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Food and Food System

Course handout

2nd year Bachelor's in Food Science

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Food plays a vital role in human life by providing the nutrients necessary for growth, development, and the maintenance of health. In a world facing increasing challenges related to food security, population growth, environmental sustainability, and changing consumption patterns, a comprehensive understanding of food and food systems has become essential. Food systems encompass all activities and stakeholders involved in the production, processing, distribution, marketing, and consumption of food, as well as their social, economic, and environmental impacts.

The “Food and Food Systems” module is designed for second-year Bachelor's students in Food Science. It aims to provide students with a solid foundation in the fundamental concepts of food, including its classification, composition, nutritional value, and role in human health. The course also introduces the structure and functioning of food systems, the various actors involved throughout the food chain, and the challenges associated with food quality, food safety, food security, and sustainability.

By the end of this module, students will be able to:

- Define the fundamental concepts related to food and food systems.
- Classify foods according to their origin, composition, and nutritional properties.
- Understand the relationship between food composition and nutritional value.
- Describe the different stages of the food chain and the stakeholders involved.
- Explain the principles of food quality, food safety, and consumer protection.
- Analyze current challenges related to food security and sustainable food systems.

This course handbook has been prepared as a learning resource for second-year Bachelor's students in Food Science. It is intended to support the teaching and learning process and to facilitate the acquisition of the essential knowledge required for further studies in food science, food technology, and related fields.

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Introduction

Our health and active life depend critically on nutritious food. While agriculture and food production increased over the past decades, millions of people are still unable to meet their dietary needs, starkly contrasting the overconsumption and the enormous amount of food wasted daily.

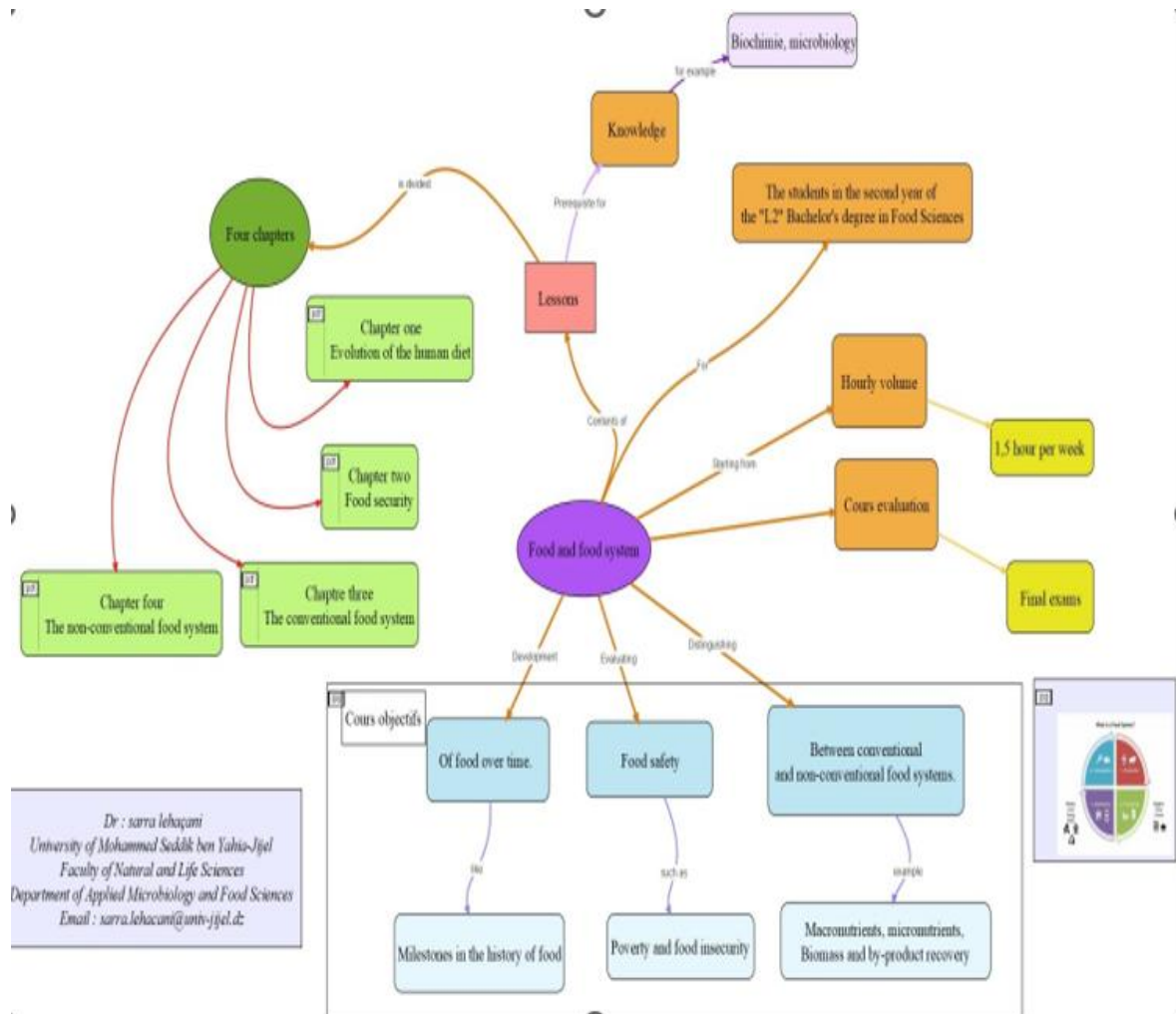


Figure 1: Conceptual map course (Figure created by the author.)

Chapter I: History and Evolution of Food

I.1. The history of food

From the origins of humans, from hunting and harvesting to intensive cultivation, our way of feeding has changed a lot. Technical advances (from the first tools to), the conquest of new territories and the discovery of new GMOs plants, the organizations of different societies have changed our diet, but have also transformed our landscapes and natural environments.

I-2 evolution of human diet

Food is vital in these stories because of the importance of its access for a tribe and the ability of food to guide evolutionary processes, potentially allowing the next generation the adaptability to survive and mate in ever-changing environmental conditions.

I.3. Origin of food

Food Substance that serves as food, i.e. for the growth and maintenance of the organism and provides the energy necessary for the vital processes of the body.

I.3.1. Animal food

Animal-based foods refer to any edible products derived from animals. These foods are a significant source of protein, fats, vitamins, and minerals in the human diet. The main categories of animal-based foods include:

- ✓ **Meat:** Derived from animals like cattle (beef), pigs (pork), chickens (poultry), and sheep (lamb).
- ✓ **Seafood:** Includes fish, shellfish, and other marine life harvested from oceans, rivers, and lakes.
- ✓ **Dairy Products:** made from the milk of mammals, primarily cows, goats, and sheep, including milk, cheese, butter, and yogurt.
- ✓ **Eggs:** Produced by birds, mainly chickens, but also ducks, quails, and other species.

I.3.2. Plant foods

Plant foods come in various types and incorporating a diverse range of them into your diet can be beneficial for your health. Here are some key categories of plant-based foods:

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- ✓ **vegetable:** These include leafy greens (like spinach and kale), root vegetables (such as carrots and beets), and other veggies like broccoli and cauliflower.
- ✓ **Fruits:** A wide variety of fruits, from apples to bananas, berries, and citrus fruits, provide essential nutrients and antioxidants.
- ✓ **Whole Grains:** Foods like brown rice, oats, barley, and quinoa fall into this category. They're rich in fiber and other nutrients.
- ✓ **Legumes:** Lentils, chickpeas, and beans (like black beans and kidney beans) are excellent sources of plant-based protein and fiber.
- ✓ **Nuts and Seeds:** Almonds, walnuts, chia seeds, and flaxseeds are packed with healthy fats, protein, and vitamins.
- ✓ **Herbs and Spices:** These add flavor and health benefits. Think of herbs like basil, parsley, and cilantro, as well as spices such as turmeric and cinnamon.

I.3.3. Synthetic Food

Synthetic foods can be defined as food substances or products that are produced artificially rather than through natural processes. Also referred to as artificial foods, these generally imitate the characteristics of natural foods including appearance, texture, and taste, and are typically manufactured under controlled laboratory conditions.

I.4. Nutrition

is the process by which living organisms obtain and utilize the macronutrients food and nutrients necessary for their growth, and maintenance the health. It involves the ingestion, digestion, absorption, transport, and metabolism of nutrients, which include (carbohydrates, proteins, and fats) and micronutrients (vitamins and minerals). These nutrients provide energy, support bodily functions, and promote the repair and maintenance of tissues. Good nutrition is essential for sustaining life, supporting proper body function, and preventing malnutrition and diet-related diseases.

