Chapitre 2: Characteristics of Foods

Milk and Dairy Products

Milk and dairy products constitute an important category of foods due to their high nutritional value and technological diversity.
They are consumed in various forms: liquid milk, cheese, yogurt, butter, and milk powder.

1. Composition and Nutritional Value

Milk is primarily composed of water (approximately 87%), which explains its liquid nature and ease of digestion.
It also contains proteins, lactose (milk sugar), lipids, vitamins, and minerals.

Nutritional Importance:
Proteins, calcium, and phosphorus contribute to growth, bone strength, and proper muscle function.
Milk is rich in vitamins A, B2, and B12, but low in iron and vitamin C.

Note:
Some individuals have lactose intolerance, which causes digestive disorders after milk consumption.

2. Lactose

Lactose is the main carbohydrate in milk. It is a specific sugar composed of glucose and galactose.

Technological Role:
It serves as a substrate for lactic fermentation, a process used to produce yogurt and certain cheeses.

Definition:
Lactic fermentation is the transformation of lactose into lactic acid by bacteria.

In processed products, lactose may crystallize or absorb moisture, especially in milk powder.

3. Milk Lipids

Lipids represent approximately 2.5 to 5% of milk, depending on the animal species.
They are present in the form of fat globules surrounded by a protective membrane.

Importance:
These lipids provide energy and influence the texture and flavor of dairy products.

Example:
Whole milk is creamier than skimmed milk due to its fat content.

4. Milk Proteins

Milk proteins are divided into two main categories:

4.1. Caseins

They represent about 80% of milk proteins and form structures called micelles.

Definition:
Micelles are protein particles dispersed in milk that ensure its stability.

They enable milk coagulation during cheese production.

4.2. Whey Proteins

They are water-soluble proteins with high nutritional value.

Example:
Whey is rich in proteins widely used in sports nutrition.

5. Milk Coagulation

Coagulation is the transformation of liquid milk into a gel or curd.

5.1. Acid Coagulation

A decrease in pH (acidification) causes the aggregation of caseins.

Example:
Yogurt production through bacterial fermentation.

5.2. Enzymatic Coagulation

An enzyme called rennet induces protein coagulation.

Example:
Production of many types of cheese.

6. Non-Enzymatic Browning

This refers to a set of chemical reactions responsible for the brown coloration of foods without enzyme involvement.

6.1. Maillard Reaction

A reaction between reducing sugars and proteins under the effect of heat.

Example:
The golden color of heated milk or cooked dairy products.

6.2. Caramelization

The transformation of sugars under high temperature.

Example:
The flavor and color of caramel in sweetened condensed milk.

Influencing Factors:
• High temperature
• Water activity
• pH and type of sugar

Prevention:
Control of temperature, humidity, and pH to limit these undesirable reactions.

Meats, Fish, and Eggs

Meat, fish, and eggs are foods rich in high biological value proteins.
They play an important role in human nutrition and in food technology due to their functional properties (texture, flavor, coagulation).

1. Muscle Protein System

Meat is mainly composed of muscle fibers, connective tissue, and lipids.
Muscle proteins are classified into three main groups:

1.1. Sarcoplasmic Proteins

These are soluble proteins that include enzymes and myoglobin.

Definition:
Myoglobin is a protein responsible for the red color of meat.

Example:
The higher the myoglobin content, the redder the meat.

1.2. Myofibrillar Proteins

They mainly include myosin and actin.

Role:
These proteins are responsible for muscle contraction and influence meat texture.

1.3. Connective Tissue Proteins

They include collagen and elastin.

Importance:
Collagen turns into gelatin after prolonged cooking, which makes the meat more tender.

2. Biochemical Changes After Death

After slaughter, several biochemical transformations modify meat quality.

2.1. Rigor Mortis

It occurs when ATP is depleted in the muscle.

Definition:
ATP is the energy molecule required for muscle relaxation.

Its absence causes muscle rigidity.
Over time, enzymes degrade proteins and the meat becomes more tender.

2.2. Muscle Acidification

After death, glycogen is converted into lactic acid.
This lowers the pH of the meat (approximately 5.4–5.8).

Importance:
A very low pH can result in dry meat, while a moderate decrease improves texture.

Influencing Factors:
Animal stress before slaughter, feeding, and storage temperature.

3. Meat Aging (Maturation)

Aging corresponds to a controlled resting phase after slaughter.

Main Effects:
• Improved tenderness
• Flavor development
• Better water retention

It depends on temperature, pH, and enzymatic activity.

4. Fish Alterations and Preservation

Fish is highly perishable due to its high water and enzyme content.

4.1. Fish Spoilage

Natural enzymes and bacteria cause off-odors, color changes, and texture modifications.
Lipid oxidation can also affect quality.

4.2. Refrigeration

Refrigeration slows microbial growth but does not completely stop it.

Example:
Rapid cooling after fishing maintains freshness.

4.3. Freezing

Freezing extends shelf life.
The rate of thawing influences the final texture.

4.4. Prolonged Storage

Inadequate temperatures cause dehydration and lipid oxidation.

Protection Methods:
Glazing (ice coating), vacuum packaging, salting.

5. Eggs: Composition and Properties

Eggs are complete foods rich in proteins and essential nutrients.

5.1. Composition

The yolk contains lipids and fat-soluble vitamins and acts as an emulsifier.
The white is rich in proteins responsible for structure.
The shell protects against contamination.

5.2. Functional Properties

- **Coagulation**
  Proteins solidify under the effect of heat.

Example:
Cooking eggs or preparing custards.

- **Foaming**
  Egg white can incorporate air and form a stable foam.

Example:
Preparation of meringue or cakes.

- **Emulsifying**
  The yolk contains phospholipids that stabilize water–oil mixtures.

Example:
Mayonnaise and sauces.