

**Mendel University in Brno
Faculty of Agronomy**

QUALITY OF ANIMAL PRODUCTS

**Miroslav Jůzl
Šárka Nedomová**

**Mendel University in Brno
Faculty of Agronomy**

QUALITY OF ANIMAL PRODUCTS

**Miroslav Jůzl
Šárka Nedomová**

Brno, 2015



INVESTMENTS IN EDUCATION DEVELOPMENT



INVESTMENTS IN EDUCATION DEVELOPMENT



This publication is co-financed by the European Social Fund and the state budget of the Czech Republic.

Innovation of studies programmes at Mendel's university for integration between Faculty of Agronomy and Faculty of Horticulture OP VK CZ.1.07/2.2.00/28.0302.

TABLE OF CONTENTS

1. INTRODUCTION.....	7
2. FOOD QUALITY	8
2.1. Explanation the concept of quality	10
2.2. Quality marks and schemes	11
2.2.1. National and regional quality marks	11
2.2.2. Protected Designations of Origin and Protected Geographical Indications	12
2.2.3. Traditional Specialities Guaranteed	13
2.2.4. Competitions and awards	13
2.3. Levels of food quality	13
2.4. Impacts on food quality	16
2.5. Questions and assignments.....	18
3. LEGISLATION, FOODSTUFF LABELING, AND REGULATIONS	19
3.1. Basic legislative regulations.....	20
3.1.1. National legislation on food	20
3.1.2. European legislation on food.....	21
3.1.3. Selected legislation on animal products	23
3.2. Supervisory authorities.....	35
3.3. Rapid Alert System for Food and Feed	37
3.4. Questions and assignments.....	38
4. GENERAL CHARACTERISTICS OF FOOD OF ANIMAL ORIGIN.....	39
4.1. Livestock	41
4.1.1. Cattle	42
4.1.2. Pigs	43
4.1.3. Sheep, goats, horses	44
4.2. Terms describing livestock production	45
4.3. Nutritional importance of food of animal origin.....	47

4.4. Questions and assignments.....	49
5. MEAT PROCESSING AND EVALUATION OF QUALITY.....	50
5.1. Basic definitions about meat	51
5.2. Data on production, processing, and consumption of meat	52
5.3. Meat, its composition and properties	55
5.4. Post-mortem processes in meat	57
5.4.1. Phases of aging of meat.....	59
5.4.2. Abnormal post-mortem processes	60
5.5. Animal slaughter	61
5.5.1. Pre-slaughter treatment, transportation, and handling of livestock.....	62
5.5.2. Livestock slaughter	63
5.5.2.1. Slaughter of cattle.....	65
5.5.2.2. Slaughter of pigs.....	66
5.5.2.3. Domestic slaughter, sale at open markets and marketplaces	66
5.5.2.4. Slaughter of animals for the needs of churches and religious communities	67
5.6. Monetisation of meat.....	68
5.6.1. Monetisation of cattle.....	69
5.6.2. Monetisation of pigs.....	70
5.6.3. Monetisation of sheep	72
5.7. Meat cuts	73
5.7.1. Beef cuts.....	74
5.7.2. Pork cuts.....	75
5.7.3. Meat cuts for meat processing.....	76
5.8. Meat production	79
5.8.1. Basic raw materials in meat production	81
5.8.2. Types of meat products according to decree	83
5.8.3. Technological stages of meat production.....	84
5.8.3.1. Whole-muscle meat products	85
5.8.3.2. Minced meat products	85
5.8.3.3. Long-life meat products	88

5.8.4. Labelling of meat products.....	90
5.9. Evaluation of meat and meat product quality.....	91
5.10. Animal by-products.....	93
5.11. Questions and assignments.....	95
6. PROCESSING AND EVALUATION OF POULTRY QUALITY	96
6.1. Production, consumption, and the importance of poultry meat	96
6.2. Poultry processing technology	96
6.2.1. Purchase and transport of poultry, preparation for slaughter	98
6.2.2. Kinds of poultry according to species and categories	98
6.2.3. Hanging of poultry	99
6.2.4. Stunning of poultry.....	99
6.2.5. Bleeding of poultry.....	100
6.2.6. Scalding and plucking	100
6.2.7. Gutting.....	100
6.2.8. Chilling.....	101
6.2.9. Weighing, packing, and shipping of poultry	102
6.2.10. Carving of poultry	102
6.3. Quality grades of poultry.....	103
6.4. Quality control in poultry processing.....	104
6.5. Questions and assignments.....	105
7. PROCESSING AND EVALUATION OF EGG QUALITY.....	106
7.1. Production, consumption, and importance of eggs	106
7.2. Sorting technology for shell eggs.....	107
7.2.1. Receiving, collection, storage, and transport of unsorted shell eggs	107
7.2.2. Sorting of eggs	108
7.2.3. Packaging of eggs.....	111
7.2.4. Storage of sorted eggs	112
7.2.5. Quality control of shell eggs	112
7.3. Egg processing for egg products	113