I.4.1. Nutrients

Organic or mineral substance, directly assimilable without having to undergo the digestive degradation processes. The main nutrients are: carbohydrates, lipids and proteins.

I.4.1.1. Carbohydrate

is a naturally occurring compound, or a derivative of such a compound, with the general chemical formula made up of molecules of carbon (C), hydrogen (H), and oxygen (O). Carbohydrates are the most widespread organic substances and play a vital role in all life.

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I.4-1-2-Lipid

are a diverse group of organic compounds that are insoluble in water and soluble in non-polar organic solvents. They include fats, oils, waxes, hormones, and certain components of biological membranes. Lipids function as energy-storage molecules, structural components of cell membranes, and chemical messengers. Together with proteins and carbohydrates, lipids are one of the principal structural and functional components of living cells.

I.4-1-3-Protein

is a naturally occurring, extremely complex substance that consists of amino acid residues joined by peptide bonds. Proteins are present in all living organisms and include many essential biological compounds such as enzymes, hormones, and antibodies.

I.5. The food system

A food system is a complex network that includes all the production and consumption. inputs and outputs associated with agricultural and food The food system is, according to Louis Malassis, the founder of the agro-food economy, “the way in which men organize themselves, in space and time, to obtain and consume their food.” This food system goes through different stages in the history of human societies and countries.



Figure 2: Food system activities (Von Braun et al., 2023)

Today world agriculture is facing major challenges, including how to feed a growing world population, how to reduce rural poverty in the world, and how to manage ecosystem goods and services in light of global environmental change. Traditionally, components of modern

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production and consumption systems have been assessed or analyzed in studies to improve the efficiency of a particular element or activity, based on the assumption that this will also improve the efficiency of the whole system. The food system therefore includes not only the basic elements of how we get our food from farm to fork, but also all of the processes and infrastructure involved in feeding a population. Systems can also exist within systems, for example, farming systems, agricultural ecosystems, economic systems, and social systems and within those are further subsets of water systems, energy systems, financing systems, marketing systems, policy systems, culinary systems, and so on. Population health is also a key factor in addressing food systems challenges, especially as nutrition-related chronic diseases such as obesity, diabetes, cardiovascular disease, and some forms of cancer. In order to plan sustainable, equitable, and healthy food systems for the future we require integrated and innovative analytical methods and approaches from a range of disciplines, as well as effective intersectoral policy analysis and multi stakeholder engagement.

I.5. The main stages of our food

I.5-1-At the beginning of time

- ✓ Hunting with traps and Foods mainly based on meat.

I.5-2-The Paleolithic

- ✓ The Appearance of First Tools
- ✓ Less dangerous hunting because you can kill the animal at a distance (bows and arrows)

I.5-3-The Neolithic

- ✓ Appearance of branches and nets Fishing as far as possible- -
- ✓ He does not start fishing for his family, but for his village.
- ✓ Beginning of Animal Farming , Milk appears in the food (we use the skin to dress), and first crops of plants (grains).

I.5-4-The Ancient Egypt

- ✓ Using Nile silt to develop wheat and barley cultivation.“
- ✓ First intensive crops to feed the workers building the pyramids
- ✓ Appropriation of the land by owners
- ✓ Changes in landscape, The first farms
- ✓ Transformation of products
- ✓ Bread becomes an essential part of food.

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- ✓ The appearance of the first oils

I.5-5-The Roman period

- ✓ Transport and commerce throughout the Roman Empire
- ✓ Thanks to the Roman fleet that navigates the Empire, wheat is notably transported from all over the Mediterranean to Rome.
- ✓ Arrival of spices and products from elsewhere in the diet; a more diverse diet less reliant on meat.
- ✓ First markets to feed citizens

I.5-6-End of Antiquity

- ✓ Arrival of invaders (Goths, Franks...)
- ✓ Return to family farming
- ✓ Reappearance of a meat-based diet symbolizing strength and energy
- ✓ Introduction of mead, which will later become beer in the diet.

I.5-7-Middle Ages

- ✓ Scarcity, famine, leading to a desire to produce more
- ✓ Crop rotation (2 years of cultivation, 1 year of rest) to improve soil fertility: better yields for sowing(agriculture)
- ✓ Invention of wind and water mills allowing large-scale grain milling; significant bread production
- ✓ Introduction of a new plow (2 wheels supporting the plowman, enabling deeper digging)
- ✓ Expansion of cattle and horse farming for plowing. Horses are favored after the invention of the horseshoe as they are faster than oxen.

I.5-8-Renaissance

- ✓ First voyages to the Indies
- ✓ Introduction of new spices believed to have digestive qualities in the diet
- ✓ Emergence of new preservation methods (using salt)
- ✓ Fewer famines in winter.
- ✓ Ability to preserve fish products, encouraging sea trade
- ✓ Black Death, famine.
- ✓ Intensive deforestation to expand cultivated land.

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I.5-9-Discovery of America

- ✓ Introduction of new products: potato, strawberry, tomato, bell pepper, beans, corn...
- ✓ Corn and potatoes, due to their high yield, become the main food for the poor.
- ✓ Desire to increase productions.
- ✓ Four-year crop rotation.

I.5-10-19th Century

- ✓ Invention of the combine harvester, binder... drawn by horses in the United States.
- ✓ Cultivated plots expand, especially in the plains of the United States
- ✓ Introduction of the train.
- ✓ The United States exports a large quantity of cereals to Europe
- ✓ Emergence of the first steam-powered machines
- ✓ More production with fewer workers; initial issues of unemployment
- ✓ First ice machines in England
- ✓ Importation of meat from Argentina and the United States.

I.5-11-20th Century

- ✓ World War I: Development of chemical warfare
- ✓ Invention of the first chemical pesticides
- ✓ 1940s: Discovery of DNA*
- ✓ 1970: A gene from an African amphibian is transferred into the DNA of a bacterium; this is the first step towards genetically modified organisms (GMOs)
- ✓ 1980s: Widespread adoption and commercialization of GMOs in agriculture, including genetically modified crops.

Example

- ✓ **Genetically modified organism (GMO)**, organism whose genome has been engineered in the laboratory in order to favour the expression of desired physiological traits or the generation of desired biological products.
- ✓ **Genetically modified organisms (GMOs)** are produced using scientific methods that include recombinant DNA technology and reproductive cloning.

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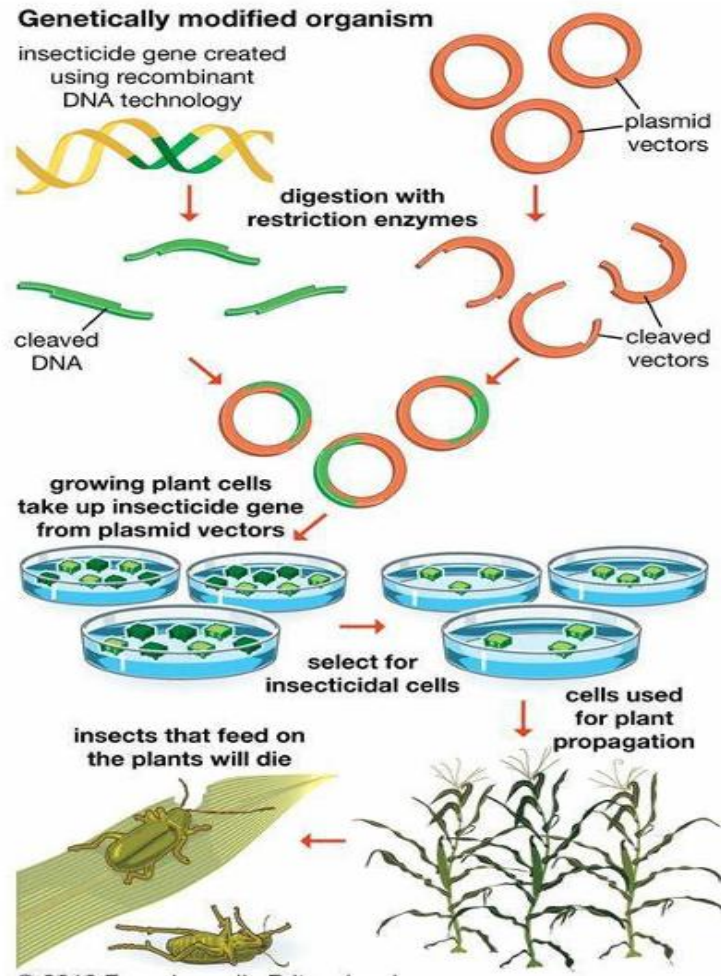


Figure 3: Genetically modified organisms (Holst-Jensen, 2009)

Chapter II: Food Security

II.1. An Introduction to the Basic Concepts of Food Security

Already in 1948, when the Universal Declaration of Human Rights was ratified, the right to food was recognized only indirectly. In 1974, the World Food Council declared that “Every man, woman and child has the inalienable right to food and must not suffer from malnutrition in order to fully develop and maintain their physical and mental abilities.” Food security, as defined by the United Nations' Committee on World Food Security, means that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life.

