtaining carbonated spring water.

Step	CCP	Control Measures	Critical Limits	Monitoring	Corrective Actions and Measures	Records, Documents	responsibilities
Mechanical filtration	CCP1	-Presseure difference monitoring at the plate filtre -Calibrating the pressure guges	Maximum 4 bar	Every hour	-Filter replacement -Filter washing -Filter inspection Staff training	-Operational control sheet -Input water quality monitoring register	-Operator -Quality control laboratory -Maintenance manager
Carbonation	CCP2	-Determining the CO2 content in the product	Minimum 2500mg/L CO2	For each batch	-CO2 cylinder replacement -CO2 flow adjustment -Staff training	-Operational control sheet -Finushed product quality monitoring register	Operator Quality control laboratory Maintenance manager

IV.3. Benefits of Implementing the HACCP System

IV.3.1. Benefits for Consumers

- Lower risk of food borne illnesses
- Greater awareness of food safety
- Greater confidence in food supply
- Better quality of life through health and socioeconomic benefits

IV.3.2. Benefits for Industry

- Greater consumer confidence on product
- Minimizes legal and insurance costs
- Increases market access
- Lower wastage, fewer no recalls, minimum or no reprocessing, and corrective action
- A consistent product
- Enhanced staff commitment to food safety
- Lower business risk

IV.3.3. Benefits for Regulatory Bodies

- Improved health among the community
- More efficient food control
- Lower public health costs
- Trade promotion
- Greater confidence of the community in the food supply

IV.4. Application of HACCP

While the application of HACCP to all segments and sectors of the food chain is possible, it is assumed that all sectors should be operating according to good manufacturing practices (GMPs) and the Codex General Principles of Food Hygiene. The ability of an industry segment or sector to support or implement the HACCP system depends on the degree of its adherence to these practices.

V.Traceability

Ability to trace the history , application or location of an object. Whene considering a product or a service traceability can relate to:

- The origin of materials and parts
- The processing history
- The distribution and location of the product or service after delivery.

The Codex Alimentarius defines traceability as “the ability to follow the movement of a food through specified stage(s) of production, processing and distribution”.

In recent years, the focus on product traceability in food supply chains has increased due to high-profile food scandals around the turn of the century. Incidents like the BSE case (**BSE (bovine spongiform encephalopathy)**) is a progressive neurological disorder of cattle that

results from infection by an unusual transmissible agent called a prion) and dioxin contamination of chicken feed prompted stronger traceability requirements in legislation and commercial standards. Advances in electronic systems for traceability now offer benefits beyond risk reduction, including:

- Reduced cost and labour related to better information logistics and less re-punching of data internally.
- Reduced cost and labour related to exchange of information between business partners through better integration of electronic systems
- Access to more accurate and more timely information needed to make better decisions in relation to how and what to produce.
- Competitive advantage through the ability to document desirable product characteristics, in particular relating to sustainability, ethics and low environmental impact

VI. Standards and quality assurance

Quality Assurance is an integral part of the Quality Approach; it ensures the quality of the service or product provided by the laboratory, including internal processes. While the Quality Approach encompasses all structural "Quality" actions, such as implementing document management, a Quality manual, or a non-conformity management system.

Most of the time, Quality Assurance actions (or product assurances) naturally arise from the requirements of "clients" and experiences. They are well understood, accepted, and widely practiced in the laboratory for a long time.

VI.1. Quality Assurance

The definition of Quality Assurance, as stated in the latest version of the ISO 9000 standard is as follows: Set of predetermined and systematic activities implemented within the quality system and demonstrated as necessary to provide appropriate confidence that an entity will meet quality requirements and implement a virtuous cycle for continuous quality improvement.

VI.2. Quality Approach

The definition found in the ISO 9000 standard for the Quality Approach is as follows: Organizational approach enabling continuous progress in addressing non-conformities. It is a participatory approach, meaning that the entire company must necessarily be involved, and consequently, it must be carried out at the highest hierarchical level.

VI.3. Certification

is the certification by an independent body that the quality organization of the company complies with a standard.

VI.4. Standards

A standard is a public document (not free of charge) establishing an optional game rule. Prepared by a recognised body after discussion and agreement of all some designations of normative bodies.

VI.4.1. Important ISO standards:

ISO 9001, Quality management systems —Requirements (also known as ISO 9001:2015).

ISO 22 000, food safety management systems requirements for any organization in the food chain.

