TVET CERTIFICATE III in Food Processing

FUNDAMENTALS OF FOOD PROCESSING AND TECHNOLOGY

FOPFF: 302

Integrate fundamentals of food processing

Learning hours: 100

Competence

Credits: 10

Sector: Agriculture and Food processing

Sub-sector: Food processing

Module Note Issue date: November, 2020

Purpose statement

This module describes the skills, knowledge and attitudes required to identify history of food processing industry, identify food safety requirements and describe important processing operations in the food industry. At the end of this module, participants will be able to identify most important historical events of the transformation of cooked ingredients, by physical or chemical means into food, or of food into other forms. Learners will be able to improve food safety-related behaviours and practices. They can describe food processing activities such as mincing and macerating, liquefaction, emulsification, and cooking, pickling, pasteurization, and many other kinds of preservation and canning or other packaging.

Table of Contents

Elements of competence and performance criteria		
Learning Unit	Performance Criteria	
1. Learning Unit 1: Identify	1.1. Proper identification of historical events in	3
food processing industry	food processing Industry in accordance with	
history	the time sequence in which they occurred	
	1.2. Detailed description of food industry by	
	evolution of food processing equipment and	
	techniques and consumer behaviours	
	1.3. Detailed description of current trends in	
	food processing industry according to culture	
	and region	
2. Learning Unit 2: Identify	2.1. Proper identification of HARPC elements	15
food safety requirements	according to the regulations	
	2.2. Proper identification of HACCP program in	
	accordance with control procedures	
	2.3. Proper identification of certification	
	bodies based on the scheme status and	
	categories of activity	
3. <u>Learning Unit 3: Describe</u>	3.1. Proper distinction of food processing	46
important food industry	industries by capability	
processes	3.2. Proper identification of industrial activities	
	in accordance with food industry processes	
	3.3. Proper identification of food processing	
	techniques according to the requirements	

Learning Unit 1 – Identify food processing industry history

LO 1.1 – Identify historical events in food processing Industry

Content/Topic 1 : Key concepts

- ✓ **Food Science** is the study of the physical, biological, and chemical makeup of food; the causes of food deterioration; and the concepts underlying food processing. It is also defined as a science that deals with the physical, chemical and biological characteristics of a food. It deals with food harvesting, food preparation /processing, food packaging and food storage concern it in order to reach a consumer without unwanted changes in physical, nutritional and safety characteristics of the food.
- ✓ **Food Technology** is a branch of food science that deals with the techniques involved in production, processing, preservation, packaging, labelling, quality management, and distribution of food products. The field also involves techniques and processes that are used to transform raw materials into food. It is, therefore, the application of food science to the selection, preservation, processing, packaging, distribution, and use of safe food.
- ✓ **Food Scientist** is expert on the biological, chemical and physical make-up of food, and how food can be processed, stored and preserved. Food scientist applies this knowledge to make new food products and to ensure that they are safe and of good quality.
- ✓ Food processing is the conversion of agricultural product to substances, which have particular textural, sensory and nutritional properties using commercially feasible methods. Food Processing is also the set of methods and techniques used to transform raw ingredients into finished and semi-finished products. It requires good quality raw materials from either plant and/or animal source to be converted into attractive, marketable and often long shelf-life food products.
- ✓ **Food preservation** is defined as the process of treating and handling food in such way as to stop or greatly prevent food borne illness while maintaining nutritional value, texture and flavour. It is also a form of processing of food to prevent it from spoilage and making it possible to store in a fit condition for future use.

Content/Topic 2: History of Food Processing

✓ Pre-historic times

History of food processing is the history of transformation process of raw ingredients into food or food into other forms. Food processing has occurred since pre-historic times. Humans have been using fire for at least 250,000 years. Food processing dates back to the prehistoric ages when crude processing including various types of cooking, such as roasting, smoking, steaming, fermenting, sun drying and preserving with salt were in practice. Cooking as a form of food processing which improves palatability, digestibility, and safety, followed thereafter. Food processing is probably one of the oldest avocations man has been involved with from time immemorial.

✓ Ancient and medieval times

More complex forms of food processing emerged in ancient and medieval times: baking bread, producing cheese, wine, sun-dried or vinegar-pickled vegetables, and salted or smoked meat. various types of cooking (such as roasting, smoking, steaming, and oven baking), Such basic food processing involved chemical enzymatic changes to the basic structure of food in its natural form, as well served to build a barrier against surface microbial activity that caused rapid decay. Salt-preservation was especially common for foods that constituted warrior and sailors' diets until the introduction of canning methods. Evidence for the existence of these methods can be found in the writings of the ancient Greek, Chaldean, Egyptian and Roman civilizations as well as archaeological evidence from Europe, North and South America and Asia. The major food preservation techniques were based on:

- ♣ Drying was used to preserve all sorts of foods. Grains like rye and wheat were dried in the sun or air before being stored in a dry place. Fruits were sun-dried in warmer climes and oven-dried in cooler regions. Meat could also be preserved through drying, usually after cutting it into thin strips and lightly salting it.
- **Salting** was the most common way to preserve virtually any type of meat or fish, as it drew out the moisture and killed the bacteria.
- ♣ **Pickling foods:** Immersing fresh vegetables and other foods in a liquid solution of salt brine was a common practice in medieval Europe. The simplest pickling was done with

water, salt and an herb or two, but a variety of spices and herbs as well as the use of vinegar, (after the 12th century) lemon led to a range of pickling flavours.

✓ Industrial revolution

Mass scale food processing (producing foods in large amounts) was introduced during the industrial revolution in the 18th and 19th century, starting with the advent of canned and pasteurized foods. In the first half of the 20th century, Europe was ravaged or withered by malnutrition (under nutrition), caused by poverty, an economic depression and two catastrophic world wars. As a result, mass food production focused on sustaining the European population; reducing food borne diseases, malnutrition and nutrient deficiencies by providing protein-rich, energy-dense and fortified foods (with vitamins) that were accessible to all.

In the 20th century, World War II, the space race and the rising consumer society in developed countries contributed to the growth of food processing with such advances as spray drying, evaporation, juice concentrates, freeze drying and the introduction of artificial sweeteners, colouring agents, and such preservatives as sodium benzoate. In the late 20th century, products such as dried instant soups, reconstituted fruits and juices, and self-cooking meals such as MRE food ration were developed. By the 20th century, automatic appliances like microwave oven, and blender, for convenience cooking.

In Western Europe and North America, the second half of the 20th century witnessed a rise in the pursuit of convenience. Food processing companies marketed their products especially towards middle-class working wives and mothers. Frozen foods (often credited to Clarence Birdseye) found their success in sales of juice concentrates

Canning

Canning is the first major industrial form of food preservation. In simple terms, it's the process by which foods are sealed in jars or cans and heated to a temperature that destroys microorganisms and inactivates enzymes. This heating (and later cooling) forms a vacuum that prevents other microorganisms from contaminating the food as long as the seal remains unbroken.

In the early 1800s, during the Napoleonic wars, the French government offered a cash award of 12,000 francs to any inventor who could devise a cheap and effective method of preserving large amounts of food to feed armies with regular supplies during winter months. In 1809, Nicolas Appert, a French confectioner and brewer, won the prize for discovering that the application of heat to food in sealed glass bottles preserved the food from deterioration

Pasteurization

Although Appert had devised a successful method to preserve foods, he did not understand why it worked. It was not until 1864, when Louis Pasteur discovered pasteurization, that the cause-and-effect connection between microbes and food borne illness became clear. Whereas Appert had believed the lack of air within the sealed vacuum killed pathogens, Pasteur proved that it was the heat itself.

Today, pasteurization is used widely in the dairy industry and other food processing industries (such as juice, vinegar, eggs, and nuts) to achieve both food preservation and food safety for packaged and unpackaged products. Typically, one of three processes is involved:

- ♣ High Temperature Short Time (HTST): the most common form of pasteurization that uses metal plates and hot water to raise temperatures to at least 161° F (72°C) for not less than 15 seconds, followed by rapid cooling.
- ♣ Ultra Pasteurization (UP): requires that foods be heated to not less than 280°F (138°C) for two seconds, resulting in a product with a longer shelf life, but still requiring refrigeration.
- ♣ Ultra High Temperature (UHT): involves heating with commercially sterile equipment and filling it under aseptic conditions into hermetically sealed packaging that is "shelf stable" with no need for refrigeration.

LO 1.2 – Describe the evolution of food processing industry

Content/Topic 1: Key drivers of growth in food processing:

✓ Satisfy customer needs and consumer behaviour

← Customer satisfaction has been one of the top tools for a successful business. Customer satisfaction is defined as an overall evaluation based on the total purchase and consumption experience with the good or service overtime. With marketing, customer satisfaction also comes along with it, which means it ascertains the expectation of the customer on how the goods and services are being facilitated by the companies.

- **↓ Consumer behaviour** reflects on the totality of consumer decisions with respect to the acquisition, consumption and disposition of goods, services etc. Buying behaviour particularly involves collective responses of buyers for selecting, evaluating deciding and post purchase behaviour. Buyers' behaviour is the study of the human response to services and marketing of product and services.
- ✓ **Civilization**: Food-processing techniques use cutting-edge technology; others have been practiced for millennia. Thousands of years before food scientists figured out how to make dinosaur-shaped chicken nuggets or pieces, early Egyptians were brewing beer and baking leavened bread.

Today, for better and for worse, nearly all our food is processed in some way. Food processing offers important benefits to businesses and consumers, including a more varied food supply and foods with a longer shelf life. Certain aspects of food processing, however, raise concerns over dietary health, worker health, and food safety.

- ✓ **Industrialization**: The increasing intensification and capitalization of the production, transport, storage, and retailing of foods, especially of 'Westernized' products, associated with agribusiness and transnational corporations. Consumers may benefit from cheaper food but there are quality implications and health externalities. As consumer confidence has been shaken, new quality agencies have been created. Tensions have emerged about the state's role as facilitator of industrial efficiencies. Food policy is thus torn between the pursuit of productivity and reduced prices and the demand for higher quality, with implications for both producers and consumers in the developing world.
- ✓ **Technological element**: This refers to the technology dependent activities needed to achieve a product with certain physical properties.
- ✓ **Innovations:** Innovation is the process of translating ideas into useful, and used, new food products, processes or services. Innovation in the food industry combines technological

innovation with social and cultural innovation. It occurs throughout the entire food system, including production, harvesting, primary and secondary processing, manufacturing and distribution.

The ultimate innovation is a new or improved consumer product and service. Innovations can be focused in one area of food technology, for example process engineering, product formulation, food qualities or consumer needs; but ripples or swells spread causing changes in other parts of the food system, in consumer eating patterns and in general social and cultural areas. Food industry innovation strategies need to be based on the total technology in the food system and concerned not only with the technological changes but also with the social and environmental changes, so as to produce food that satisfies the nutritional, personal and social needs and wants of all communities.