Over the coming decades, a changing climate, growing global population, rising food prices, and environmental stressors will have significant uncertain impacts on food security.

Strategies and policy responses to global change, including options for:

- Handling water,
- Land use patterns,
- Food trade
- Postharvest food processing,
- Food prices and safety are urgently needed

II.2. The four dimensions of food security

Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. From this definition, four main dimensions of food security can be identified:

II.2-1- Physical availability of food

Food availability addresses the “supply side” of food security and is determined by the level of food production, stock levels and net trade.

II.2-2- Economic and physical access to food

An adequate supply of food at the national or international level does not in itself guarantee household level food security. Concerns about insufficient food access have resulted in a greater policy focus on incomes, expenditure, markets and prices in achieving food security objectives.

II.2-3- Food utilization

Utilization is commonly understood as the way the body makes the most of various nutrients in the food. Sufficient energy and nutrient intake by individuals is the result of good care and feeding practices, food preparation, diversity of the diet and intra-household distribution of food. Combined with good biological utilization of food consumed, this determines the nutritional status of individuals.

II.2-4- Stability of the other three dimensions over time

Even if your food intake is adequate today, you are still considered to be food insecure if you have inadequate access to food on a periodic basis, risking a deterioration of your nutritional status. Adverse weather conditions, political instability, or economic factors (unemployment, rising food prices) may have an impact on your food security status.

For food security objectives to be realized, all four dimensions must be fulfilled simultaneously.

II.3. Hunger and food insecurity

FAO's imperative is to make sure no one suffers from hunger. Yet, while many people may not be “hungry” in the sense that they are suffering physical discomfort caused by a severe lack of dietary energy, they may still be food insecure.

They might have access to food to meet their energy requirements, yet are uncertain that it will last, or they may be forced to reduce the quality and/or quantity of the food they eat in order to get by. This moderate level of food insecurity can contribute to various forms of malnutrition and can have serious consequences for health and wellbeing.

What is hunger?

Hunger is an uncomfortable or painful physical sensation caused by insufficient consumption of dietary energy. It becomes chronic when the person does not consume a sufficient amount of calories (dietary energy) on a regular basis to live a normal, active and healthy life. For decades, FAO has used the Prevalence of Undernourishment indicator to estimate the extent of hunger in the world, thus “hunger” may also be referred to as undernourishment.

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What is food insecurity?

A person is food insecure when they lack regular access to enough safe and nutritious food for normal growth and development and an active and healthy life. This may be due to unavailability of food and/or lack of resources to obtain food. Food insecurity can be experienced at different levels of severity. FAO measures food insecurity using the Food Insecurity Experience Scale (FIES) shown below:



Figure 4: Food Insecurity Experience Scale (FIES) (Practical, 2008)

The (FIES-SM) consists of eight questions regarding people's access to adequate food, and can be easily integrated into various types of population surveys. The FIES-SM questions refer to the experiences of the individual respondent or of the respondent's household as a whole. The questions focus on self-reported food-related behaviors and experiences associated with increasing difficulties in accessing food due to resource constraints.

1. You were worried you would not have enough food to eat?
2. You were unable to eat healthy and nutritious food?
3. You ate only a few kinds of foods?
4. You had to skip a meal?
5. You ate less than you thought you should?
6. Your household ran out of food?
7. You were hungry but did not eat?
8. You went without eating for a whole day?

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The set of eight questions compose a scale that covers a range of severity of food insecurity. The FIES global reference scale is based on results from the application of the FIES survey module. The FIES is a statistical scale similar to other widely-accepted scales designed to measure unobservable traits such as aptitude/intelligence, personality, and a broad range of social psychology and health-related conditions. Responses to the questions must always be analyzed together as a scale, not as separate items. Comparability of results across countries is achieved through the use of statistical techniques borrowed from the toolkit of Item Response Theory models, commonly used in the educational and psychological testing fields.

II.4- How are hunger and food insecurity related?

When someone is severely food insecure, they have run out of food and gone a day or more without eating. In other words, they have most likely experienced hunger.

Severe food insecurity is one extreme of the scale, but even moderate food insecurity is worrisome. For those who are moderately food insecure, access to food is uncertain. They might have to sacrifice other basic needs, just to be able to eat. When they do eat, it might be whatever is most readily available or cheapest, which might not be the most nutritious food. The rise in obesity and other forms of malnutrition is partly a result of this phenomenon. Highly processed foods that are energy-dense, high in saturated fats, sugars and salt are often cheaper and easier to come by than fresh fruits and vegetables. Eating those foods may mean your daily requirement of calories is met, but you are missing essential nutrients to keep your body healthy and functioning well. In addition, the stress of living with uncertain access to food and going periods without food can lead to physiological changes that can contribute to overweight and obesity. Children facing hunger, food insecurity and undernutrition today may have a higher risk of overweight, obesity and chronic diseases like diabetes later in life. In many countries, undernutrition and obesity coexist and both can be consequences of food insecurity.

II.5. The duration of food insecurity

Food security analysts have defined two general types of food insecurity:

II.5-1-Chronic food insecurity

- ✓ Is long-term or persistent.
- ✓ Occurs when people are unable to meet their minimum food requirements over a sustained period of time.
- ✓ Result from extended periods of poverty, lack of assets and inadequate access to productive or financial resources.

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- ✓ Can be overcome with typical long term development measures also used to address poverty, such as education or access to productive resources, such as credit. They may also need more direct access to food to enable them to raise their productive capacity.

II.5-2-Transitory food insecurity

- ✓ Is short-term and temporary.
- ✓ Occurs when there is a sudden drop in the ability to produce or access enough food to maintain a good nutritional status.
- ✓ Result from short-term shocks and fluctuations in food availability and food access, including year-to-year variations in domestic food production, food prices and household incomes.
- ✓ Can be overcome with transitory food insecurity is relatively unpredictable and can emerge suddenly. This makes planning and programming more difficult and requires different capacities and types of intervention, including early warning capacity and safety net programmes (see Box 1).

The concept of seasonal food security falls between chronic and transitory food insecurity. It is similar to chronic food insecurity as it is usually predictable and follows a sequence of known events. However, as seasonal food insecurity is of limited duration it can also be seen as recurrent, transitory food insecurity. It occurs when there is a cyclical pattern of inadequate availability and access to food. This is associated with seasonal fluctuations in the climate, cropping patterns, work opportunities (labour demand) and disease.

Box 1. What are Safety Nets?

Measures to enhance direct access to food are more likely to be beneficial if these are embedded in more general social safety net programmes. Safety nets include income transfers for those chronically unable to work—because of age or handicaps—and for those temporarily affected by natural disasters or economic recession. Options include:

- Targeted direct feeding programmes. These include school meals; feeding of expectant and nursing mothers as well as children under five through primary health centres, soup kitchens and special canteens.
- Food-for-work programmes. Food-for-work programmes provide support to households while developing useful infrastructure such as small-scale irrigation, rural roads, buildings for rural health centres and schools.

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- Income-transfer programmes. These can be in cash or in kind, including food stamps, subsidized rations and other targeted measures for poor households.

II.6- The Severity of food insecurity

When analyzing food insecurity, it is not enough to know the duration of the problem that people are experiencing, but also how intense or severe the impact of the identified problem is on the overall food security and nutrition status.

This knowledge will influence the nature, extent and urgency of the assistance needed by affected population groups. Different 'scales' or 'phases' to 'grade' or 'classify' food security have been developed by food security analysts using different indicators and cut-off points or 'benchmarks'. Examples include:

II.6.1. Measuring the severity of undernourishment

The measure for hunger compiled by FAO, defined as undernourishment, refers to the proportion of the population whose dietary energy consumption is less than a pre-determined threshold. This threshold is country specific and is measured in terms of the number of kilocalories required to conduct sedentary or light activities. The undernourished are also referred to as suffering from food deprivation.