7.3.1. Production of egg products	113
7.3.2. Quality control of egg products.....	119
7.4. Other egg products	121
7.5. Production and quality of mayonnaise	121
7.5.1. Quality control of mayonnaise	122
7.6. Questions and assignments.....	123
8. PROCESSING AND EVALUATION OF MILK QUALITY.....	124
8.1. Importance and consumption of milk and milk products.....	124
8.2. Basic composition of milk.....	125
8.3. Hygiene and technology of milk processing	127
8.4. Processing and quality control of milk.....	129
8.5. Dairy milk treatment	130
8.6. Assortment of dairy products	132
8.7. Labelling and marketing of dairy products	135
8.8. Questions and assignments.....	136
9. REFERENCES.....	137

1. INTRODUCTION

The topic of food production is familiar to everybody. Ensuring adequate intake of essential nutrients from products of plant and animal origin was, is, and will be a fundamental priority of every individual. Animal products contain important nutrients that are essential for growth, development, and comprise basic human needs. Meat, milk, eggs and other foods derived from both the farm and wild animals are a traditional part of our diet. In the case of targeted rejection, we face a problem how to substitute them. In contrast, the effects of excess nutrients, which these foods are rich in, can be just as dangerous as insufficient supply of essential nutrients. The development of society has caused certain changes in reality and needs. Since the initial need of humans to obtain food to cover their energy expenditure, they chose available foods available in proportion to their needs, and even financial possibilities. Humans have been subjectively assessing the quality of food from the beginning of time. Currently, this initial caution, whether any food is good enough, became an assumed certainty within the government-run control of foodstuffs. Humans transformed from hunters gatherers to farmers and became consumers. From our experience with raw materials and food production, we more and more base our knowledge only on information from product labels and from mass media.

This text is an aid for a course by the same for students in the Horticulture program, in the field of Quality of plant food sources. It tries to provide basic information about raw materials of animal origin, as well as processing and quality assessment of foodstuffs from different perspectives. Chapter 8 is due to the abundance of literature only a brief introduction about the requirements for milk as raw material and about types of dairy products.

Other materials available in electronic or printed form are an extension of this study aid. Together with answering the questions at the end of each main chapter, the *Quality of Animal Products* might become a welcome source of information and topics for discussion for students of other disciplines and inter-faculty education.

Brno, November 2014

Ing. Miroslav Jůzl, Ph.D. and doc. Ing. Šárka Nedomová, Ph.D.

2. FOOD QUALITY

Originally humans have obtained food through collecting, hunting, and later by targeted activities ensuring greater quantities and stable supply in times of emergency. This included cultivation of crops and livestock breeding as well as processing of the products into first food. Food production since the times when humans first gathered, hunted, or grown food has changed significantly. So has changed people's assessing of food quality. Just as people who merely collected the available food, modern man also has a primary requirement, namely food safety. Currently, the basic requirement for food is to be safe and properly labelled. It must comply with regulations under applicable legislation, according to which, it must not jeopardize consumers' health or be deceptive. A set of applicable laws affects not only the person who produces. In the sense of the above mentioned, distributors and sellers are bound by them as well as not to compromise the health of consumers, but also their rights.

Legislation now very closely defines the basic concepts in the production and labelling of food. This is to prevent people from being misled, but oftentimes it happens that customers have no clue about how a commodity is produced and processed. Food labels have become complex and incomprehensible. Often people are confused due to misinformation about their manufacturing or conversely about positive or negative effect on their health. Consumers have the feeling of distrust stemming from recent times. Compared to the olden days, currently, there are better conditions for economic gain through deception of customers despite the legal overkill from their perspective. Above all food became a commodity, even though it still remains a necessary condition for our lives.