The last three examples are more typical of innovation activities conducted in food businesses. It is clear from these examples that not all new products need to be highly technical. Line extensions, packaging changes and good positioning can also provide companies with the opportunity to succeed. The key requirements for all of the above examples are a clear understanding and awareness of the consumer and the market place.

✓ **Mechanization:** It covers all levels of farming and processing technologies, from simple and basic hand tools to more sophisticated and motorized equipment. It eases and reduces hard labour, relieves labour shortages, improves productivity and timeliness of agricultural operations, improves the efficient use of resources, enhances market access and contributes to mitigating climate related hazards. Sustainable mechanization considers technological, economic, social, environmental and cultural aspects when contributing to the sustainable development of the food and agricultural sector.

In mechanization, specialized labour often involves repetitive tasks that can be performed by machines. This meant routine jobs like sowing seeds, harvesting crops, milking cows, and feeding and slaughtering animals could be mechanized, reducing (and in some cases eliminating) the need for human and animal labour.

- ✓ **The economic growth:** the food processing industry is a major contributor to the health of the national economy. In the same way too, the sector is impacted by both the local economy where it manufactures as well as by the global economy in terms of food logistics and imports and exports.
- ✓ **Increasing welfare of people:** food processing sectors use fewer resources to produce greater quantities of existing foods and develop innovative new foods that are nutritionally appropriate for the promotion of health and well-being, have long shelf lives and are conveniently transportable.

Food processing also uses the creative potential of the processor to change basic raw materials into a range of tasty attractive foods that provide interesting variety in the diets of consumers. Without food processing it would not be possible to sustain the needs of modern urban populations, and the choice of foods would be limited by seasonality.

✓ Development of a nutritious, safe, environmentally sustainable, affordable, and abundant food supply: Sustainable food is food that is healthy for consumers and produced in an humane, ecologically benign or caring, socially responsible and economically fair way. That is a wide range of criteria, but true sustainability extends beyond merely reducing greenhouse gas emissions. Sustainability implies the use of resources at rates that do not exceed the capacity of the Earth to replace them. For food, a sustainable system might be seen as encompassing a range of issues such as security of the supply of food, health, safety, affordability, quality, a strong food industry in terms of jobs and growth and, at the same time, environmental sustainability, in terms of issues such as climate change, biodiversity, water and soil quality.

Content/Topic 2 : Evolution of tasks done by food processing equipment

- ✓ **Mincing** is a food preparation technique in which food ingredients are finely divided into uniform pieces. Minced food is in smaller pieces than diced or chopped foods, and is often prepared with a chef's knife or food processor or in the case of meat by a specialized meat grinder.
 - ✓ Macerating is a process of breaking down and softening various substances. Liquids for maceration include liquors, liqueurs, wine, fruit juice, vinegars, and water that may

- (and in the case of water must) be infused with all sorts of flavourings, like spices, herbs, tea, and coffee.
- ✓ **Liquefying** is a process that generates a liquid from a solid or a gas. The melting point is the temperature and pressure at which a solid becomes a liquid in food preparation. This may be done with a blender, or liquidizer.
- ✓ Emulsifying: this is a process adding food additives alter the texture of foods. Emulsifiers, for example, prevent ingredients from separating into unappealing globs or globules in food such as mayonnaise and ice cream.
- ✓ Cooking is the process of producing safe and edible food by preparing and combining ingredients, and (in most cases) applying heat. Cooking is a means of processing food, without which many foods would be unfit for human consumption.
- ✓ **Pickling** is the process of preserving or extending the shelf life of food by either anaerobic fermentation in brine or immersion in vinegar. In East Asia, vinaigrette (vegetable oil and vinegar) is also used as a pickling medium. The pickling procedure typically affects the food's texture, taste and flavour.
- ✓ Pasteurizing is heat-treatment process that destroys pathogenic microorganisms in certain foods and beverages. It is named for the French scientist Louis Pasteur, who in the 1860s demonstrated that abnormal fermentation of wine and beer could be prevented by heating the beverages to about 57° C (135° F) for a few minutes. Pasteurization of milk, widely practiced in several countries, notably the United States, requires temperatures of about 63° C (145° F) maintained for 30 minutes or, alternatively, heating to a higher temperature, 72° C (162° F), and holding for 15 seconds (and yet higher temperatures for shorter periods of time
- ✓ Preserving is a form of processing of food to prevent it from spoilage and making it possible to store in a fit condition for future use. Preservation process including heating or boiling to destroy micro-organisms, oxidation, toxic inhibition, dehydration or drying, osmotic inhibition, freezing, a sort of cold pasteurization which destroys pathogens and various combinations of all these methods
- ✓ Packaging is the science, art and technology of enclosing or protecting products for distribution, storage, sale and use. A package provides protection, tampering

resistance, and special physical, chemical, or biological needs. It may bear a nutrition facts label and other information about food being offered for sale.

LO 1.3 – Describe current trends in food processing industry

Content/Topic 1 : The factors that influence consumers' food choice:

- ✓ Quality: For the Oxford English Dictionary, for example, quality is "the standard of something as measured against other things of a similar kind; the degree of excellence of something". ISO 9000 also defines quality simply as "the degree to which a set of inherent characteristics fulfils requirements". These requirements are the needs or expectations, generally implied or obligatory, of interested parties such as customers, suppliers and society. Thus food quality is the extent to which the all the established requirements relating to the characteristics of food are met.
- ✓ **Price:** Household income and the price of food is an important factor influencing food choice, especially for low-income consumers. Price is primarily considered in a (consumer) customer-oriented net value sense. It is the basis for quality/price perception.
- ✓ **Appearance:** the role appearance plays in influencing consumer perception and subsequent acceptance of a food product. Texture and flavour have long since been known to exert an effect on consumer perception. However, the "first taste is almost always with the eye". This is especially the case where a food product is sold through its appearance, rather than through its packaging. In addition, appearance can have a halo effect, which modifies subsequent flavour perception and food acceptability.
- ✓ **Taste:** It is, and has always been, one of the major and often the major criteria for evaluating food products. Taste is the most important, but not the only, aspect in what we can call the hedonic quality dimension of food. The term hedonic means "to do with pleasure", and is related to the philosophy of hedonism, which holds that pleasure is the ultimate goal of all human behaviour. Many food products have aesthetic or sensual qualities that give the consumer pleasure, as opposed to utilitarian (functional) aspects of food products. The hedonic aspects of food include appearance, smell, and especially taste

- ✓ Health: Health is mainly related to the content of unsaturated fat and cholesterol, but also to the oil being a pure and natural product. The term "functional foods" or" healthy foods" covers food products that have been enriched with natural substances/components with specific physiological preventive and/or health-promoting effects.
- ✓ Family preferences: Food choices change as reciprocal responsibilities develop when couples establish relationships and cohabit. The arrival of children also changes family dynamics. Food preferences are influenced by family rule setting as adults attempt to shape food choices of children. Conversely, children can also influence adult food choice in families. The role of social class and single parent status play an important role in food choice.
- ✓ Habits: Food habits have been described as "the way in which individuals in response to social and cultural pressures select, consume, and utilize portions of the available food supply". Food habits evolve from learned experience, which leads to the development of attitudes towards food. Thus food habits become a form of self-expression.
- ✓ Food safety refers to the absence of hazards or the existence of hazard levels with an acceptable risk. It is also defined as assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use.
- ✓ Production methods: Consumer concern regarding the way food products are produced has increased during the last 10-15 years. There are three broad areas of interest: (1) Interest in organic production (2) Interest in animal welfare (3) Interest in products manufactured in a 'natural' way, i.e. without the use of advanced technology

However, the use of GMOs in food production was given as an example of an advanced technology, which consumers regard as unnatural and therefore reject.

Process-related qualities of a food product are almost exclusively credence characteristics, since the consumer is seldom able to evaluate whether a food product has actually been produced under the promised conditions. Even during cooking and consumption, the consumer has no possibility of determining whether the food product has the promised process qualities. As with other credence quality dimensions (e.g. health), consumers'

perception of quality is a question of the number of and trust in cues or indications signalling these qualities. Organic farming, for example, is mainly characterized by a ban against the use of fertilizers, chemical crop sprays, prophylactics and industrial feed additives.

- ✓ **Country of origin:** Consumer understanding and use of country-of-origin in food choice. The consumer perceptions of product-country are related to specific issues of confidence and trust in integrity of production, certification and regulatory systems.
- ✓ **Culture and/or religion:** Cultural influences lead to the difference in the habitual consumption of certain foods and in traditions of preparation, and in certain cases can lead to restrictions such as exclusion of meat and milk from the diet. Cultural influences are however amenable to change: when moving to a new country individuals often adopt particular food habits of the local culture.
- ✓ Brand name: Consumer understanding and use of country-of-origin in food choice. The consumer perceptions of product-country are related to specific issues of confidence and trust in integrity of production, certification and regulatory systems.
- ✓ Availability: This concerns availability of products, ingredients and or raw materials, at the right moment, correct amount and in the right place.

Sometimes food that consumers want may not be available. They will then have to decide to either make a substitution or not have that food at all. On other hand, there are food items such as apple that tend to regularly be available. Thus knowing that the consumers usually get food items may influence their decision as well.

✓ Avoiding food allergies: A food allergy occurs when the body's immune system triggers an abnormal response to food. Symptoms of allergic reaction to a specific food range from sneezing and nasal congestion or blocking to anaphylaxis.

Many people react to a substance, or allergen, with watery eyes, a runny nose, and maybe a rash. However, a severe allergic reaction can lead to a serious condition known as anaphylaxis. Food allergic consumers' food choices are influenced by a number of factors that differ to

those of non-food allergenic (NFA) consumers. It is therefore important to offer people with food allergies or intolerances advice that goes beyond how to avoid allergens.

Content/Topic 2 : Processed food new trends:

- ✓ **Experience**: this is just as important as taste, and social media is key for trend setting in this possible future. Looking to have more food experiences, people have many snacks, rather than three meals a day.
- ✓ Health: It seems like a motive to purchase food, being healthy, proactive measure for later life.
- ✓ **Sustainability:** It reflects on natural and organic foods that have increased importance level of the consumers of environmental sustainability values.
- ✓ Convenience: This is about the time saving, easy to prepare and clean-up of processed food.
- ✓ **Pleasure:** Premium or top quality foods: fun, enjoyment.

Learning Unit 2 – Identify the food safety requirements

LO 2.1 – Identify HARPC elements

Content/Topic 1: Hazard Analysis and Risk-based Preventive Controls (HARPC)

HARPC stands for "Hazard Analysis and Risk-Based Preventive Controls." The term comes from Food Safety Modernization Act (FSMA), a sweeping food safety legislation amending the Food, Drug and Cosmetic Act that was enacted in January of 2011. As required by FSMA, FDA promulgated the HARPC regulation (also referred to as the "Preventive Controls Rule" for the food industry on September 17, 2015.

HARPC requires virtually every food manufacturer, processer, packer, and storage facility to:

- * Identify food safety and adulteration hazards associated with their foods and processes,
- ※ Implement controls to minimize the hazards,
- * Verify that the controls are working, and
- * Design and implement corrective actions to address any deviations from the controls that might arise in a food safety plan.