The severity of undernourishment indicates, for the food deprived, the extent to which dietary energy consumption falls below the pre-determined threshold.

The IPC is a classification system for food security crises based on a range of livelihood needs:

IPC Phase Classification	Indicators
Generally food secure	- Crude Mortality Rate - Malnutrition prevalence
Chronically food insecure	- Food Access/ Availability
Acute food and livelihood crisis	Dietary Diversity Water
Humanitarian emergency	Access/Availability - Coping strategies - Livelihood Assets
Famine / humanitarian catastrophe	

Figure 5: The Integrated Food Security Phase Classification (IPC) sysetem (Devereux, 2006)

II.7. Vulnerability

The dynamic nature of food security is implicit when we talk about people who are vulnerable to experiencing food insecurity in the future. Vulnerability is defined in terms of the following three critical dimensions. vulnerability to an outcome; from a variety of risk factors; because of an inability to manage those risks. Indeed, a person can be vulnerable to hunger even if he or she is not actually hungry at a given point in time. Vulnerability analysis suggests two main intervention options:

- ✓ Reduce the degree of exposure to the hazard;
- ✓ Increase the ability to cope. By accounting for vulnerability, food security policies and programs broaden their efforts from addressing current constraints to food consumption, to include actions that also address future threats to food security.

Box 2. Analyzing the Risk of Becoming Food Insecure

For example, we may be interested in analyzing the risk of becoming food insecure as a result of a flood. If a household lives outside a flood plain then the exposure to flooding is low and therefore the risk of a flood causing the household to become food insecure is low (unless their crops are in the valley!). However, if they live on the flood plain, but they have the ability to cope with the hazard, for example by being very mobile, and being able to move their animals and/or food crops to safety, then the risk may still be low.

II.8. Hunger, malnutrition and poverty

It is important to understand how these three concepts are related to food insecurity. Hunger is usually understood as an uncomfortable or painful sensation caused by insufficient food energy consumption. Scientifically, hunger is referred to as food deprivation.

Simply put, all hungry people are food insecure, but not all food insecure people are hungry, as there are other causes of food insecurity, including those due to poor intake of micro-nutrients.

Malnutrition results from deficiencies, excesses or imbalances in the consumption of macro-and/or micro- nutrients. Malnutrition may be an outcome of food insecurity, or it may relate to non-food factors, such as: Inadequate care practices for children, insufficient health services; and an unhealthy environment.

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While poverty is undoubtedly a cause of hunger, lack of adequate and proper nutrition itself is an underlying cause of A current and widely used. “Poverty encompasses different dimensions of deprivation that relate to human capabilities including consumption and food security, health, education, rights, voice, security, dignity and decent work.

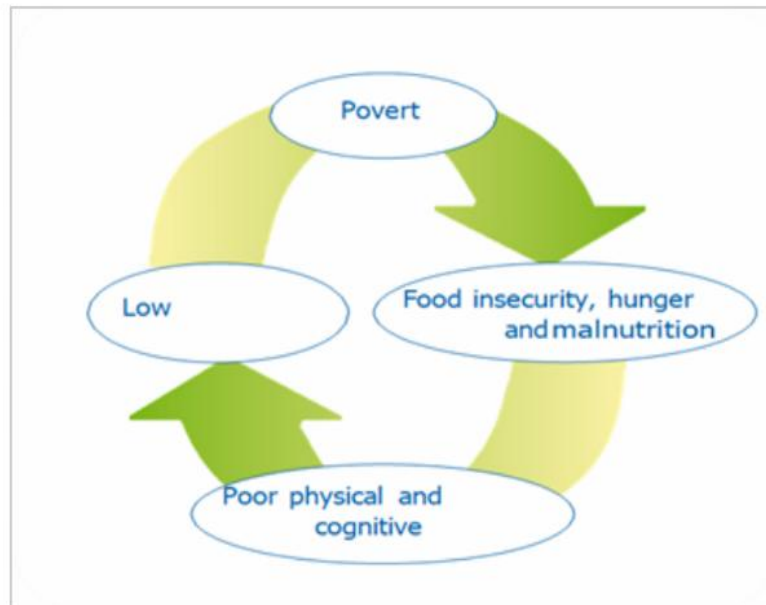


Figure 6: Food insecurity, malnutrition and poverty are deeply interrelated phenomena
(Dilley & Boudreau, 2001)

It is argued that a strategy for attacking poverty in conjunction with policies to ensure food security offers the best hope of swiftly reducing mass poverty and hunger. However, recent studies show that economic growth alone will not take care of the problem of food security. What is needed is a combination of: income growth; supported by direct nutrition interventions; and investment in health, water and education.

II.9- Types of Food Security

There are several types of food security, each focusing on different aspects of the availability, access, and utilization of food. Here are some of the key types of food security:

- ✓ **Physical Food Security:** Ensures the physical availability of sufficient food to meet the nutritional needs of the population.
- ✓ **Economic Food Security:** Means that people have the financial means to purchase nutritious food. This involves having stable income and affordable food prices.

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- ✓ **Utilization Food Security:** Refers to individuals' ability to prepare and consume food in a healthy and hygienic manner. This encompasses access to cooking facilities, clean drinking water, and proper hygiene practices.
- ✓ **Cultural Food Security:** Implies that the available foods align with the cultural, religious, and social norms of the population. This can include specific food preferences or traditional dietary practices.
- ✓ **Political Food Security:** Means that government policy and food systems are in place to ensure that all citizens have access to adequate and nutritious food.
- ✓ **Environmental Food Security:** Refers to the environmental sustainability of food systems, ensuring that food production does not deplete natural resources and cause excessive environmental harm.

These different types of food security are interconnected and all contribute to ensuring that individuals and communities have stable, sustainable, and healthy access to nutritious food.

II. 10. The Consumer and Food Security

The consumer plays a crucial role in maintaining food security, both at the individual and collective levels. Here's how the consumer is related to food security:

- ✓ **Informed Food Choices:** Consumers can contribute to their own food security by making informed food choices. This means understanding the nutritional value of foods, reading labels, and opting for balanced and nutritious foods.
- ✓ **Demand for Quality Products:** By demanding quality products, consumers encourage producers and distributors to maintain high standards. This can contribute to the availability of safe and nutritious food products in the market.
- ✓ **Participation in Local Agriculture:** By supporting local markets and local farmers, consumers help strengthen local agriculture. This can increase the availability of fresh and local foods, thereby enhancing community food security.
- ✓ **Reduction of Food Waste:** By avoiding food waste, consumers can help maximize the use of existing food resources. Less waste means more food available for everyone.
- ✓ **Awareness and Education:** Informed consumers can raise awareness among other members of society about food security issues. Education and awareness can contribute to policy and social changes aimed at improving food security.

Chapter III :Conventional Food System

III.1. Food System

As discussed in Chapter I, the food system comprises all activities involved in bringing food from production to consumption. These activities include production, processing, distribution, marketing, consumption, and waste management. Understanding these components is essential for improving the efficiency and sustainability of food systems.



Figure 7 : A simplified representation of the food system and its activities (Bongaarts, 2021)

III. 2. food system and its activities

A simplified representation of the food system and its activities can be visualized as follows:

- ✓ **Production:** Farmers grow crops and raise livestock to produce basic foods such as cereals, vegetables, fruits, meat, milk, etc.
- ✓ **Processing:** Raw foods are processed into ready-to-consume food products. This can include turning fruits into juice, baking bread, processing milk into dairy products, etc.

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- ✓ **Distribution:** Processed foods are distributed to local markets, supermarkets, restaurants, and other points of sale where consumers can purchase them.
- ✓ **Marketing:** Businesses and farmers promote their products to attract consumers. This often involves marketing and advertising strategies.
- ✓ **Consumption:** Individuals and families purchase, cook, and consume the foods. This is the stage where foods are integrated into daily meals.
- ✓ **Waste Management:** Food waste and packaging are disposed of properly, either through recycling, composting, or other environmentally friendly methods.

These activities form a continuous cycle that constitutes the food system.

III.3. The different types of nutrients and their sources

Food: These are complex natural substances that contain at least two nutrients. They provide the nutrients (carbohydrates, proteins, lipids, vitamins, and minerals) necessary for the proper functioning of the human body.

