Salahaddin University- Erbil

College of Agricultural Engineering Sciences

Department of Animal Resources

2nd Stage/ 2nd Semester

“Dairy Science and Technology”

Introduction to the Course and Milk Composition

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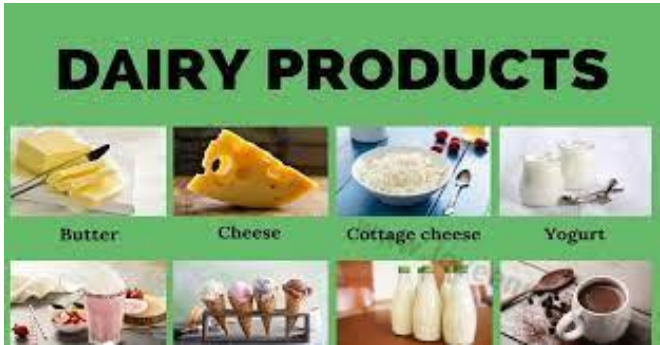
Dairy science and technology

- **Dairy science and technology** is the production and manufacturing of all dairy products that are produced from milk as well as the machinery and methods used in the dairy industry.

- The largest part of the food supply chain is the dairy industry.



Dairy science and technology

- This industry is an integral part of our food economy that not only supplies consumers with many ready-to-eat products such as milk, butter, and cheese but also produces many of the ingredients like milk powder and condensed milk that are found in processed foods.

- Milk itself has also become a key ingredient as a probiotics and for the development of functional foods designed to improve consumer health.

What is Milk?

- Milk is the liquid, excreted by the mammary glands of both humans (women) and mammals, which is serving the newlyborn as food.

- Milk is the product obtained by simple or multiple milking of mammals that are kept for the purpose of milk production

- Raw milk for processing generally comes from cows, but occasionally from other mammals such as goats, sheep, and water buffalo. Water is the main constituent of milk (about 90%).

- They are rich sources of energy.

Sources of dairy products

- **Milk and milk products** for human consumption include:
- raw milk
- dairy products
- colostrum
- colostrum-based products

- Milk of various types (including whole milk, skim milk, buttermilk), yoghurt, cheese (e.g. Swiss cheese, cheddar cheese, cottage cheese), and ice cream are dairy products. Of all milk products, milk, yoghurt and cheese are the best sources of calcium.

Milk Sources

- Milk can be obtained from many different sources, such as goats, cattle, buffalos, and camels; yet, the cow milk is the most popular.
- Whatever the milk source is, it is greatly similar in terms of properties; however, the proportions of the nutritional elements slightly vary from one source to another.

Milk Composition

- The **Milk Composition** section describes the chemical and physical properties and effects of pasteurization on the compounds in milk.

- Milk contains hundreds of types of protein, most of them in very small amounts. Classified in various ways according to their chemical or physical properties and their biological functions.

- Composition of Milk Water 87.5% Lactose 4.9% Protein 3.2% Fat 3.7%

Table 2./2 Average composition of breast milk, cow's milk and milk from other animals[1]

	Dry Matter [%]	Fat [%]	Total Protein [%]	Casein [%]	Whey Protein [%]	Lactose [%]	Ash [%]
Human	12.4	3.8	1.0	0.4	0.6	7.0	0.2
Cow	13.0	4.0	3.4	2.8	0.6	4.8	0.7
Goat	13.2	4.5	2.9	2.5	0.4	4.1	0.8
Sheep	19.3	7.3	5.5	4.6	0.9	4.8	1.0
Donkey	8.5	0.6	1.4	0.7	0.7	6.1	0.4
Horse	11.2	1.9	2.5	1.3	1.2	6.2	0.5
Buffalo	17.2	7.4	3.6	-	-	5.5	0.8
Camel	13.6	4.5	3.6	2.7	0.9	5.0	0.7
Lama	16.2	2.4	7.3	6.2	1.1	6.0	-
Yak	17.3	6.5	5.8	-	-	4.6	0.9
Elk	21.5	10.0	8.4	-	-	3.8	1.5
Reindeer	33.1	16.9	11.5	-	-	2.8	-

[1] See Kielwein, G.: Leitfaden der Milchkunde und Milchhygiene, Berlin und Hamburg: Verlag Paul Parey,1976

Table 2./1 Energy content of milk and dairy products in comparison to other food

Food type	Energy content	
	Average values	
	In kJ	In kcal
Whole milk 3% fat	2900	690
Skim milk	1600	380
Butter 80% fat	33500	8000
Cheese (Tilsit) 45% fat in dry basis	16750	4000
Quarg 40% fat on dry basis	8800	2100
Beef, lean	5850	1400
Pork, lean	10500	2500
Eggs	7100	1700
Herring	10425	2490

General Carbohydrate Chemistry

- The main carbohydrate in milk is a disaccharide called lactose. It is made up of two simple sugars – glucose and galactose.