The "RPC" in HARPC stands for "Risk-based Preventive Controls." This portion of HARPC requires companies, whether foreign or domestic, to develop and implement a series of risk-based controls to significantly minimize or prevent the identified hazards to ensure the safety of the food it manufactures, processes, holds and distributes.

The Company must designate controls at food processing steps that are appropriate for ensuring the safety of the food, especially, the critical control point (CCP). CCPs are critical manufacturing points, where the Company can apply controls to minimize or eliminate the hazard or reduce the hazard to an acceptable level under normal manufacturing operations.

Examples of types of preventive controls include:

- ★ Sanitation procedures at food surface contact points
- * Sanitation of utensils and equipment
- * Staff hygiene training
- ₩ Food allergen control program
- Recall plan
- Current Good Manufacturing Practices (cGMPs)

※ Supply-chain controls

The Company must have written preventive controls. For each hazard that requires a preventive control, the Company must establish a written recall plan.

If a particular hazard will be controlled by another facility in the supply-chain (whether a supplier or later distributor/processor), the Company is not required to implement a preventive control as long as the Company records and obtains written assurance from the other facility that the hazard is being controlled.

However, HARPC plan differs from HACCP plan as follow:

Hazards: In addition to the biological, chemical, and physical hazards typically identified in a HACCP plan, a HARPC plan must also consider:

- ✓ Radiological hazards
- ✓ Natural toxins, pesticides, drug residues, decomposition, parasites, allergens, and unapproved food and color additives
- ✓ Naturally occurring hazards or unintentionally introduced hazards
- ✓ Intentionally introduced hazards for economic gain

Controls: While HACCP plans may apply process controls at critical control points, a HARPC plan may also apply:

- ✓ Allergen controls
- ✓ Sanitation controls
- ✓ Supply chain controls
- ✓ Other preventive controls

Components: HARPC introduces components not addressed by HACCP. Under HARPC, most facilities are required to establish:

- ✓ A recall plan
- ✓ A supply chain program
- ✓ Critical Control Points (CCPs)

CCPs is a point, step, or procedure in a food process at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce such hazard to an acceptable level. CCP's are usually practices/procedures which, when not done correctly, are the leading causes of food borne illness outbreaks. Examples of critical control points include: cooking, cooling, re-heating, holding.

Examples of critical control points and critical limits that food industry could apply.

CCPs	Critical limits
Cooking	Time and Temperature
Cooking	Time and Temperature
(PH Level) Formulation	Concentration (ppm),PH
(Moisture activity) Dehydration	Water activity (Aw)
Freezing for parasite control	Time and Temperature
Sifting	Mesh size
Chlorination	Concentration, Volume
Filtration	Filter size

- → Pasteurization: an example of a lethal heat treatment that reduces microbial pathogens but does not lead to a shelf stable product. Pasteurization typically is applied to foods to kill non spore forming pathogens such as Salmonella, Listeria monocytogenes, and pathogenic strains of E. coli.
- ♣ Cooking: Foods are cooked to temperatures below for the specified time: Shell eggs cooked for immediate service, fish, meat, and all other potentially hazardous food not specified below cooked to 145°F(63°C) for 15 seconds; Shell eggs cooked other than for immediate service, ground fish and meats, commercially raised game animals, and injected meats cooked to 155°F(68°C) for 15 seconds; Whole roasts (for rare roast beef) cooked to 130°F(44°C) and held for at least 112 minutes; Poultry; stuffed meat, stuffed pasta or poultry; or stuffing containing fish meat, or poultry cooked to 165°F (74°C)for 15 seconds; Raw animal foods cooked to 165°F (74°C)and held for 2 minutes, when using microwave oven for cooking; Fruits, vegetables for hot holding cooked to at least

- 135°F(57°C); and Undercooked seared beefsteak cooked to 145° F(63°C) for 15 seconds, must have a "cooked" colour change on surface, and regulatory approval of process used.
- **4 Cooling:** Ready-to-eat potentially hazardous foods for cold service are cooled to an internal temperature of 41°F (5°C) within 4 hours. Cooked foods are cooled from 135°(57°C) F to 70° F within 2 hours and from 70°(21°C) to 41°F(5°C) within an additional 4 hours.
- ♣ P^H level: One critical control point for all acidified foods is a finished equilibrium pH of 4.6 or below.
- ♣ Moisture activity: Water activity is frequently used as a critical control point for Hazard Analysis and Critical Control Points (HACCP) programs. Samples of the food product can be tested to ensure water activity values are within a specified range for food quality and safety.
- ✓ Prerequisite Programs (PRPs): These are steps or procedures, including GMPs and SSOPs, which control the operational conditions within a food establishment and promote environmental conditions that are favourable for the production of safe food.
 Prerequisite programs are the foundation of a Food Safety/HACCP System. It includes also operating conditions necessary to support the Food Safety plan. Examples of PRPs are GMPs, Pest control, Sanitation and allergen control.
 - ♣ Good Manufacturing Practices (GMPs): GMPs are practices required in order to conform to guidelines recommended by agencies that controls the authorization and licensing of the manufacture and sales of food and beverages. GMPs means also a combination of manufacturing and quality control procedures aimed at ensuring that the products are consistently manufactured according to their specifications. GMP system ensures that manufacturing products, such as food, are consistently produced and controlled according to set quality standards.

• Benefits of GMPs compliances are:

- ✓ Increased consumer satisfaction
- ✓ Reduced consumer complaints
- ✓ Improved internal procedures and competences

- ✓ Improved product quality
- ✓ Compliance with regulatory and legal requirements
- ✓ Increased reputation of the company
- ✓ Reduced operating costs and improved profit margins
- ✓ Improved employee's morale
- ✓ Improved food safety system
- ✓ Removed potential export barriers
- ♣ Pest control: Pests pose a major threat to food safety and suitability of food as they are inherently drawn towards food. The food industry is one of the most vulnerable segments which cannot do without pest control to maintain their high levels of food safety. Pests are carriers of a wide variety of disease causing bacteria, viruses and a host of other microorganisms causing health adverse effects to staff involved in the processing and handling of food, to consumers

Some pests which are found commonly across a majority of food industries are rodents, cockroaches, flies, birds and beetles

- Pest control program is needed to be implemented for the following reasons:
- ✓ Pest infestation can across where there are bleeding sites and a supply of food;
- ✓ They damage food materials and food packaging materials;
- ✓ They are source of microorganisms that spread diseases through a transfer of pathogens;
- ✓ They can cause the bad reputation and loss of credit to food industry and
- ✓ The Prosecution and closure of food industry due to the poor pest control program.
- The measures to be taken for pest control in food industry
 - ✓ The interior walls may contain as less as possible cracks
 - ✓ The exterior windows have to be provided with the insect screen
 - ✓ The unloading and loading gates have to be closed after loading and unloading.
 - ✓ The company and the outside company needs to kept neat and clean
 - ✓ The apparatus and rooms that are not used need to be clean
 - ✓ The prolonged staying of a pool of water has to be avoided in the surrounding of a company

- ✓ The placement of baits, traps in, and the surrounding of the company
- ✓ Insects killers have to be placed where necessary; especially on unloading and loading platforms and where their direct entrance to outside or cleaning zones
- ✓ The ultra-violets lamps are often used and yearly replaced according to manufacturer instructions.

Sanitation

Sanitization is the use of any chemical or other effective method to reduce the initial bacterial load on the surface of raw materials or food processing equipment. Effective sanitation includes both outside and inside of the plant such as specific floor, approved materials used in construction, adequate light, air ventilation, direction of air flow, separation of processing areas for raw and finished products, sufficient space for operation and movement, approved plumbing, water supply, sewage disposal system, waste treatment facilities, drainage, soil conditions, and the surrounding environment.

The sanitation of clean areas is particularly important. They should be cleaned thoroughly in accordance with a written programme. Where disinfectants are used, more than one type should be employed. Monitoring should be undertaken regularly in order to detect the development of resistant strains. Disinfectants and detergents should be monitored for microbial contamination; dilutions should be kept in previously cleaned containers and should only be stored for defined periods unless sterilised.

→ Allergen control: Food allergy refers the response of the immune system involves the formation of allergen-specific immunoglobulin E antibodies (IgE), which cause a range of reactions that can clinically manifest in various forms like anaphylaxis, eczema, vomiting, asthma, etc.

Food intolerances do not involve the immune system but other substances than proteins cause the adverse reactions. Typical reactions involve anaphylactic reactions, metabolic food disorder.

Food allergen means food substance which is in some sensitive individuals, cause an immune response causing bodily reactions resulting in the reactions resulting in release of histamine and other substances in the tissues from the body's mast cells in eyes, skin, respiratory system and intestinal system.

Dealing with allergens during food manufacturing

Food manufacturer should concentrate this attention dealing effectively with "Major Serious Allergens (MSAs)" such as milk, eggs, wheat, peanuts, shellfish, fruits, and tree nuts. It could also include the so-called" second eight" which includes sesame seeds, sunflower seeds, cottonseeds (meal, not oil), poppy seeds, molluscs, beans other than green beans, peas, lentils.

Control of food allergens during processing

The following means should be followed in order to control allergens:

MSAs produced in more than one site, or in different building on the same site, serious consideration should be given to the production segregation

- ❖ In case the production segregation is not possible, separate production equipment should be used if possible
- Where shared production equipment between one or more MSAs-free products and a MSAs-containing product is unavoidable, the MSA-containing product should be run the last production of the day immediately before cleaning.
- Equipments used to manufacture MSAs containing products should be cleaned before.

Control of Food allergens through the product labelling

Appropriate information about the presence of MSAs in product is necessary on the product label.

The presence or potential presence of MSAs should be separately stated on label prominent an easily way, where the potential purchaser under normal conditions of display will clearly see it.

Where the product contains one or more than MSAs (whether as individual

Ingredient or as component(s) in a compound ingredients, the presence of MSAs should be stated for instance "contains PEANUTS" to which some people may be allergic.

The terminology used to state the presence of MSAs in the product should be clearly understandable by ordinary consumer for example:

- ✓ Where calcium caseinate is MSA concerned, the information on the label should be read:
 contains "MILK PROTEIN" to which some people may be allergic and not contains
 "CALCIUM CASEINATE".
- ✓ Where a product normally free from MSAs is produced on the production line shared with a MSA containing product a suitable statement should be "May be contain traces of "PEANUTS" to which some people may be allergic.
- ✓ Where a product nominally free from MSAs is produced in free same factory building as SMA-containing products, a suitable statement should be 'produced in factory where PEANUT is also handled'
- ✓ Operational Prerequisite Programs (OPRPs): Prerequisite Program (PRP) are defined as the basic conditions and activities necessary to maintain a hygienic environment throughout the food chain which are suitable for the production, handling and provision of safe end products and safe food for human consumption whereas Operational Prerequisite Programs (OPRPs) is defined as a control measure identified by the hazard analysis as essential in order to control the likelihood or probability of introducing food safety hazards and/or the contamination or proliferation of food safety hazards in the product(s) or in the processing environment. Thus OPRPs are essential in reducing the likelihood of a specific hazard occurring.
 - ♣ Temperature control: 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, monitoring food temperatures, and when necessary, controlling ambient temperatures to ensure the safety and suitability of food.