Nutrition: It is the set of reactions (metabolic) through which our body transforms and utilizes food to obtain everything it needs for its proper functioning and to stay alive.

Nutrients: are chemical substances required by the body to sustain basic functions and are optimally obtained by eating a balanced diet. There are six major classes of nutrients essential for human health: carbohydrates, lipids, proteins, vitamins, minerals, and water. Essential nutrients for health include macronutrients and micronutrients.

Macronutrients: These include proteins, lipids, and carbohydrates. They are typically large molecules with complex structures that require breakdown (digestion) into smaller, simpler molecules for absorption.

Micronutrients: These encompass minerals and vitamins and play essential roles in metabolism.

III.4. Water in food

Water: All foods contain water unless it is intentionally removed through industrial techniques (oil, sugar, etc.). Even dehydrated or powdered foods still contain some water, as it is challenging to separate the water bound to cellular components.

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Figure 8 : Water percentage in food (Sandulachi, 2012)

III.5. Water and Food Preservation

Foods rich in water are more perishable than those with low water content; the microorganisms that spoil food cannot survive if the moisture level is below 12-14%. This is why items such as cereals, flour, pasta, dried vegetables, and sugar have a long shelf life.

Food preservation, any of a number of methods by which food is kept from spoilage after harvest or slaughter. Such practices date to prehistoric times. Among the oldest methods of preservation are drying, refrigeration, and fermentation. Modern methods include canning, pasteurization, freezing, irradiation, and the addition of chemicals.

III.6. Types of water: Free, Bound, and Entrapped Water

Most natural foods contain water up to 70% of their weight or greater unless they are dehydrated, and fruits and vegetables contain water up to 95% or greater. Water that can be extracted easily from foods by squeezing or cutting or pressing is known as free water, whereas water that cannot be extracted easily is termed as bound water.

Whereas water that cannot be extracted easily is termed as bound water. Bound water is usually defined in terms of the ways it is measured; Many food constituents can bind or hold water molecules such that they cannot be easily removed and they do not behave like liquid water. Some characteristics of bound water include:

- ✓ It is not free to act as a solvent for salts and sugars

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- ✓ It can be frozen only at very low temperatures (below the freezing point of water).
- ✓ It exhibits essentially no vapor pressure
- ✓ Its density is greater than that of free water

Entrapped water is the water that is retained by the microscopic or submicroscopic structures or membranes in tissues. Entrapped water is unable to flow freely, so sometimes it is called immobilized water or intercepting water.

III.7.Macronutrients

III. 7.1.Carbohydrates (Carbs)

Carbohydrates are organic compounds made of carbon, hydrogen, and oxygen, primarily found in plant-based foods.

They primarily serve an energy function: **1 gram provides 4 kilocalories.**

Carbohydrates can either be completely burned, releasing significant energy, or stored as reserves by the liver or muscles in the form of glycogen, or within tissues as lipids.

The general formula for a CHO* can be written as $C_x(H_2O)_y$.

III.7.1.1.Monosaccharides

Monosaccharides commonly found in foods are hexoses, meaning they consist of sugars with 6 carbon atoms ($C_6H_{12}O_6$). The arrangement of carbon, hydrogen, and oxygen atoms within the molecule varies based on the type of sugar. Monosaccharides are easily assimilated: glucose (found in fruits, honey, certain vegetables, etc.), fructose (found in fruits, honey, certain vegetables, etc.), galactose (found in milk, dairy products, etc.), etc.

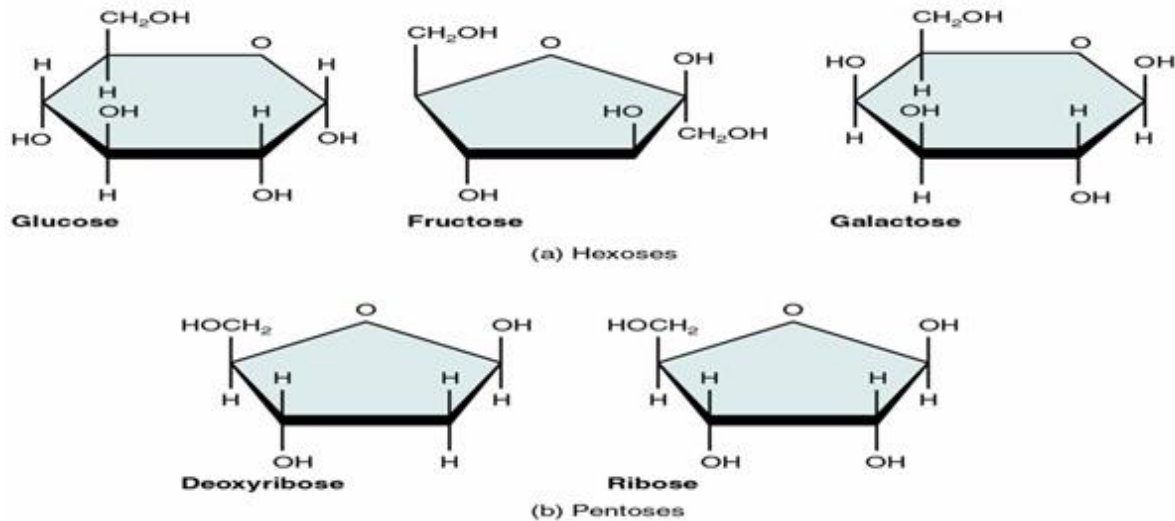


Figure 9: Monosaccharides(Tzia, et al 2012)

III.7.1.1.1. Physicochemical Properties of Monosaccharides

- ✓ These sugars cannot be broken down into other sugars.
- ✓ They are soluble in water.
- ✓ They are directly absorbable in the intestine.
- ✓ Heat melts them and transforms them into caramel.
- ✓ They can ferment under the action of yeast to produce alcohol and carbon dioxide.

III.7.1.2. Oligosaccharides (2 to 10 units of monosaccharides)

Oligosaccharides with 2 units (Disaccharides): The chemical formula of disaccharides is $C_{12}H_{22}O_{11}$. A disaccharide can yield two monosaccharides under the action of an acid, or better, an enzyme with the participation of H_2O .

A glycosidic bond is formed between two monosaccharides. If carbon 1 on one monosaccharide joins to carbon 4 on another monosaccharide, it is called a 1,4-glycosidic bond.

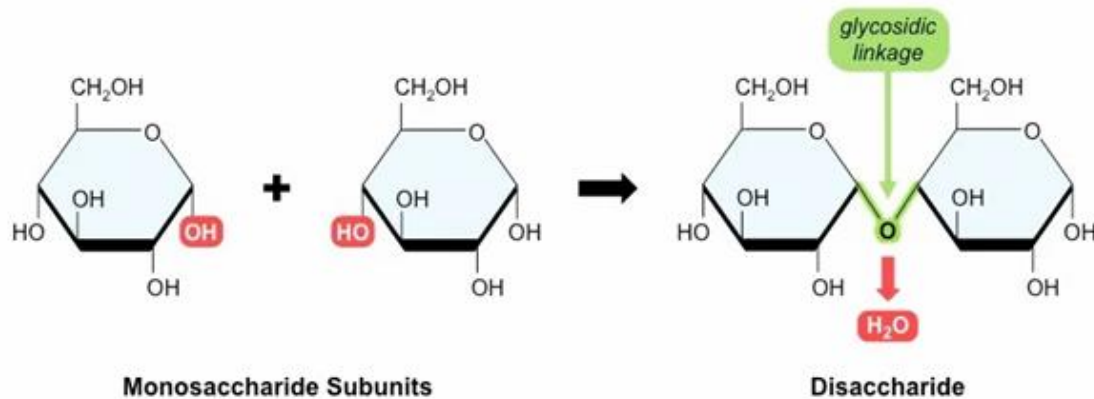


Figure 10 : Disaccharides formation (Izydorczyk et al ., 2005)

III.7.1.3.Oligosaccharides with 3 to 10 units (tri-, tetra- to decasaccharides)

The most common ones are raffinose (trisaccharide: galactose + glucose + fructose) and stachyose (fructose + glucose + two units of galactose). Both are present in legumes such as dry beans and peas. Neither of them is hydrolyzed or digested by the human digestive system and they become food for bacteria in the large intestine.

III.7.1.4.Polysaccharides (>10 units of monosaccharides)

Homoglycans (same unit of monosaccharides): Examples include starch (600-10000 units of glucose), glycogen (30000 units of glucose), cellulose (1500 units of glucose).