A-ISO 9001 Quality management systems

The adoption of a quality management system is a strategic decision for an organization that can help to improve its overall performance and provide a sound basis for sustainable development initiatives.

The potential benefits to an organization of implementing a quality management system based on this international standards are:

- The ability to consistently provides products and services that meet customer and applicable statutory and regulatory requirements.
- Facilitating opportunities to enhance customer satisfaction.
- The quality management system requirements specified in this international standards are complementary to requirement for products and services.

This international standards employs the process approach, which incorporates the PDCA cycle and risk-based thinking.

The process approach enables an organization to plan its processes and their interaction.

Quality management principles are Customer focus, leadership, engagement of people, improvement, relationship management.

B. ISO 22 000, food safety management systems requirements for any organization in the food chain

Food safety is related to the presence of food borne hazards in food at the point of consumption (intake by the consumer). As the introduction of food safety hazards can occur at any stage of the food chain, adequate control throughout the food chain is essential. Thus food safety is ensured through the combined efforts of all the parties participating in the food chain.

Organization within the food chain range from feed producers and primary producers through food manufacturers, transporters and storage operators and subcontractors to retail and food service outlets (together with inter-related organizations such as producers of equipment, packaging material, cleaning agents, additives and ingredients). Service providers are also included.

This international standard specifies the requirements for a food safety management system that combines the following generally recognized key elements to ensure food safety along the food chain up to the points of final consumption:

- Interaction communication
- System management
- Prerequisite programmes
- HACCP principles

Communication along the food chain is essential to ensure that all relevant food safety hazards are identified and adequately controlled at each step within the food chain.

Recognition of the organization's role and position within the food chain is essential to ensure effective interactive communication throughout the chain in order to deliver safe food products to the final consumer.

This international standard integrates the principles of the HACCP system and the application steps developed by the Codex Alimentarius Commission. By means of auditable requirements it combines the HACCP plan with prerequisite programmes.

Hazard analysis is the key to an effective food safety management system since conducting a hazard analysis assists in organizing the knowledge required to establish an effective combination of control measures.

This international standard requires that all hazards that may be reasonably expected to occur in the food chain including hazards that may be associated with the type of process and facilities used are identified and assessed.

This international standard specifies the requirements for a food safety management system where an organization in the food chain needs to demonstrate its ability to control food safety hazards in order to ensure that food is safe at the time of human consumption.

It is applicable to all organizations regardless of size which are involved in any aspect of the food chain and want to implement systems that consistently provide safe products. The means of meeting any requirements of this international standard can be accomplished through the use of internal and/or external resources.

This international standard specifies requirements to enable an organization :

- To plan, implement, operate, maintain and update a food safety management system aimed at providing products that according to their intended use are safe for the consumer.
- To demonstrate compliance with applicable statutory and regulatory food safety requirements.
- To effectively communicate food safety issues to their suppliers, customers and relevant interested parties in the food chain.
- To seek certification of its food safety management system by an external organization.

Case study 1

Suppose that your company's website is down. You obviously need to get the site back up and running as a priority. Immediately after the site is back up and running you might then find it

useful to use the 5 Whys technique to ensure that all the causes of the problem are addressed so that it doesn't happen again.

Case study 2

Imagine you are managing a restaurant. Describe the hygiene good practices that should be implemented to ensure food safety and customer well-being. Include specific measures for food preparation, storage, handling, and staff training.

Case study 3

A manufacturing company has been experiencing defects in its products, leading to customer complaints and decreased satisfaction. Using the PDCA cycle, outline the steps the company should take to address this issue and improve its product quality.

1. Algerian Regulatory Framework for Food Safety

Food safety is a major public health concern in Algeria. To protect consumers and ensure the safety and quality of food products placed on the market, Algeria has established a comprehensive legal and regulatory framework governing food hygiene, food safety, consumer protection, and fraud prevention. This framework is based on laws, executive decrees, ministerial orders, and official control systems that apply throughout the food chain.

2. Main Algerian Legal Texts Related to Food Safety

2.1. Consumer Protection and Fraud Prevention

Law No. 09-03 of 25 February 2009 on Consumer Protection and Fraud Prevention

This law is the cornerstone of Algerian food safety legislation. It establishes the general principles for consumer protection and requires that products placed on the market be safe and compliant with regulatory requirements. It also defines the responsibilities of producers, importers, distributors, and service providers regarding product safety and quality.