Effective use of temperature either high or low is one of the most useful means available to food industries or business to make food safe for human consumption and ensure that it remains safe.

High temperature can be effective in killing pathogenic microorganisms and bringing them to safe level whereas low temperature are effective in preventing or slowing the multiplication of harmful bacteria in food.

Inadequate food temperature control is one of the most common causes of foodborne illness or food spoilage. Such controls include time and temperature of cooking, cooling, processing and storage. Systems should be in place to ensure that temperature is controlled effectively where it is critical to the safety and suitability of food.

Temperature control systems should take into account:

- The nature of the food, e.g. its water activity, pH, and likely initial level and types of microorganisms;
- The intended shelf-life of the product;
- The method of packaging and processing; and
- The intended use of product e.g. further cooking/processing or ready-to-eat.

Such systems should also specify tolerable limits for time and temperature variations.

Temperature recording devices should be checked at regular intervals and tested for accuracy.

Sanitation effectiveness (pathogen or allergen)

Swab test

- > Take swab stick
- Scooping the cleaned surface
- Swab strict is submerged into the dilution fluid
- Streaking in appropriate agar
- Incubate at appropriate agar
- Counting colonies

RODAC: Replicate Organism Detection And Counting

- Pre-prepared agar
- It is made to be in contact with cleaned area

- > Agar is incubated at appropriate temperature
- Microbial colonies are counted

ATP (Adenosine Triphosphate) Measurement

- Swab stick
- Swab strict is put on machine
- ➤ Light reflected or ATP is proportional to the number of microorganisms
- Hand washing and sanitizing

Hand Washing

For persons handling directly food, unclean hands are usually the most possible way of transferring contaminants and hazards to food. Therefore, hands should be washed according to instructions and indicating hand washing signs and posts. Hands should be washed in designated hand washing sinks or stations in all food handling areas and in restrooms. Such hand washing facilities should be provided with running water, soap, and means to dry hands.

A waste container at the hand washing facility is also necessary. For food handling persons, hands are washed:

- ✓ Before starting work
- ✓ When moving products or materials from one area to another
- ✓ Before putting on or changing gloves
- ✓ After using the toilet
- ✓ After sneezing, coughing, or using a handkerchief or tissue
- ✓ After touching hair, face, or body
- ✓ After smoking, eating, drinking, or chewing gum or tobacco
- ✓ After handling raw materials
- ✓ After any clean up activity such as sweeping, mopping, or wiping
- ✓ After touching dirty machines, equipment, or utensils
- ✓ After handling trash
- ✓ After handling money

- ✓ After any time the hands may become contaminated
 For food handling persons, hands should be washed as follows:
 - ✓ Wet hands and forearms with running water and apply soap.
 - ✓ Scrub lathered hands and forearms, under fingernails, and between fingers for at least 10-15 seconds. Rinse thoroughly under running water for 5-10 seconds.
 - ✓ Dry hands and forearms thoroughly with single-use paper towels or hand drier.
 - ✓ Dry hands for at least 30 seconds if using a warm air hand dryer.

Sanitizing

When using hand sanitizers, food-handling persons should follow these recommendations:

- ✓ Use hand sanitizers only after hands have been properly washed and dried.
- ✓ Use only hand sanitizers that comply with any stated Food Code requirements. Confirm with the manufacturers that the hand sanitizers used meet these requirements.
- ✓ Use hand sanitizers in the manner specified by the manufacturer.
 - Glass/metal control (not designated as CCP)

Food companies must ensure that their products are of the utmost quality and free from hazardous contaminants including glass and metal in order to maintain the company's reputation and consumer trust when a food product is recalled due to potential foreign body contamination. This led to the companies' money expenses from potential led action.

- ❖ Metals: Metal pieces may be found, for example, in cooked chicken products that can cause adverse reactions or injuries due to consuming these products, a recall of these products results in money loss and significant food product waste.
- Glass: It is another dangerous contaminant in the food industry. Many food and beverage products are packaged in glass containers, however, when these glass jars or bottles break in the manufacturing environment, this opens up the possibility of glass particles being found in the food or beverage products as well.

Common foreign body detection systems in the food industry include X-ray inspection and metal detection machines that offer a variety of benefits when it comes to ensuring food safety, both devices have their own unique advantages. X-ray devices

are some of the most commonly used food safety devices in the food industry. They are used to protect consumers from foreign body contamination, ensure food quality, protect a brand's reputation and prevent expensive recalls.

X-ray systems are able to detect metal, glass, mineral stone, calcified bone and high-density plastic and rubber. These machines can also be used to measure the mass of products and their counting components (for example, how many grapes are in a single lot). X-rays are also able to identify missing or broken products, monitor fill levels, and inspect seal integrity for trapped contaminants or food products and check for damaged packaging.

LO 2.2 – Identify HACCP program

<u>Content/Topic 1: Relationship between HACCP, GMPs and Sanitation Standard Operating</u>

<u>Procedures</u> (SSOPs)

HACCP: Hazard Analysis and Critical Control Point

HACCP (Hazard Analysis and Critical Control Point): A system, which identifies, evaluates, and controls hazards that are significant for food safety.

It is also a system that provides the framework for monitoring the total food system, from harvesting to consumption, to reduce the risk of food borne illness.

Hazard analysis: The process of collecting and evaluating information on hazards and conditions leading to their presence to decide which should be addressed through a preventive control.

HACCP Principles: There are seven principles of HACCP. They are summarized below.

Principle 1: Hazard analysis The hazard analysis accomplishes three purposes: (i) Hazards of significance are identified (ii) Likely hazards are selected (iii) Identified hazards can be used for developing preventive measures Hazards can be biological, chemical or physical in nature, and the potential risk of each hazard is assessed based on its likelihood of occurrence and its severity. Hazard assessment is based on a combination of experience, epidemiological data and information in the technical literature.

Principle 2: Identify the critical control points (CCPs) A CCP is a point, step or procedure at which control can be applied and a food safety hazard can be prevented, eliminated or reduced to acceptable levels. It is important to identify potential CCP(s) in food preparation. CCPs can be cooking, chilling, sanitation procedures, product formulation control (pH, salt, and water activity), and prevention of cross contamination or employee and environmental hygiene. Different facilities preparing the same food may differ in the risk of hazards depending on the operation. A CCP Decision Tree is helpful in assigning CCPs — see diagram below.

CRITICAL CONTROL POINT DECISION TREE — APPLY TO EACH STEP Does a control measure exist at this step? yes no Modify step, process, or product Does this step eliminate Is control necessary or reduce hazard? at this step? yes no not CCP no ves CCP Could contamination occur or increase not CCP to an unacceptable level at this step? yes yes no Will subsequent step yes eliminate hazard? not CCP

Principle 3: Establish critical limits for preventive measures associated with each CCP Critical limits are the boundaries for safety for each CCP and may be limits with respect to temperature, time, meat patty thickness, water activity, pH, available chlorine, etc. Critical limits may be derived from regulatory standards or guidelines, literature, experiments and expert opinion.

Principle 4: Establish procedures to monitor CCPs Monitoring is a planned sequence of

observations and measurements to assess whether a CCP is under control and to produce an

accurate record. This record can be used in case of complaints about the product, and is also

used in the verification of HACCP. The measurements for monitoring are visual observations,

temperature, time, pH, water activity, etc. The measurements must be done "on-line"; there

is no time to wait for lengthy laboratory tests. There must be written documentation for who

has the responsibility for monitoring.

Principle 5: Establish corrective actions Corrective actions are taken to get the process under

control when monitoring shows a deviation has occurred and a critical limit has been

exceeded There must be written instructions for actions to be taken (re-process, condemn,

etc.) when critical limits have been exceeded. Additionally, the instructions should indicate

who has the authority for the action. Sometimes regulatory agencies must be consulted.

Principle 6: Establish record keeping system: This system is established to document the

HACCP system. This is necessary for internal audits and for verification of the HACCP system

sometimes by third parties. It is also important in case of consumer complaint.

Principle 7: Establish verification procedures Verification procedures indicate whether the

HACCP system in place is working properly or not. Verification is based on the HACCP

documentation, and may include internal audits and/or verification done by a third party

(e.g., outside consultant). Additionally, verification may include validation studies (i.e.,

laboratory testing of samples of food and/or the environment)

GMPs: Good Manufacturing Practices

Good Manufacturing Practices (GMPs) are practices and procedures that are conducted by

food processors to insure the safety of food for human consumption. GMPs take into account

personnel, equipment, process or operation, and the environment of food production. The

GMPs are not plan or process specific. A good manufacturing practices (GMP) program is

therefore a collection of basic operational requirements necessary to enable a food business

to produce food safely.

Page 28 of 60

- **1. Personnel**: According to GMP regulations, plant management shall take all reasonable measures and precautions to ensure:
 - ➤ **Disease Control:** Excluding individuals who might pose a risk of contamination of food, food-contact surfaces, or food-packaging materials from any operations that might lead to product contamination. Examples include sick individuals, and people with open lesions, boils, sores, infected wounds, etc.
 - ➤ Cleanliness: Exercising proper hygienic practices while on duty to protect against contamination of food. This includes, but is not limited to, wearing outer garments (e.g., aprons), maintaining adequate personal cleanliness, washing hands thoroughly, sanitizing hands if necessary, removing all unsecured jewelry, wearing gloves and maintaining them clean, use of impermeable gloves, wearing effective hair restraints, hair nets, caps, and beard covers, storing personal belongings in areas away from food, food-contact surfaces and food-packaging materials, confining eating food (e.g., snacks, lunches), drinking beverages, chewing gum, or using tobacco to areas other than where food, food-contact surfaces and food-packaging materials may be exposed, and taking precautions against foreign substances such as cosmetics, chemicals, or medicines applied to skin from contaminating food, food-contact surfaces, and food-packaging materials.
 - ➤ Education and Training: Provide a level of understanding regarding production of clean and safe food. This includes understanding consequences of sanitation failures, appropriate food handling techniques, food protection principles, and the danger of poor hygienic practices.
 - > **Supervision:** This involves assigning competent individuals to assure compliance by all personnel with all requirements of GMPs.
- **2. Equipment:** Plant equipment and utensils need to be made of adequately cleanable and corrosion-resistant materials. They should withstand the action of food, intended use, and cleaning compounds and sanitizing agents. Equipment should be installed in locations that

facilitate their cleaning. Also, the design of the equipment should not allow adulteration of food with metal fragments, lubricants, fuel, contaminated water, etc. Seams or layers on contact surfaces should be smoothly bonded to reduce accumulation of food matter or dirt and minimize microbial proliferation. Non-food-contact equipment as well as holding, conveying and manufacturing systems should have designs that enable maintenance of proper sanitary conditions. Food freezers or cold storage areas should be equipped with thermometers, or temperature monitoring devices to indicate that the temperature is properly controlled in those area. Temperature monitoring devices should be equipped with automatic alarm systems to alert for any deviations. Compressed air and other gases introduced to food or used to clean food-contact surfaces need to be clean and fit for that use to avoid contamination of food.