Heteroglycans (2-6 units of different monosaccharides): Examples include hemicelluloses (xylose, mannose, galactose, rhamnose, arabinose).

Polysaccharides are composed of a more or less long chain of associated molecules: starch (cereals, legumes, tubers, some fruits, etc.), glycogen (meat, liver), dietary fibers (wheat bran, fruits, and cellulose in most vegetables).

Fibers are carbohydrates not assimilated by humans; however, they are digestible in ruminants and horses, for example. Fibers play an interesting role in intestinal transit.

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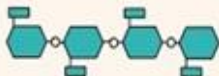
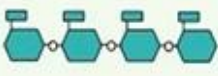
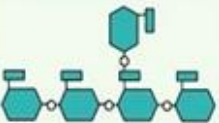
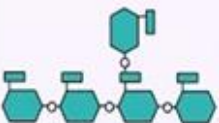
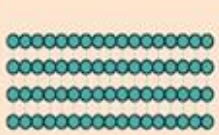
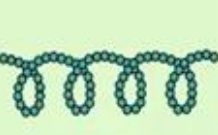
	Cellulose	Starch		Glycogen
		Amylose	Amylopectin	
Source	Plant	Plant	Plant	Animal
Subunit	β -glucose	α -glucose	α -glucose	α -glucose
Bonds	1-4	1-4	1-4 and 1-6	1-4 and 1-6
Branches	No	No	Yes (~per 20 subunits)	Yes (~per 10 subunits)
Diagram				
Shape				

Figure 11 : Polysaccharides (>10 units of monosaccharides) (Izydorczyk et al., 2005)

Table 1 : The main difference between starch, cellulose and glycogen (Vanderhoof, 1998)

Starch	Starch is made up of long chains of α -glucose (Amylose and Amylopectin).	Starch is the main energy storage materials in plants
Glycogen	Glycogen is made of α -glucose linked together by glycosidic bonds.	Glycogen is the main energy storage materials in animals.
Cellulose	Cellulose is also made of many β -glucose molecules linked by glycosidic bonds between carbon 1 and carbon 4.	Cellulose is the major component of cell walls in plants.

III.7.1.5. Roles of carbohydrates in the body

Energetic Role: Glucose is the molecule primarily used to provide energy. Its breakdown allows for the formation of ATP (adenosine triphosphate). This energy is used to ensure muscle contraction.

Structural and Functional Role: Some carbohydrates have a role known as "constitutive" and contribute to the synthesis of cell membranes. They are involved in the composition of fundamental tissues in the body, such as cartilage (connective and elastic tissues).

III.7.2-Proteins and Non-Protein Nitrogenous Substances

Proteins are organic compounds made up of amino acids nitrogen, and sometimes sulfur, all containing a chemical group called amine (NH_2). This name, amino acid, signifies that each contains an amino (NH_2) and carboxylic acid (COOH) groups. A protein is composed of at least 50 amino acids (10 to 50: polypeptide, fewer than 10: peptide). Individual amino acids are joined together using a peptide bond (green) and is shown in the figure 12 below.

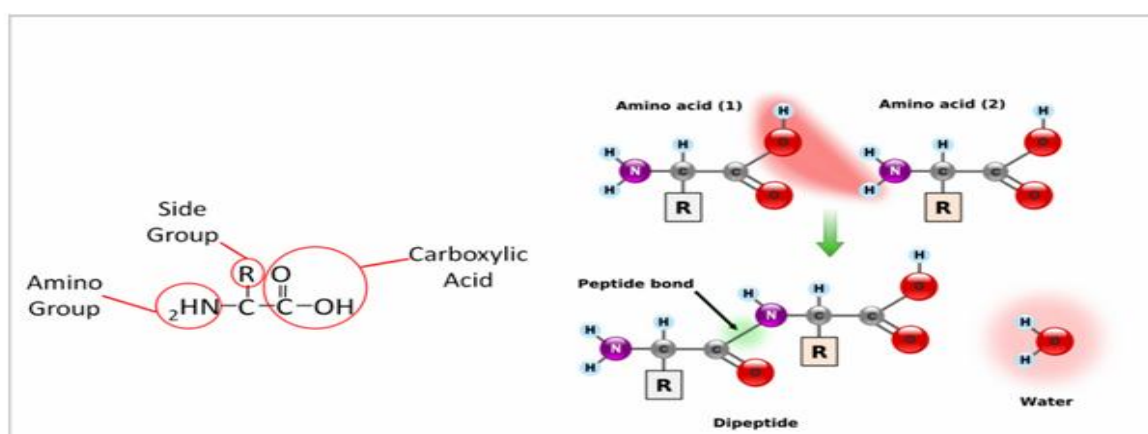


Figure 12: Structure of an amino acid and peptide bond formation. (Malinowska-Pańczyk, 2023)

III.7.2.1. Different types of proteins are generally distinguished

1. Albumin (plasma protein produced by the liver, found in milk, eggs, muscles, and blood plasma, for example),
2. Globulin (plasma and globular protein),
3. Collagen (present in the extracellular matrix, secreted by connective tissue cells, providing tissues with mechanical resistance to stretching),
4. Keratin (main component of appendages: hair, fur, feathers, horns, nails, beaks, etc.),
5. Contractile proteins such as actin and myosin, Ossin in bones,
6. Legumin in legumes, Casein in milk, etc.

Proteins primarily have an energetic role: **1 g provides 4 kilocalories**. Proteins are the only source of essential nitrogen for the body to produce its own protein compounds.

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Proteins are essential components of cells and tissues and play a role in cell renewal, growth, tissue repair, and the formation of most hormones, immune antibodies, many enzymes (especially digestive enzymes), and blood components (hemoglobin).

There are about twenty amino acids in nature, of which 8 are called "essential" because the human body cannot synthesize them and must be supplied through diet. They are called essential or indispensable amino acids: isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, valine.

Two are called "semi-essential" because they can, under certain conditions, be synthesized: histidine and arginine.

Non-essential amino acids that can be produced in our body. Most of them are produced from glucose. Of course, they are also found in the diet, in both plant and animal foods. include alanine, aspartic acid, citrulline, cystine, glutamic acid, glycine, proline, hydroxyproline, serine, and tyrosine.

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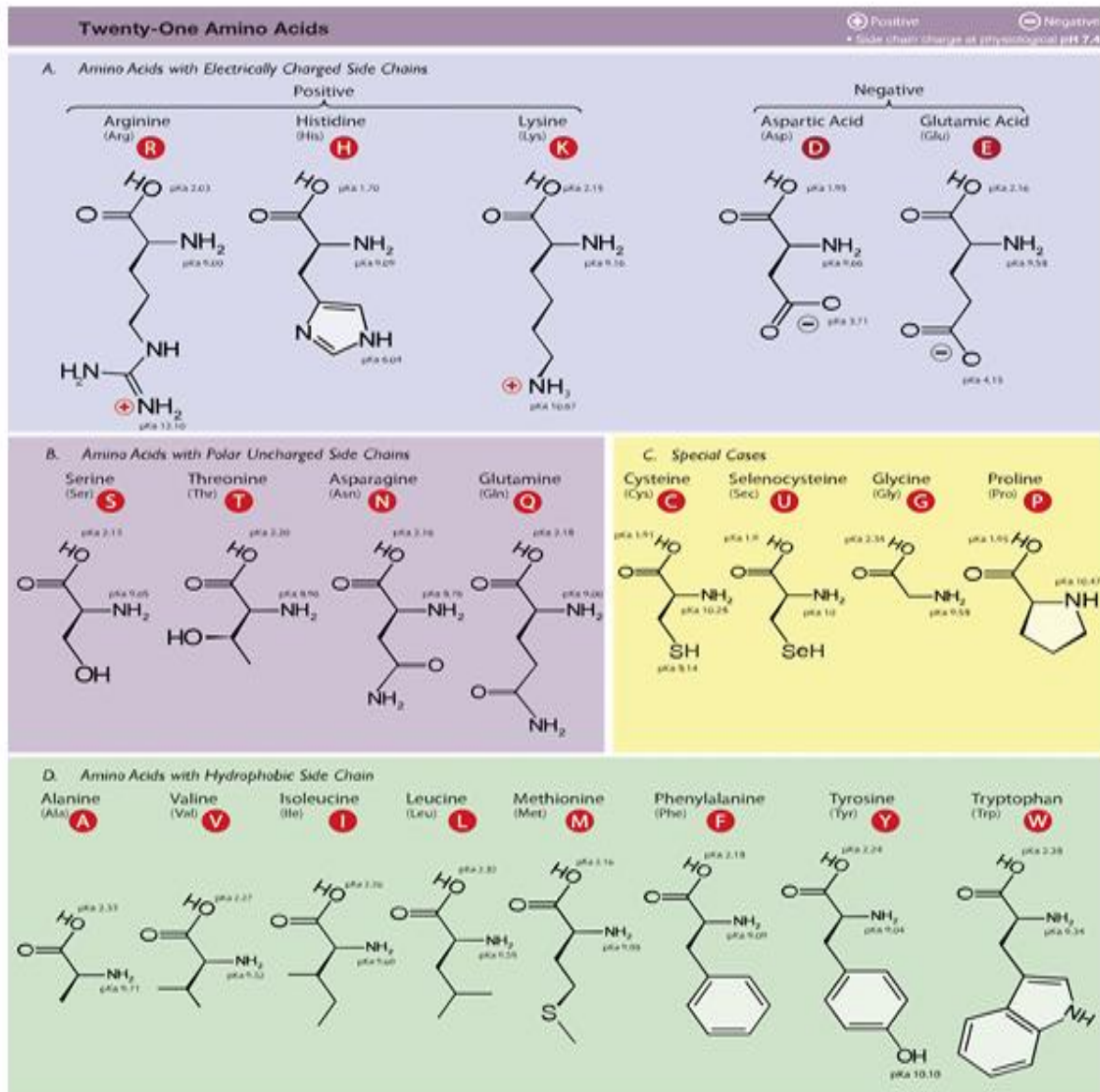