2.2. Food Hygiene and Sanitation Requirements

Executive Decree No. 17-140 of 11 April 2017

This decree establishes hygiene and sanitation requirements during the process of placing food products on the market for human consumption. It applies to all stages of the food chain, including production, importation, processing, storage, transportation, distribution, and retail sale. The decree incorporates principles consistent with Good Hygiene Practices (GHP), HACCP, and Codex Alimentarius recommendations.

2.3. Food Product Safety

Executive Decree No. 12-203 of 6 May 2012 relating to product safety rules

This decree specifies the obligations of economic operators regarding the marketing of safe products and strengthens consumer protection measures.

2.4. Food Additives

Executive Decree No. 12-214 of 15 May 2012

This decree defines the conditions and procedures governing the use of food additives in foods intended for human consumption.

2.5. Food Contaminants

Executive Decree No. 14-366 of 15 December 2014

This decree establishes the conditions and limits applicable to contaminants tolerated in food products, contributing to consumer protection against chemical hazards.

2.6. Microbiological Specifications of Food Products

Executive Decree No. 15-172 of 25 June 2015

This decree establishes the conditions and procedures applicable to microbiological specifications of food products intended for human consumption. It requires food operators to

ensure the microbiological safety of food products and provides the legal basis for microbiological criteria used in official controls.

Interministerial Order of 4 October 2016

This order establishes the microbiological criteria applicable to various categories of food products and complements Executive Decree No. 15-172.

3. National Authorities Responsible for Food Safety

Several governmental bodies are involved in food safety control and surveillance in Algeria:

1. **Ministry of Commerce and Internal Market Regulation.** responsible for:
Consumer protection; Market surveillance; Food quality control; Fraud prevention;
Labeling compliance.
2. **Ministry of Agriculture, Rural Development and Fisheries,** responsible for:
Veterinary control; Animal health; Plant health protection; Inspection of agricultural products.
3. **Ministry of Health,** responsible for: Public health protection; Monitoring foodborne diseases; Epidemiological surveillance of food poisoning outbreaks

4. Food Safety Governance in Algeria

Food safety responsibilities in Algeria are shared among several ministries and official inspection services operating under a coordinated regulatory framework. In Algeria, the National Office for Food Safety (**Office national de sécurité sanitaire des produits alimentaires**) is responsible for supporting food safety governance through risk assessment, scientific expertise, surveillance, and coordination between stakeholders involved in food control.

5. Harmonization with International Standards

The Algerian food safety system is increasingly aligned with international standards, including:

- Codex Alimentarius Commission recommendations;
- HACCP (Hazard Analysis and Critical Control Points);
- International Organization for Standardization ISO 22000 Food Safety Management Systems;

The Algerian regulatory framework for food safety is founded on Law No. 09-03 of 25 February 2009 and is supported by several executive decrees and ministerial orders covering food hygiene, microbiological criteria, food additives, contaminants, labeling, and consumer protection. The implementation of these regulations contributes to safeguarding public health, improving food quality, and strengthening consumer confidence. For students in Food Technology and Quality Control, understanding this legal framework is essential for ensuring compliance with food safety requirements and for future professional practice in the agri-food sector.

General Conclusion

Food hygiene and safety play a vital role in ensuring the quality and safety of food products and in protecting public health. Throughout this course, the fundamental concepts of food hygiene, foodborne hazards, contamination pathways, Good Hygiene Practices (GHP) and the principles of the Hazard Analysis and Critical Control Points (HACCP) system have been presented and discussed. These concepts provide the scientific and technical basis for preventing, controlling, and managing food safety risks across the entire food chain.

The knowledge acquired through this module enables students to understand the importance of implementing preventive measures and quality assurance systems in food production and processing environments. It also highlights the responsibility of food professionals in maintaining food safety standards and complying with national and international regulations.

As future professionals in the fields of Food Technology and Quality Control, students will be called upon to apply these principles in various sectors of the agri-food industry, including food manufacturing, quality assurance, food inspection, laboratory analysis, and food safety management. Furthermore, emerging challenges such as globalization of food markets, climate change, antimicrobial resistance, food fraud, and the integration of new technologies in food production emphasize the need for continuous learning and adaptation.

The concepts and tools presented in this course therefore constitute an essential foundation for both professional practice and advanced studies in food quality, food safety management, and public health protection. Through the application of these principles, future graduates can contribute effectively to the production of safe, high-quality, and sustainable food products.

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