- **3. Processing Operations:** All food processing operations including receiving, segregating, preparing, manufacturing, packing, inspecting, storing, and transporting should be conducted under adequate and controlled sanitary conditions to ensure that food is fit for human consumption. Chemical, microbial and physical testing procedures should be conducted to prevent possible food contamination. Possible food contamination can be prevented by identifying and addressing sanitation failures during food processing operations. Adulterated food shall be rejected, treated or processed (if allowed by law) to eliminate contamination.
- **4. Environment (plant and grounds):** Food plants and the grounds about them should be adequately maintained and kept under conditions that will minimize and protect the contamination of food. As such, roads, yards, parking lots, draining areas should be maintained clean. Any litter or waste within the facility and immediate vicinity should be removed because it can attract pests and become their breeding grounds. Plant construction and design should be of proper size for the operation and easy to maintain and clean. Sufficient space should be provided for equipment, materials (including packaging, cleaning supplies, etc.), and raw ingredients and finished product. In addition, light bulbs and fixtures should be adequately installed to prevent food contamination if glass breaks. Additionally, proper lighting and ventilation should be provided in work areas

SSOPs: Sanitation Standard Operating Procedures

SSOPs are plant-specific while HACCP plant is product- specific. Moreover By definition, an **SOP** is a set of written instructions that document a food manufacturer's routine or repetitive

activity. For all sanitation-related processes, jobs or activities, the term **SSOP** (Sanitation **SOP**) is reserved.

Sanitation Standard Operating Procedures (SSOPs) are the specific, written procedures necessary to ensure sanitary conditions in the food plant. They include written steps for cleaning and sanitizing to prevent product adulteration or contamination.

Sanitation standard operating procedures (SSOPs) are plant-specific operations. Cleaning and maintenance of sanitary conditions are vital for providing consumers with wholesome and safe food. Thus, it is important to keep buildings, fixtures, equipment, utensils, and food-contact surfaces properly cleaned and sanitized (if necessary) to prevent food from becoming adulterated. Food- contact surfaces, in particular, should be cleaned frequently to prevent microbial proliferation and biofilm formation.

Cleaning and sanitizing compounds should be stored away from food; in separate areas. An effective sanitation system would entail a variety of cleaning procedures that account for the type of food soils and the proper cleaning or sanitizing chemicals. Such a system also should include effective measures for control of pests on the premises, and proper water supply. To maintain a sanitary water supply, an adequate plumbing system must be in place. This should allow sufficient quantities of water to be moved into and throughout the plant as needed with proper drainage, release or discharge of excess or waste water. Thus, a proper sewage disposal system must be in place.

Additional sanitary controls include maintaining toilet facilities, keeping the premises in good repair, providing hand-washing stations and refuse receptacles (in strategic locations).

• Content/Topic 2: Key sanitation conditions and practices are:

✓ The safety of water used with food

Safety of water, steam and ice is crucial as they are used in every part of food processing from transport to cleaning and sanitizing to ingredient use. It is essential that potable water, cooling water, steam, and ice must be available in sufficient quantities, at suitable pressures and temperatures, to meet the needs of the operation

Factors that must be considered include:

1. Water Source

- ✓ Both the water and the plumbing system that transport to the facility must provide a safe supply for all water needs.
- ✓ When using a municipal water source, the water treatment authority is responsible for the safety of the source as well as the means of conveyance to the facility.
 - The processor/facility should have documentation to identify the source of the water and annual water quality test results.
 - ♣ The processor/facility should independently test for microbiological activity.
 - The municipality should immediately notify the facility when any tests are out of specification.
- ✓ When using private water systems (wells, etc.), a facility is directly responsible for the monitoring and documentation of the safety of their water source.
 - Tests should be routinely performed to test for chlorine levels and microbiological activity.

2. Protection

- ✓ Care must be taken to prevent contamination from potential cross-connections and backflow.
 - ♣ Backflow prevention devices should be inspected and tested routinely.
 - Connections without backflow prevention devices must also be routinely inspected and tested.

3. Control Measures

- ✓ Monitoring
 - Water quality test results
 - ♣ Review of plumbing system records

4. Corrective Actions

♣ Operations must cease production until a safe source and plumbing are assured.

✓ Condition and cleanliness of food contact surfaces

All food contact surfaces, including but not limited to equipment, piping, and utensils, used in a food processing facility must be designed, fabricated, maintained in such a way that they are easy to clean and can withstand regular usage. Equipment should have smooth seams and be made of impervious materials such as stainless steel or plastic. Corroded or worn parts should be replaced.

Cleaning and Sanitizing

Procedures

Cleaning and sanitizing procedures for all food contact surfaces must be established and maintained. Cleaning should be done with appropriate detergents at the proper concentration and water at the appropriate temperature. Sanitizing is accomplished utilizing approved sanitizing agents at appropriate concentrations. Written documentation of cleaning, sanitizing, and maintenance procedures is necessary.

Frequency

Suggested frequencies for cleaning and sanitizing include:

- ✓ Before use
- ✓ After processing interruptions
- ✓ At product changeover
- ✓ After use
- ✓ As necessary

Monitoring

What

- ✓ Condition and construction of contact surfaces
- ✓ Condition of gloves, outer garments, and utensils

- ✓ Preventative maintenance programs and all repairs
- ✓ Cleanliness and sanitation of food contact surfaces
- ✓ Type and concentration of cleaning chemicals and sanitizers
- ✓ Employee training and hygiene practices
- ✓ CIP and COP systems

When

✓ Many procedures must be monitored daily, while others may be monitored less frequently (such as preventative maintenance and training)

How

- ✓ Pre-operation visual inspection
- ✓ Recording instruments
- ✓ Chemical testing
- ✓ Sanitizer concentrations
- ✓ Alkalinity/acidity of cleaning solutions

• Verification Check

- ✓ Microbial Test on surface
- ✓ Rinse water testing
- ✓ Visual inspection

✓ Prevention of cross contamination

Contaminants such as bacteria are unable to move from one place to another on their own.

Cross contamination occurs when food, water, air, people, or equipment carry these contaminants from one location to another.

Many factors can contribute to cross contamination, but the most common causes include:

- · Poor hygiene
- Employee mistakes
 - ✓ Non-compliance with GMPs
 - ✓ Employee traffic patterns
- Poor food handling practices
- Failure to separate raw and cooked/RTE products
 - ✓ Product flow
 - ✓ Common equipment and utensils
- Inadequate cleaning and sanitizing
 - ✓ Utilizing color-coded brushes and cleaning equipment
- Poor plant design
 - ✓ Especially important when dealing with allergens
 - ✓ No cross connections between raw and pasteurized product in piping or flow

✓ Maintenance of hand-washing, hand-sanitizing, and toilet facilities

It is imperative that in addition to clean food processing equipment, the facilities associated with production must be cleaned, stocked, and properly maintained.

Hand washing facilities

- ✓ Should be at each location where GMPs require their use
- ✓ Condition and cleanliness of facilities must be monitored daily
- ✓ Much be equipped with soap, water at the appropriate temperature, disposal towels/hand dryers, and adequate waste disposal
- ✓ Employees should be properly trained in appropriate hand wash technique
- ✓ Should be used for hand washing only, not cleaning of parts/COP

Sewage disposal

✓ A properly functioning sewage disposal system is required

Toilet facilities

✓ Should be adequate and readily accessible with self-closing doors to protect

from airborne contamination

✓ Must be in good repair and maintained in a sanitary condition.

✓ Must be properly supplied with paper products, soap, and warm water

✓ Protection from adulterants

Food adulteration is the addition or removal of any substances to or from food, so that the

natural composition and quality is affected.

Section 402 of the Food, Drug, and Cosmetic Act defines adulterated food if "food bears or

contains any poisonous or deleterious substance which may render it injurious to health

and/or if it has been prepared, packed, or held under unsanitary conditions whereby it may

have become contaminated with filth, or whereby it may have been rendered injurious

health." Ingredients, packaging materials, food contact surfaces, and finished product must

be protected from various microbiological, chemical, and physical contaminants including but

not limited to:

• Sources of Contamination

✓ Water: e.g: Condensate, Splashing from floors, walls, and/or ceilings and leaks

✓ Chemical Hazards: e.g Fuels ,Non-food grade lubricants, Cleaning and/or

sanitizing compounds and pesticides

✓ Physical Hazards: eg: Glass, Metal, Plastic ,Dirt/Rust and Pests

✓ Additives eg : Vitamins

✓ Allergens

• Monitoring: Procedures must be set in place to monitor any possible contamination

of food or food contact surfaces according to GMPs.

Page **36** of **60**

✓ Labelling, storage, and use of toxic compounds

Toxic compounds, such as cleaning and sanitizing chemical and pesticides, must be properly labeled, used, and stored in a way that protects food, food contact surfaces, and packaging materials from contamination. A secured area with limited access and removed from food storage, processing, and packaging areas is an essential condition in this prerequisite program.

Labelling:

- ✓ Original container label must remain intact, visible, and include:
- Name of compound or solution in container
- Name and address of manufacturer
- Instructions for proper use
- Potential hazards and cautions
- ✓ Working container label must include:
- ♣ Name of compound or solution in container
- Instructions for proper use
- Potential hazards and cautions

Storage

- ✓ Room/area with limited access
- ✓ Segregate food grade compounds from non-food grade
- ✓ Segregated from food equipment, utensils, and other food contact surfaces
- ✓ Working containers should be kept in a secure location that prevents misuse, spills, or product contamination

Use

- ✓ Use according to the manufacturer's instructions
- ✓ Procedures should exist that will not result in the adulteration of products
- ✓ Keep Material Safety Data Sheets (MSDS) for proper handling

Disposal

✓ Dispose of unused compounds in an approved manner

✓ Employee health conditions

Food processors and handlers with an apparent illness, wound, or open lesion are a potential source of microbiological contamination of food, food packaging, and food contact surfaces.

Policies

Policies must be in place that exclude or restrict employees who show or who are diagnosed with systems of an illness or wounds that could be a source of microbial contamination.

Monitoring

✓ Daily

- ♣ All employees should adhere to the Illness and Injury Notification Policy.
- Supervisors should observe employees for signs of illness and/or exposed wounds.

✓ Annually

Employees should undergo documented GMP training upon initial hiring and on an annual basis

✓ Exclusion of pests

Pests, such as rodents, birds, and insects, are excluded from relevant areas of the plant to the extent possible and should confirm that approved procedures are followed to prevent and/or eliminate infestation without contaminating foods or food processing equipment. In the event that pest control is contracted to an outside company, it is up to the processor to ensure that the facility is free of pests.