Figure 13 : Types of amino acid (Malinowska-Pańczyk, 2023)

Generally, proteins of animal origin (meat, fish, eggs, milk and dairy products, liver, etc.) have a higher biological value than proteins of plant origin (rice, soy, beans, lentils, bread, etc.). Plant proteins are often deficient in one or more essential amino acids, referred to as the limiting factor. This most commonly includes lysine (for cereals in general), methionine (for legumes), and tryptophan (for corn).

Non-Protein Nitrogenous Compounds: These compounds are not made up of amino acids. They include: nitrogen bases of nucleic acids, amines, amides, alkaloids, simple nitrogen forms, nitrates, etc. They are also found in the vacuoles of plant cells.

III.7.3. Lipids

Lipids (fats, oils, etc.) are organic compounds composed of fatty acids. Dietary lipids are primarily composed of triglycerides (one glycerol molecule associated with three units of fatty acids). Sterols (especially cholesterol), phospholipids, tocopherol(vitamine E est une vitamine liposoluble), etc., are also found in lipids. Cholesterol is often associated with a fatty acid.

Lipids serve as a significant form of caloric energy storage. Unlike carbohydrates, which are assimilated directly, lipids are stored in adipose tissue in the form of triglycerides, constituting reserves that are utilized for energy purposes only in case of insufficient dietary intake.

They are the primary constituents of cell membranes and also have a considerable energy role; **one gram of lipids provides 9 Kilocalories.**

Dietary lipids come from both animals (milk, butter, cheese, lard, foie gras, eggs, meats, fish, etc.) and plants (peanut, olive, sunflower, oil, nuts, almonds, cereals, etc.).

The physical and nutritional properties of lipids depend on the nature of fatty acids.

III.7.3.1. types of fatty acids

Different types of fatty acids are distinguished:

- ✓ **Saturated fatty acids** (the most important being butyric acid, palmitic acid, stearic acid (C18), caproic acid, caprylic acid, capric acid, lauric acid, and myristic acid): contain only single bonds. Fats containing mostly saturated fatty acids are solid at room temperature and are mostly of animal origin (butter, lard, cheese, milk, etc.).

Saturated fatty acids are considered one of the main contributors to cardiovascular diseases due to increased cholesterol levels (LDL: Low-Density Lipoprotein). HDL cholesterol is often known as 'good cholesterol' because it helps to protect your heart and blood vessels from disease. Cholesterol easily adheres to arterial walls, causing atherosclerotic plaque, which obstructs blood circulation to varying degrees.

- ✓ **Monounsaturated fatty acids** (oleic acid being the most important C18:1): have a single double bond. They are primarily found in vegetable oils, olive oil (73%), rapeseed oil (62%), peanut oil (58%), palm oil (38%), corn oil (28%), soybean oil (20%), etc.

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High-Density Lipoprotein (HDL) cholesterol, on the other hand, prevents cardiovascular diseases. HDL cholesterol cleans arteries by breaking down atheroma deposits and removing or metabolizing them through hepatic function.

- ✓ **Polyunsaturated fatty acids** (the most important being Linoleic (18:2 (n-6) or 18:2 cis-9,12), alpha-linolenic (18:3 (n-3) 18:2 cis-9,12,15), and arachidonic acid (C20:4(5,8,11,14)): have multiple relatively unstable double bonds.

Oils rich in polyunsaturated fatty acids are liquid at room and cold temperatures. They are very sensitive to high temperatures and oxidize quickly in light.

Fatty fish are privileged sources of polyunsaturated fatty acids. It's worth noting that the body cannot synthesize either alpha-linolenic acid (source of omega-3) or linoleic acid (source of omega-6). Both are therefore termed "essential" fatty acids, meaning they must be provided through the diet. Omega-3 fatty acids are mainly found in fatty fish and their oils, as well as in certain vegetable oils like grape seed oil, soybean oil, and flaxseed oil. Omega-6 fatty acids are present in most vegetable oils, mainly sunflower oil and corn oil.

Polyunsaturated fatty acids tend to lower LDL cholesterol levels, but they also cause a slight decrease in HDL levels. Omega-3s help reduce triglyceride levels in the blood, thus preventing cardiovascular diseases. They are also essential for the development and functioning of the retina, brain, and nervous system, help prevent high blood pressure, and have a beneficial influence on the quality of cell membranes and anti-inflammatory and immune reactions.

III.7.3.2.Characteristics of lipids

There are saturated fats and unsaturated fats.

Omega-3 and 6 are considered essential because the body cannot produce them.

Lipids are predominantly found in vegetable oils, butter, industrial products, etc.

They are components of all cell membranes in the body.

III.7.3.3.Roles of lipids in the body

Energetic: Lipids provide 9 kcal per gram. Therefore, they contribute to meeting energy needs.

Structural Role: Lipids, especially unsaturated fatty acids, are major components of cell membranes and cells in the nervous system. They also ensure the plasticity and elasticity of the skin as essential components of dermal cells.

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Transport of Fat-Soluble Vitamins in the body, some vitamins can only be transported with the help of lipids. These are known as fat-soluble vitamins: vitamins A, D, E, and K.

III.8.Micronutrients

The term micronutrients refers to vitamins and minerals, which can be divided into macrominerals, trace minerals and water and fat-soluble vitamins. An adequate amount of micronutrients often means aiming for a balanced diet. Your body needs smaller amounts of micronutrients relative to macronutrients. That's why they're labeled "micro."

III.8.1.Vitamins

Vitamins are devoid of caloric energy, but they are organic substances necessary for the functioning of the body. They constitute the majority of enzymatic systems used in energy production and are essential for the functioning of the immune, hormonal, and nervous systems.

They ensure the proper progress of metabolic chemical reactions and thus contribute to the body's growth. They also play a role in nutrient assimilation (vitamin B1 for carbohydrates, B6 for proteins, and C for calcium and iron). The body cannot synthesize vitamins, so their intake must be ensured through our diet because deficiencies can lead to various health problems.

Fat-soluble vitamins: These vitamins are soluble in fats. They include vitamin A (found in meat, milk, eggs, liver, and carrots), vitamin D (found in egg yolk and fish), vitamin E (found in cereals, green salad, liver, and vegetable oils), and vitamin K (found in green vegetables, liver, fish, and cheese).

Water-soluble vitamins: These vitamins are soluble in water. They include vitamin B1, B2, B3 (or niacin), B5, B6, B8 (biotin), B9 (folate), B12 (found in fish, milk, cereals, eggs, and liver), and vitamin C (found in acidic fruits, raw vegetables, and bell peppers).