- The monosaccharides important in food and health are glucose (sometimes called dextrose), fructose, and galactose. The disaccharides are sucrose (glucose + fructose), lactose (glucose + galactose), and maltose (glucose + glucose).

General Carbohydrate Chemistry

Milk contains approximately 4.9% carbohydrate that is predominately lactose with trace amounts of monosaccharides and oligosaccharides.

Lactose is a disaccharide of glucose and galactose.

Lactose supports the absorption of calcium and phosphorus and the synthesis of some B complex vitamins in the small intestine.

General Fat Definition and Chemistry

- Fats are made from individual fatty acid molecules attached to glycerol, a 3-carbon backbone.
- Milk contains approximately 3.4% total fat.
- Milk fat has the most complex fatty acid composition of the edible fats.
- Over 400 individual fatty acids have been identified in milk fat.
- However, approximately 15 to 20 fatty acids make up 90% of the milk fat.

General Fat Definition and Chemistry

- Milk and milk products also contain fat. Cow's milk contains fat that is in the form of glycerides. The fat in cow's milk is a poor source of essential fatty acids.
- The fat content of milk varies:
- Whole milk contains 3.9 g fat per 100 ml,
- Semi-skimmed milk provides 1.7 g fat per 100 ml
- Skim milk provides 0.2 g fat per 100 ml
- 1% milk, a blend of skimmed and semi-skimm has recently become available. It contains 1 g less per 100 ml.

Fat

- Milk fat contains approximately 65% saturated, 30% monounsaturated, and 5% polyunsaturated fatty acids.
- Milk fat Of all the components, the fat varies the most (from 3.2% to 6.0%).
- This variation is due to the breeding of the different types of cows.
- In addition, feeding, maintenance and health as well as the specific characteristics of the milk animals play a role.

Deterioration of Milk Fat

- Milk fat can be degraded by enzyme action, exposure to light, and oxidation.
- Enzymes that degrade fat are called lipases, and the process is called lipolysis.

General Protein Definition & Chemistry

- There are 22 different amino acids that can be combined to form protein chains. There are 9 amino acids that the human body cannot make and must be obtained from the diet. These are called the essential amino acids

Whey protein

- Whey is the serum or watery part of milk that is separated from the curd in making cheese, the watery part of milk produced when raw milk sours and coagulates

Casein protein

- Casein protein makes up 80% of the protein.
- Only found in milk

Vitamins in Milk

- Vitamins have many roles in the body, including metabolism co-factors, oxygen transport and antioxidants. They help the body use carbohydrates, protein, and fat.
- Milk contains the water soluble vitamins thiamin (vitamin B1), riboflavin (vitamin B2), niacin (vitamin B3), pantothenic acid (vitamin B5), vitamin B6 (pyridoxine), vitamin B12 (cobalamin), vitamin C, and folate. Milk is a good source of thiamin, riboflavin and vitamin B12 .

- Milk contains the fat soluble vitamins A, D, E, and K. The content level of fat soluble vitamins in dairy products depends on the fat content of the product.

- **Vitamins and minerals**
- Milk and milk products are an excellent source of vitamins and minerals, particularly calcium. Milk has significant amounts of vitamin A and B vitamins such as thiamine, riboflavin and nicotinic acid, but is a poor source of vitamin C and vitamin E. It also contains vitamin B12.
- The important minerals in milk are calcium, phosphorus, sodium and potassium. It is, however, a poor source of iron. Calcium is a mineral that the body needs for numerous functions, including building and maintaining bones and teeth, blood clotting, the transmission of nerve impulses, and regulation of the heart's rhythm.

Minerals in Milk

- Minerals have many roles in the body including enzyme functions, bone formation, water balance maintenance, and oxygen transport.
- Milk is a good source of calcium, magnesium, phosphorus, potassium, selenium, and zinc.
- Milk contains small amounts of copper, iron, manganese, and sodium and is not considered a major source of these minerals in the diet.