Content / Topic 3 : Other Prerequisite Programs:

- ✓ Facilities means premises where operations involve production, preparation, and processing, formulating, filling, refining, transformation packing, packaging or repackaging of food.
- ✓ Production Equipment: This must be well-designed and allows the proper production or processing of safe products.

- ✓ **Standard Operating Procedures (SOPs)**: it is a set of step by step instructions compiled by an organization to help workers carry out complex routine operations with the aim of achieving efficiency, quality output and uniformity of performance while reducing miscommunication and failure to comply with industry regulations.
- ✓ **Supplier Controls**: Suppliers should be approved and wherever possible they should provide a written product specification.
- ✓ Product Specifications: Specification means a written document giving description of material, machinery, equipment, process of product in terms of its required property or performance.
- ✓ Personnel Policies: well skilled and trained personnel with clear responsibilities and authority must be found in food industry to produce safe and high quality food products.
- ♣ Quality assurance procedures: Quality assurance (QA) is a set of activities for ensuring quality in the processes by which products are developed. It's a proactive process and aims to prevent defects by concentrating on the process

Used to make the product. The goal of QA is to improve development and test processes so that defects don't arise when the product's being developed. Quality control (QC) is a set of activities for ensuring quality in products by identifying defects in the actual products produced. It's a reactive process and aims to identify (and correct) defects in finished products.

QC can be achieved by identifying and eliminating sources of quality problems to ensure customer's requirements are continually met. It involves the inspection aspect of quality management and is typically the responsibility of a specific team tasked with testing products for defects.

- ✓ **Standard processing procedures**: Standard components is a food technology term, when manufacturers buy in a standard component they would use a pre-made product in the production of their food. They help products to be the same in consistency, they are quick and easy to use in batch production of food products. Some examples are pre-made icing, ready-made pastry.
- ✓ **Product formulations and recipes**: Food product formulation is a vital step in any product development, however, it is a complex process and formulators face a great

amount of challenges when developing a recipe. They have to take into consideration various requirements from different teams, from marketing, quality to regulatory affairs. It is also crucial to stay ahead of the rapidly evolving demand for new products and the emerging trends. Formulators are also challenged by the constant needs for innovation and sustainable manufacturing. A recipe is a list of ingredients and a set of instructions or directions for making or preparing any food product.

LO 2.3 – Identify certification bodies

Content/Topic 1 : Key concept:

Accredited registrar: It is also called an **accredited** certification body (CB), is an organization **accredited** by an accepted authorizing body for its competence to audit and issue certification confirming that an organization meets the requirements of a standard (e.g. ISO 9001or ISO 14001).

Standard: Standard is something established by authority as a rule for the measure of quantity, weight, extent, value, or quality. It is also the basis of value in a monetary system.

A standard is also a document that pins down the characteristics of a product or a service. These characteristics may cover design, weight, size, performance, environmental requirements, interoperability, materials, production process or service delivery. The standard may include or deal exclusively with terminology, symbols, and packaging, marking or labelling requirements as they apply to a product, process or production method.

- ✓ Technical regulation: a document or legislation that lays down product characteristics or their related processes and production methods. A technical regulation may also include or deal exclusively with terminology, symbols, packaging, marking or labelling requirements as they apply to a product, process or production method.
- ✓ **Certification:** This refers to the confirmation of certain characteristics of an object, person, or organization. This confirmation is often, but not always, provided by some form of external review, education, assessment, or audit. Accreditation is a specific organization's process of certification.
- ✓ Accreditation: This means that certification and inspection bodies have been assessed against recognized standards to demonstrate their competence, impartiality and capability.

Content/Topic 2 : Purpose of certification bodies:

- ✓ Audit and issue certification confirming that an organization meets the requirements of a standard
- ✓ Establish and publish standards

Content/Topic 3: Certification bodies at national, regional and international levels

✓ International Organization for Standardization (ISO)

International standards are standards formulated or adopted by international standards organization or in certain cases a technical specification adopted by an international Standardization body such as ISO and Codex Alimentarius Commission.

The Codex Alimentarius, or "Food Code" is a collection of standards, guidelines and codes of ISO and Codex Alimentarius Commission intergovernmental body of the Food and Agriculture Organization of the United Nations (FAO) and WHO with 188 Member Countries and one Member Organization (The European Union). Codex has worked since 1963 to create harmonized

International food standards to protect the health of consumers and ensure fair trade practices.

Benefits of standard.

To consumers:

- ✓ Standards ensure that consumers are protected from hazards to their health and safety;
- ✓ Standards promote and protect economic interests of consumers;
- ✓ Standards ensure that consumers have easier access to and greater choice in goods and services;
- ✓ Standards ensure improved quality and reliability;
- ✓ Standards ensure the better operation and compatibility between product and services.

To Small business

✓ Standards inspire the added trust on the business;

- ✓ Standards assist business to meet the mandatory regulations;
- ✓ Standards create a competitive advantage by improving the quality of goods and services;
- ✓ Standards reduces the cost in the business;
- ✓ Standards opens the new markets by assuring new customers that the business meet their quality requirements;
- ✓ Standards attract new customers;

To government

- ✓ Standards benefit the government by complementing regulation and promoting international trade;
- ✓ It reduces the technical barrier to international trade, thus positioning the country industries to compete in the world of economy;
- ✓ Standards are used to regulate and monitor industry as to prevent adverse business practices;
- ✓ Standards help to make the law consistent.

Major interventions of Rwanda Government needed to apply in order to increase the levels of food safety in private and public food processing industries are:

- ✓ Education, information and communication
- ✓ Legislation and Regulation
- ✓ Research and subsidies
- ✓ Control, inspection and supervision
- ✓ Enforcement.

Regional standards

These are standards formulated or adopted by regional standards organization or in certain cases a technical specification adopted by regional standardization body.

For example: EAS 453:2007, Butter, fermented milks and fresh cheese – Enumeration of contaminating microorganisms – Colony-count technique at 30 degrees C.

This East African Standard specifies a method for the enumeration of contaminating microorganisms by means of the colony-count technique at 30 °C. The method is applicable to butter, fermented milks and fresh cheese.

√ Rwanda Standards Board (RSB)

National standard is formulated by national standards organization or in certain cases a technical specification adopted by a national standardization body.

The Rwanda Standards Board is operating **voluntary product and system certification schemes** through offering **Quality Marks** to products and systems complying with relevant Standards.

Currently RSB provide two types of certification:

Product certification which is an attestation following assessment that attribute characteristics, quality or status of goods are in accordance with established standards. Product certification is also the mechanism whereby a certification organization attests that products, either a batch or the continuous production thereof, have been inspected and tested by it and that the products collectively comply with specified requirements, usually contained in a standard. The attestation by the certification organization is in the form of a certificate supported by a product certification mark that the manufacturer or producer affixes on the product after being licensed to do so. The certification organization therefore provides an assurance about the quality of the product

eg S-Mark



According to RSB, the following are the product certification processes.

- ✓ Filling-in application form
- ✓ Certification fee payment
- ✓ To conduct audit of the production line and take samples
- ✓ Product sampling and testing
- ✓ Submission of audit report to client
- ✓ Closure of corrective actions (if any)
- ✓ Certification decision by independent committee
- ✓ Issuance of certificate of conformity
- ✓ Surveillance audit
- ✓ Market surveillance

- ✓ Re-certification(after 2 years)
- System certification which is an attestation following assessment that attributes, characteristics quality or status of organization, service or procedures is in accordance with the established requirements. It deals with processes and procedures of manufacturers, producers, suppliers or service providers and can be assessed against the requirements of the relevant standards and if found to conform, certified by a certification body.
 - a. QMS: Quality Management System (ISO 9001:2008): It is concerned with organization: product and quality service.



b. EMS: Environment Management System (ISO 14001:2004): it is good means of demonstrating compliance with legal environmental requirements.



c. HACCP: Hazard Analysis Critical Control Point (RS 184:2013) it is concerned with production system, agribusiness and food industries.



d. FSMS: Food Safety Management System (ISO 22000:2005). It is concerned with Requirements for any organization in the food chain which incorporates HACCP principles



According to RSB, the following are system certification processes

- Filling-in application form
- Certification fee payment
- Stage 1 audit (desk audit & on site visit)
- Stage 2 audit (full audit)
- Submission of audit report to client
- Closure of corrective actions (if any)
- Certification decision by independent committee
- Issuance of certificate of conformity
- Surveillance audit
- Re-certification (after 3 years)

• Benefits of Certification

- It gives confidence to interested parties that certified organizations, goods or services, procedures or processes fulfil specified requirements
- It is a strong marketing tool hence promoting business
- Reduces production/service costs through increased efficiency
- Reduces losses hence increased profits
- Increases government revenue through trade
- Increased consumer safety and satisfaction

Learning Unit 3 – Describe important food industry processes

LO 3.1 – Distinguish food processing industries

Content/Topic 1: Food industries with or without seasonal activities:

The term food industries cover a series of industrial activities directed at the processing, conversion, preparation, preservation and packaging of food stuffs. The raw materials used are generally of vegetable or animal origin and produced by agriculture, farming, breeding and fishing.

Industry	Materials	Storage	Processing	Preserving	Packaging of
	processed	requiremen	techniques	techniques	finished
		ts			products
Meat	Beef, lamb,	Cold stores	Slaughtering,	Salting,	Loose or in
processing	pork,	Cold Stores	cutting up,	smoking,	cans,
and	pork,		boning,	refrigeration,	cardboard
	poultry		<u> </u>		Caruboaru
preserving			comminuting	deep-	
			, cooking	freezing,	
				sterilization	
Fish	All types of	Cold stores	Heading,	Deep-	Loose in
processing	fish	or salted	gutting,	freezing,	refrigerated
		loose or in	filleting,	drying,	containers or
		barrels	cooking	smoking,	in cans
				sterilization	
	- 16 1				_
Fruit and	Fresh fruit	Processed	Blanching or	Sterilization,	Bags, cans or
vegetable	and	immediately	cooking,	pasteurizatio	glass or
preserving	vegetables	; fruits may	grinding,	n, drying,	plastic bottles
		be stabilized	vacuum-	dehydration,	
		with sulphur	concentratio	lyophilization	
		dioxide	n of juices		