III.8.2.Minerals

Minerals are inorganic particles that must be obtained from the diet even though they are not sources of energy. They are major cellular components, regulating membrane permeability and osmotic pressure (Na, K), neuromuscular excitability (Ca, Mg, Na, K), etc. They are essential for bone composition (Ca, P, Mg) and are involved in numerous enzymatic processes (Cu, Se, Cr, Zn, P), etc

Macro-minerals: These include calcium (found in milk and dairy products), magnesium (found in cocoa, soy, and almonds), sodium (added as sodium chloride to foods), potassium

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(found in meats), chlorine (found in cheese and bread), phosphorus (found in soy and cheese), sulfur, etc.

Trace minerals (or trace elements): These include iron (found in soy, red meats, liver, and green vegetables), copper (found in liver), zinc (found in meats and fish), fluorine (found in tea), iodine (found in fish), chromium (found in liver and egg yolks), selenium (found in fish and seafood), manganese (found in cereal products, mollusks, legumes, vegetables, and nuts), etc.

Chapter IV: Non Conventional Food System

IV. 1. unconventional food resources

The concept of unconventional food resources refers to foods that are not commonly used in the general dietary practices of the population but are generally recognized and accepted as foods within the existing consumption patterns of a given country or society.

These foods may have unusual characteristics compared to traditional dietary habits and are often considered as alternatives or supplements to more conventional food sources. The acceptance of unconventional food resources largely depends on cultural norms, individual preferences, and nutritional considerations.

Among these foods, some may not have an appealing appearance even though they possess good nutritional value. Additionally, certain foods might have a questionable taste.

Unconventional food resources come from both flora and fauna, playing a significant role in achieving food security at the household level, especially in rural communities.

This has been the case for a long time. Their crucial role in providing energy, supplying food, and enhancing the quality of life in rural populations has often enabled these communities to survive droughts and famines.

These unconventional resources challenge. A large variety of edible foods contribute to the resilience and sustainability of communities facing various can be found in forests, fields, mountains, hills, pastures, as well as in rivers, streams, ponds, and lakes.

Rural populations derive a diversity of food items from both fauna and flora, both in terms of quality and quantity. In many places, small rodents, reptiles, snails, insects, large animals, flowers, edible leafy vegetables, roots, and tubers occupy a significant place in the diet.

Little effort has been made to incorporate these resources into agricultural and food development programs with the aim of harnessing their potential to address nutritional deficiencies and promote the achievement of food security goals.

IV.2. Constraints to the improvement of non-conventional food resources

include:

1. **Lack of Awareness:** Many people may not be aware of the nutritional value and benefits of non-conventional food resources.
2. **Cultural Barriers:** Traditional beliefs and cultural norms may hinder the acceptance and integration of these unconventional foods into mainstream diets.
3. **Limited Research:** There may be insufficient scientific research on the nutritional content, cultivation, and processing methods of non-conventional foods.
4. **Perceived Taste and Appearance:** Some non-conventional foods may have unfamiliar tastes or appearances, leading to resistance in incorporating them into regular diets.
5. **Access and Availability:** Limited access to these foods, especially in urban areas, may pose a challenge. Additionally, seasonal availability could be an issue.
6. **Environmental Factors:** Climate change and environmental degradation may affect the growth and availability of non-conventional food sources.
7. **Policy and Regulatory Challenges:** Lack of supportive policies and regulations may hinder the production, distribution, and marketing of non-conventional foods.
8. **Infrastructure and Technology:** Inadequate infrastructure and technology for harvesting, processing, and preserving non-conventional foods can be a constraint.
9. **Economic Factors:** The economic viability of cultivating and promoting non-conventional foods may be a challenge for farmers and businesses.
10. **Education and Training:** There may be a lack of education and training programs to inform communities about the benefits and methods of utilizing non-conventional food resources.

IV.3. Unconventional Food Resources in Algeria

In Algeria, some examples of unconventional food resources include:

Edible Wild Plants: Some wild plants are consumed in rural areas, such as purslane, thistle, or wild fennel.

Insects: In certain cultures, some insects are consumed, providing an alternative source of protein. This may include grasshoppers, worms, or other edible insects.

Desert Plants: Plants adapted to arid conditions, such as Atriplex (locally known as "Chih") or the Nopal (prickly pear cactus), are sometimes used for food.

IV.4.Valorization of By-Products

The term "by-product" refers to any residue from a production or transformation process that can be utilized or is intended to be utilized.

IV.4.1.Fish By-Products:

The remains of processed fish and non-toxic but less sought-after fish can be reduced to fish meals used in animal feed. Various outlets include:

- **Utilization in Human or Animal Feed:** Fish meals and oils, protein hydrolysates, aromatic extracts, and concentrates.
- **Utilization in Dietetics and Nutraceuticals:** Refined oils, mineral supplements, marine gelatin, marine lecithins, etc.
- **Utilization in Cosmetics:** Chitins, collagen, keratin.
- **Various Uses:** Fishing bait, fertilizers, etc.

IV.4.2. Co-products of the meat industry

Abattoir waste consists of animal by-products not intended for human consumption but derived from healthy animals:

Co-products intended for human or animal consumption: offal (18% of live weight) and fats (10% of live weight). White offal includes the rumen, intestines, snout, feet, and udders, while red offal comprises the liver, heart, lungs, brain, spleen, tongue, cheeks, and kidneys. These are processed in different valorization sites to be transformed into meat meal (animal proteins and fats).

The recycling of animal proteins as feed for livestock is prohibited, except in aquaculture. The only food destination for animal proteins is the pet-food industry (pet food). Animal proteins are also used as organic fertilizers. Animal fats are primarily used in soap making, and the pet food industry.

Blood meal is a significant source of digestible proteins with biological value higher than those in oilseed meals and cereals due to its lysine richness. The maximum rate in complete pig and poultry rations is 5%.

Bone meals: Bones are a material that is not easily subject to decay, collected from the remains of animal skeletons after the meat has been sold in markets and butcher shops, with the intention

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of drying or calcining them to produce bone meal. Bone meals are used as sources of minerals, particularly calcium and phosphorus, in animal feed.

IV.4.3. Co-products of the dairy industry

The main co-products of the dairy industry are:

Whey: resulting from the curdling process of milk in cheesemaking; it is a yellowish-greenish liquid, a residual product of milk coagulation. Whey is characterized by its low fat content (1g/l), high lactose content (47g/l), and significant content of soluble proteins (7g/l). Whey, also known as "little milk," is valorized through drying, producing whey powder used in both human and animal nutrition.

Buttermilk: Fermented milk after the extraction of butter through churning. Buttermilk has two valorization pathways: Drying for the production of buttermilk powder used in animal feed. Recycling by mixing with skimmed milk (reconstitution of skimmed milk powder).

Caseins and caseinates: Protein substances used in cheese production, produced by precipitation after adding acid or rennet to milk.

IV.4.4. Lignocellulosic co-products

Cereal straws, oilseed residues (rapeseed, sunflower, soy, etc.), or legume residues (beans and peas, etc.) and corn stalks are the residual parts of plants after harvesting the grains:

Cereal and pea straw: it serves as a dietary supplement and is used as bedding for animals.

Corn stalks, sorghum stems (stalks + leaves), corn cobs, and corn husks: used as a dietary supplement.

IV.4.5. Co-products of cereal industries

are obtained during the grain milling process. They consist of bran (the outer layer of the grain), middlings (the second flour extracted from the bran separated from the endosperm), and low-grade flours (composed mainly of small particles of bran and germ). These by-products are obtained in addition to the flour during cereal milling. Co-products from cereal industries are 99% valorized in animal feed.

IV.4.6. Co-products of the sugar industry

Beet pulps are utilized in animal feed and the production of compound feeds because they are **rich in fibers**.

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IV.4.8.Oilseed Cakes

These are the solid residues from the extraction of fats from rich in digestible oilseeds (rapeseed, sunflower, soy, etc.). They are highly proteins with a biological value superior to that of cereal proteins, making them nutritionally valuable for livestock feed.

IV.5.Natural Foods

Foods often produced by small businesses with the aim of offering minimally processed products. They are less widely known and do not contain chemical preservatives. Available in natural food stores (health food stores) for several decades, they are now sold in regular grocery stores, typically in the organic section. Here are some examples of foods:

Table 2 : Represent non-conventional and conventional foods. (Dahouda et al., 2009)

Natural Foods (Nonconventional foods)	Conventional foods
Whole wheat bread	Wheat bread
Stone-ground whole grain flour	white flour
Brown sugar	white sugar
Fresh fruits and vegetables	Canned fruits and vegetables
High-quality water and fruit juice	Carbonated beverage" or "soft drink

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