			(freeze drying)	
Grains	Silos may be	Grinding,	Drying	Silos
	fumigated in	sifting,	cooking or	(conveyed
	storage	milling,	baking	pneumatically
		rolling), sacks or
				bags to other
				processes, or
				boxed for
				retail trade
Flour and	Silos, super	Kneading,	Baking,	Packaged for
other dry	sacks and	fermentation		wholesale
-	bags	, laminating	surface	trades,
water, oils		surface	treatments	restaurants
,		treatments	and	and retail
		of seasoning	packaging	markets
Flour,	Silos, super	Mixing,	Baking,	Bags, boxes
cream,	sacks and	kneading,	cutting	for
butter,	bags	laminating	surface	institutional
sugar, fruit		moulding	treatments	and retail
and			and	trades
seasoning			packaging	
Flour, eggs	Silos	Kneading,	Drying	Bags, packets
		grinding,		
		cutting,		
		extrusion or		
		moulding		
	Flour and other dry goods, water, oils Flour, cream, butter, sugar, fruit and seasoning	Flour and other dry goods, water, oils Flour, cream, butter, sugar, fruit and seasoning fumigated in storage Silos, super sacks and bags Silos, super sacks and bags	Flour and other dry goods, water, oils Flour, cream, butter, sugar, fruit and seasoning Flour, eggs Flour, eggs Flour, sacks and butter, sugar, fruit and seasoning Flour, eggs Flour, eggs Flour, cream, butter, bags laminating moulding moulding grinding, cutting, extrusion or	Grains Silos may be fumigated in storage Flour and other dry goods, water, oils Flour, cream, bags acks and batter, sugar, fruit and seasoning Flour, eggs Flour, eggs Flour, sacks and seasoning Flour, cream, bags Flour, cream, baking, creatments Flour, cream, baking, cream, baking, creatments Flour, cream, baking, cream, cream, baking, cream, c

Sugar	Sugar beet,	Silos	Crushing,	Vacuum	Bags, packets
processing	sugar cane		maceration,	cooking	
and refining			vacuum		
			concentratio		
			n,		
			centrifuging,		
			drying		
Chocolate	Cocoa	Silos, sacks,	Roasting,	_	Packets
making and	bean sugar,	conditioned	grinding,		
confectioner	fats	chambers	mixing,		
У			conching,		
			moulding		
Brewing	Barley,	Silos, tanks,	Grain milling,	Pasteurizatio	Bottles, cans,
Dicwing	hops	conditioned	malting,		barrels
	Πορς			n	Darreis
		cellars	brewing,		
			filter		
			pressing,		
			fermentation		
Distilling	Fruit, grain,	Silos, tanks,	Distillation,	Pasteurizatio	Barrels,
and	carbonated	vats	blending,	n	bottles, cans
manufactur	water		aeration		
e of other					
beverages					
Milk and	Milk, sugar,	Immediate	Skimming,	Pasteurizatio	Bottles,
milk	other	processing;	churning	n,	plastic
products	constituent	subsequentl	(butter),	sterilization	wrapping,
processing	S	y in ripening	coagulation	or	boxes
		vats,			
		conditioned			

		vats, cold	(cheese),	concentratio	(cheese) or
		store	ripening	n, desiccation	unpacked
Processing	Groundnut	Silos, tanks,	Milling,	Pasteurizatio	Bottles,
of oils and	s, olives,	cold stores	solvent or	n where	packets, cans
fats	dates,		steam	necessary	
	other fruit		extraction,		
	and grain,		filter		
	animal or		pressing		
	vegetable				
	fats				

Content/Topic 2: Diversity of the food industries with manufacturing ranges:

The food industry today has become highly diversified, with manufacturing ranging from small, traditional, family-run activities that are highly labour intensive, to large, capital-intensive and Highly mechanized industrial processes.

Many food industries depend almost entirely on local agriculture or fishing. In the past, this meant seasonal production and hiring of seasonal workers Improvements in food processing and preservation technologies have taken some of the pressure off workers to process food quickly to prevent spoilage. This has resulted in a decrease in seasonal employment fluctuations. However, certain industries still have seasonal activities, such as fresh fruit and vegetable processing and increases in production of baked goods, chocolate and so forth for holiday seasons. Seasonal workers are often women and foreign workers.

LO 3.2 – Identify industrial activities of food industries

Content/Topic 1: A series of industrial activities of foodstuffs

Reception is the act of receiving, or getting something, or the way it is received.

Testing: The following are two main types of testing

- **Organoleptic Testing**: The analysis of the properties of products and materials mainly foodstuffs by means of the sense organs. Tasters usually do organoleptic testing.
- Laboratory testing is an important process, which relies on scientific analysis to identify problems with food products.
 - ✓ Processing, especially food processing, is the transformation of agricultural products into food, or of one form of food into other forms.
 - ✓ **Conversion**: Primary **processing** is the **conversion** of raw materials to **food** commodities. Milling is an example of primary **processing**. Secondary **processing** is the **conversion** of ingredients into edible products this involves combining foods in a particular way to change properties.
 - ✓ **Preparation** can be defined as "any change that is made to a **food** to alter its eating quality or shelf life". All **food** manufacturers should make safe foods so that consumers are not at risk.
 - ✓ **Food preservation**: Over time, yeasts, molds, bacteria, and other forces cause food to spoil, making it foul tasting, less nutritious, and potentially unsafe to eat. Many of the oldest food processing methods, such as drying fruit, pickling vegetables, salting meat, and fermenting dairy (e.g., to make cheese or yogurt) remain important to this day because they preserve food, delaying spoilage. Preservation allows people to ship foods over greater distances, stock them in stores longer, and enjoy them for a greater part of the year with more nutrients intact.

Processing can also help to inhibit or destroy pathogens (disease-causing organisms) that may contaminate food. Preservation methods such as refrigeration, fermentation, dehydration, and the use of salt, sugar, or chemical preservatives can slow or stop the growth of pathogens. Heat processes, such as pasteurization and cooking, are used to destroy them.

Food preservation is defined as the process through which physical and /or chemical agents are used to prevent spoilage of food. It is important to prevent any deterioration of food products, as much for the quality of the products as for the more serious risk of contamination or threat to the consumers' health.

Two general principles are employed in food preservation: Inhibiting and Killing principles

- Inhibiting principle: food preservation is achieved by inhibition of growth and multiplication of microorganisms. The inhibition principle is attained by any of the following methods:
 - ✓ Reduction of water activity: eg: salting and drying
 - ✓ Reduction of P^H eg : Fermentation and addition of acids
 - ✓ Use of preservatives eg: Sodium benzoate
 - ✓ Use of low temperature eg: chilling or freezing.
 - ✓ Smoking: this has a drying and preservation effect.

Preservation of food by inhibition methods does not necessary imply destruction of Microorganisms or removal of inhibition influence the food undergo spoilage as microorganisms present will grow and multiply to cause spoilage.

- Killing principle: This food preservation principle implies the destruction of microorganisms. It is achieved by
 - ✓ Heat treatment: Through pasteurization and sterilization. Pasteurization is the process of heat treatment at specific temperature and times.

Pasteurization is aimed at destroying the vegetative bacteria without affection of nutritional value of the food. Three methods of pasteurization: Low Temperature long time (63°C for 30 min), High Temperature Short time (72°C for15 Sec and Flash method 80°C for 1-2 Sec. Furthermore, Sterilization is the use of physical or chemical means to destroy all microorganisms present in food. Sterilization can be achieved by heating at the temperatures 100-140°C or Irradiation, which kills bacteria, spores and insects as well as inactivate enzymes.

- ✓ Irradiation: Radiations kills microorganisms by destruction of DNA and creating toxic reactive compound on a medium and in microbial cells. Eg Gamma rays
- ✓ Use of gases: the use of gases of ethylene oxides or Ozone. These gases destroy the both vegetative and spore-former bacteria

✓ Food Packaging is defined as enclosing food to protect it from tempering or
contamination from physical being the most common packaging system used for
preserving food products.

The Functions of food packaging are

A. Contain

- ✓ Portion control (profitability)
- ✓ Consistency
- ✓ Company reputation
- ✓ Consumer expectation
- ✓ Consumer convenience

B. Protect

- ✓ Contamination
- ✓ Maintain quality
- ✓ Legislation (Codex, local legislation)
- ✓ Product consistency
- ✓ Company reputation

C. Inform (labelling)

- ✓ Nature of the contents
- ✓ Legislation, Codex, and other codes
- ✓ Nutrition
- ✓ Instructions for use
- ✓ Elimination of fraud
- ✓ Storage requirements

D. Attract

✓ Advertise that this product is satisfying and fun and healthy

However, there are many methods of packaging food, including canning, aseptic packaging and frozen packaging.

Canning process consists of taking cleaned food, raw or partly cooked but not intentionally sterilized, and packing it into a can that is sealed with a lid. The can is then heated, usually by steam under pressure, to a certain temperature for a period of time to allow penetration of

the heat to the centre of the can, destroying the microbial life. The can is then cooled in air or chlorinated water, after which it is labelled and packed.

Aseptic packaging process is fundamentally different from conventional canning. In the aseptic method the food container and closure are sterilized separately, and the filling and closing are done in a sterile atmosphere. Product quality is optimal because heat treatment of the foodstuff can be controlled precisely and is independent of the size or material of the container.

Frozen packaging in food industry utilizes all methods of deep-freezing fresh food at temperatures below their freezing point, thus forming ice crystals in the watery tissues. The food may be frozen raw or partially cooked (e.g., animal carcasses or made-up meat dishes, fish or fish products, vegetables, fruits, poultry, eggs, ready-made meals, bread and cakes). Frozen perishable products can be transported over long distances and stored for processing and/or sale when demand arises, and seasonal products can be available at all times.

Food for freezing must be in prime condition and prepared under strict hygienic control. Packaging materials should be vapor- and aroma-proof and resistant to low temperatures. The quality of the product depends on the rate of freezing: if too slow, the structure of the food may be damaged by large ice crystals and enzymatic and microbiological properties destroyed. Small items, such as peas, can be frozen quickly, which makes for an improvement in quality.

Content/Topic 2: Processing and preserving techniques

Food Storage is the process in which both cooked and raw materials are stored in appropriate conditions for future use without any entry or multiplication of microorganisms.

Packaging is the science, art and technology of enclosing or protecting products for distribution, storage, sale and use. A package provides protection, tampering resistance, and special physical, chemical, or biological needs. It may bear a nutrition facts label and other information about food being offered for sale.

Aeration is the process of allowing air to be combined into ingredients to make them lighter and/or create more volume.

Baking is a method of preparing food that uses dry heat, normally in an oven, but can also be done in hot ashes, or on hot stones. The most common baked item is bread but many other types of foods are baked such as: cake and Biscuits

Blanching: Blanching is a mild heat treatment commonly applied to fruits and vegetables prior to freezing, drying, or canning. Blanching is performed to inactivate enzymes, enhance drying and rehydration, removes tissue gases, enhance colour of green vegetables, and reduce microbial load. The effectiveness of blanching is usually evaluated by assaying for peroxidase and catalase activity. Blanching is usually accomplished by bringing the product into contact with hot water, hot air, or steam for a specified period of time, depending upon the product and/or enzyme of interest.

Blending is the term used to describe the process of combining only dry ingredients.

Boning refers to the process of removing the bones and skin from meat and fish

Brewing is the production of beer by steeping a starch source (commonly cereal grains, the most popular of which is barley) in water and fermenting the resulting sweet liquid with yeast.

Centrifuging is a process for separation of phases (liquid-liquid or solid-liquid) that differ from each other in their density, using centrifugal acceleration.

Churning (butter) is a mechanical mixing process used to separate the fat phase from a fatwater system; universally used in the manufacture of butter.

Coagulation is defined as the change in the structure of protein (from a liquid form to solid or a thicker liquid) brought about by heat, mechanical action or acids. Enzymes may also cause protein coagulation e.g. cheese making.

Comminuting is the reduction of solid materials from one average particle size to a smaller average particle size, by crushing, grinding, cutting, vibrating, or other processes.

Conching is a process where shear and heat are applied to the develop mixture in two phases – dry and wet.

Cooking occurs in many manufacturing operations: canning and preserving of meat, fish, vegetables and fruits; ready-to-serve meat-processing plants (e.g., chicken); in bakeries, biscuit making, breweries; and so on. In other cases, cooking is done in a vacuum-sealed container and produces a concentration of the product (e.g. sugar refining and tomato-paste production).

Crushing refers to the pressing, grinding, or pounding of an item into smaller particles, a powder, or a paste.

Cutting surface treatments are the processes of preparing raw materials before processing such as passions fruits, mangoes, Apple.

Cutting up is a process in which head of fruit is removed.

Deep-freezing is an industrial technique, which involves cooling rapidly and brutally (a few minutes to an hour) food by exposing them intensely to temperatures from -30°C to -50°C, until the product core temperature reaches -18°C. With this process, the water contained in the cells is finely crystallized.

Dehydration is defined as means by which many types of food can be preserved for indefinite periods by extracting the moisture, thereby inhibiting the growth of microorganisms. Dehydration is one of the oldest methods of food preservation and was used by prehistoric peoples in sun-drying seeds.

Desiccation is process of drying or desiccating something or the state of being or becoming dried up or removal or loss of moisture thorough drying. It is also defined as the state of extreme dryness, or the process of extreme drying. A desiccant is a hygroscopic (attracts and holds water) substance that induces or sustains such a state in its local vicinity in a moderately sealed container.

Distillation is a process used in the making of spirits where the fermented liquid is treated to separate grain or fruit, is vaporized in a still; the condensed vapour is then collected as liquid ethyl alcohol.

Drying is defined as the application of heat under controlled conditions, to remove the water present in foods by evaporation to yield solid products. It differs from evaporation, which yields concentrated liquid products.

Drying cooking or baking is a method of preparing food that uses dry heat, normally in an oven, but can also be done in hot ashes, or on hot stones.

Extrusion or mouldingis a process that uses a die in order to get a material with a constant cross-sectional cut. The die is what the material is pushed through in order to get the desired shape. Each product has a specific die that will create that shape and characteristics.

Fermentation refers to an addition of a microorganism to the previously prepared product and it is practiced in bakeries, breweries, the wine and spirits industry and the cheese products industry.

Filleting is coming from from the French word filet (pronounced meaning a thread or strip), fish fillet is the flesh of a fish which has been cut or sliced away from the bone by cutting lengthwise along one side of the fish parallel to the backbone. In preparation for filleting, any scales on the fish should be removed.

Filter pressing is a process that occurs during the crystallization of insensitive igneous bodies in which the needed liquid is separated from the crystals by pressure.

Grain milling is a series of operations involving the grinding of grains to produce starch or flour, most commonly from wheat, oats, corn, rye, barley or rice. The raw product is ground and sifted until the desired size is reached.

Grinding is a method of food processing where big pieces or particles of food are cut into fine pieces or bits.

Gutting is a process of removing viscera during animal slaughtering.

The main reason for gutting is to prevent autolytic spoilage rather than bacterial spoilage

Heading refers to removal of head during animal slaughtering process.

Kneading is a process in the making of bread or pasta dough, used to mix the ingredients and add strength to the final product. Its importance lies in the mixing of flour with water.

Laminating moulding is the technique/process of manufacturing a mould as material in multiple layers, so that the composite material achieves improved strength, stability, appearance or other properties from the use of the differing materials. A laminate is a permanently assembled object created using heat, pressure, welding, or gluing.

Lyophilisation or freeze drying is a relatively recent method of preserving food. It involves freezing the food, then removing almost all the moisture in a vacuum chamber, and finally sealing the food in an airtight container. Today, many fruits, vegetables, meats, eggs, and food flavourings are freeze-dried.

Maceration: In food preparation, maceration is softening or breaking into pieces using a liquid. Raw, dried or preserved fruit or vegetables are soaked in a liquid to soften the food and/or absorb the flavour of the liquid into the food.

Malting is a process of producing malt extract which is frequently used in the brewing of beer. Its production begins by germinating barley grain in a process known as malting, immersing

barley in water to encourage the grain to sprout, then drying the barley to halt the progress when the sprouting begins.

Milling is process which begins with cleaning the grain and tempering it by adding water. The tempered grain is ground in a series of roller mills to remove the bran and to cut the endosperm. Milling, in which the coarse fibrous bran or seed coat of the grain is removed, results in significant nutrient losses particularly of by Vitamins and minerals.

Mixing refers the process of combining wet and dry materials whereas blending is the term used to describe the process of combining only dry ingredients.

Moulding refers to the technique of giving shape of finished dish by using molds or moulds e.g. mould baking pans.

Packaging is the enclosing of food to protect it from damage, contamination, spoilage, pest attacks, and tampering, during transport, storage, and retail sale. The package is often labelled with information such as amount of the contents, ingredients, nutritional content, cooking instructions (if relevant), and shelf life. The package needs to be designed and selected in such a manner that there are no adverse interactions between it and the food. Packaging types include bags, bottles, cans, cartons, and trays.

Pasteurization is process designed to reduce the population of pathogenic bacteria in a product, sufficient to ensure product safety but with modest impact on the nutritional properties and flavour of the product. Traditionally, this term has been applied to thermal processes but it can also refer to emergent alternative technologies with the purpose of pathogens inactivation. Pasteurization is particularly reserved for liquids such as fruit juice, beer, milk or cream.

Refrigeration is the practice of cooling a space, substance, or system to lower and/or maintain its temperature below the ambient one.

Ripening is the process by which fruits attain their desirable flavour, quality, colour, palatable nature and other textural properties.

Roasting is a cooking method that uses dry heat, where hot air covers the food, cooking it evenly on all sides with temperatures of at least 150 °C from an open flame, oven, or other heat source. Roasting can enhance the flavour through caramelization and Maillard browning on the surface of the food.

Rolling is a type of motion that combines rotation (commonly, of an axially symmetric object) and translation of that object with respect to a surface (either one or the other moves), such that, if ideal conditions exist, the two are in contact with each other without sliding.

Salting is the preservation of food with dry edible salt. It is related to pickling in general and more specifically to brining (preparing food with brine, that is, salty water) and is one form of curing.

Sifting is the preparation procedure of passing a dry ingredient such as flour, Tea leaves or sugar through a mesh bottom sieve. This process combines air with the ingredient being Sifted, making it lighter and more uniform in texture, which improves the baking or food preparation process.

Skimming means to remove a small amount of something from the surface. In cooking, it usually refers to removing fat from the surface.

Slaughtering,

Smoking is a method of assuring dehydration and giving a distinctive flavour and is carried out mainly on fish, ham and bacon.

Solvent or steam extraction: in food processing, extraction is defined as the transfer of one or more components of a biological feed from its source material into a fluid phase, followed by separation of the fluid phase and recovery of the component(s) from the fluid.

Sterilization or concentration,

Sterilization refers to any process that eliminates, removes, kills, or deactivates all forms of life (in particular referring to microorganisms such as fungi, bacteria, viruses, spores, unicellular eukaryotic organisms such as Plasmodium, etc.).

Vacuum concentration: This reflects on the process where liquid food like juices are concentrated by rotary evaporator under vacuum (22 mmHg) at 45-50°C. The concentration process was continued until the total soluble solids (T.S.S.) of the juice reached to about double folds for fruits juices including apricot and peach.

Vacuum- concentration of juices: Concentration of liquid food (milk, sugar juice, etc.) by evaporation under vacuum in a batch vacuum pan or a falling film evaporator is common practice. Evaporation under vacuum reduces the boiling point and hence heat damage to the food product. The concentration under vacuum of fruits juices led to significant increase in total solids, total soluble solids, colour index, total sugars, reducing - sugars, non-reducing

sugars and ash contents. The concentration under vacuum led to decrease total bacterial viable count, moulds and yeasts of fruits juices.

Vacuum cooking: Sous-vide' is the French word for 'cooking under vacuum'. This cooking method aims to maintain the integrity of ingredients by heating them for an extended period (usually 8-10 hours, sometimes well over 24 hours) at relatively low temperatures (usually between $60-70^{\circ}$ C) and pressures of 50-250 mbar absolute (40-60 mbar lower than the vapour pressure of water at a given temperature. But, there are cooks that prepare food 'sous vide' at temperatures as low as 55° C. However, for food safety reasons, that practice is not really recommended. After vacuum cooking, the food should be held at 55° C or above until served for immediate consumption, or should be rapidly cooled to below 3.3° C. A water ring pump is used to produce the absolute vacuum pressures required.

Reference(s):

- 1. https://www.ift.org/career-development/learn-about-food-science/food-facts/about-fs-and food 20technology application,control%2C%20and%20food safety management.
- 2. https://www.sciencedirect.com/topics/food-science/food-preservation
- 3. https://www.thoughtco.com/medieval-food-preservation-1788842
- 4. https://blog.smartsense.co/food-preservation-in-the-industrial-age
- 5. https://www.britannica.com/technology/pasteurization
- 6. https://daa.asn.au/wp-content/uploads/2016/12/59-2-what-does-research-on....pdf
- 7. https://www.cdfa.ca.gov/ahfss/Animal_Health/PHR250/2007/25007HACCP [2].pdf
- 8. https://www.extension.purdue.edu/extmedia/fs/fs-21-w.pdf
- https://www.intracen.org/uploadedFiles/intracenorg/Content/Publications/Export%20Q uality%20Management web.pdf
- 10. https://www.harpc.com/harpc-requirements/
- 11. https://takecaretermite.com/blog/the-importance-of-pest-control-in-food industry/:text=The%20types%20of%20pests%20found,be%20employed%20for%20effec tive%20results.
- 12. https://www.who.int/foodsafety/areas work/food-standard/en/
- http://www.rsb.gov.rw/fileadmin/user_upload/files/pdf/new_stds/2015 Standards Published.pdf
- 14. https://www.iso.org/standard/65464.html
- 15. https://www.rsb.gov.rw/index.php?id=108
- 16. https://www.iloencyclopaedia.org/part-x-96841/food-industry/overview-and-health-effects/item/857-food-industry-processes
- 17. https://www.eaglepi.com/blog/quality-control-or-quality-assurance-in-the-food-industry/#:~:text=QC%20can%20be%20achieved%20by,with%20testing%20products%2 Ofor%20defects.
- 18. https://www.inno-foodproducts-brainbox.com/2018/06/21/formulation-challenge-and-how-to-face-them/
- 19. https://www.collinsdictionary.com/dictionary/english/recipe
- 20. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/food-packaging
- 21. https://www.newworldencyclopedia.org/entry/Food_packaging