In the Czech Republic, as in the whole European Union, food production is the backbone of the manufacturing industry. Importance of food production is given by securing the population's diet by manufacturing and sale of healthy, safe, quality and largely affordable food, via increasing efficiency and competitiveness of this sector. Some food companies are directly linked to agricultural production, while others are involved in finalizing high-end products. Many food companies in the Czech Republic have invested considerable resources and effort into hygiene and upgrading their facilities to meet the requirements of EU legislation (Czech Ministry of Agriculture, <http://eagri.cz/>). All 28 European Union countries, (last one to join was Croatia in 2013) have a long tradition of food production. They gave some of them to the world, so that in the current state of globalization they exceeded their original boundaries and are available worldwide. Likewise, they have high

potential and can produce a lot more than they can consume. Therefore, agriculture and related processing industries represent a very important area, both economically and politically.

Over the past 20 years the Czech market has changed so radically as the markets in Western European countries did in the entire post-war period. In the 1990s there was a dynamic increase in international chains entering our market and the concentration of trade. The number of retail chains grew rapidly until 1998. This was followed by a period of relative stability. Since 2006, some retail chains gradually left the Czech market and commerce became increasingly concentrated. Customer satisfaction with their main shopping places prevails over dissatisfaction. Shoppers' requirements for food vary.

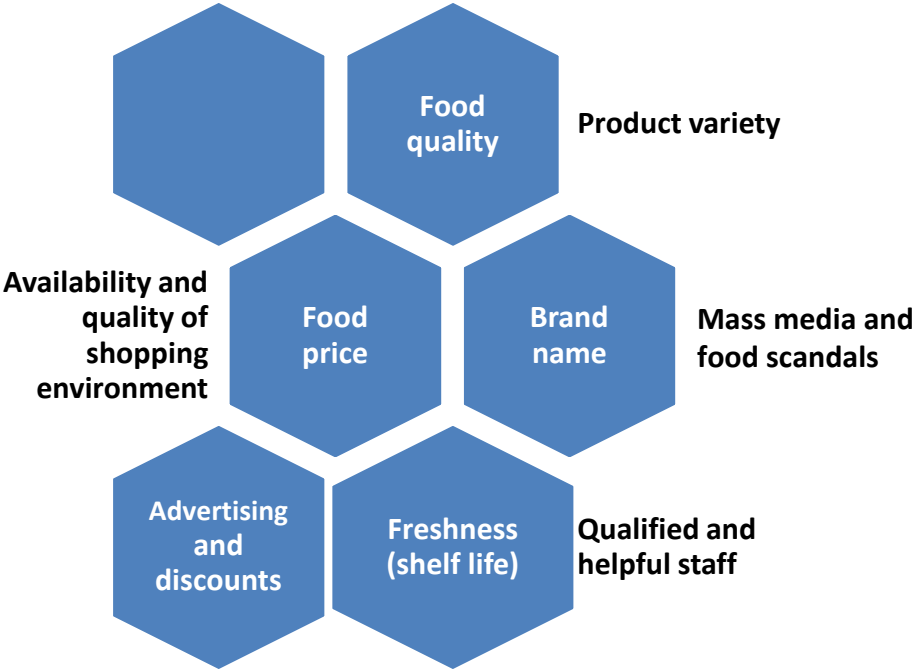


Figure 1: Factors in the customer decision-making process.

For example, according to information and studies of the Ministry of Agriculture, hypermarket customers put an disproportionate emphasis on great variety of products. Customers prefer discount stores especially for their overall favourable price level. They decide on supermarkets mostly for their easy accessibility. For small stores, customers named abnormally often times the ease of access, as well as friendly staff and quick shopping.

2.1. Explanation the concept of quality

There are different ways how to explain the concept of quality. Sometimes the explanations are quite different. Yet these are generally results of the assessment of several requirements, which somebody who assesses the quality has on the subject of evaluation. It does not matter whether it is food, service, or anything else. Over time, the quality assessment shifted from the subjective to the objective area. Thus, the individual assessment shifted from whether it suits me, to the collective assessment, to criteria set by legislation and government supervision. After the evaluation, whether the product serves the purpose or not is followed by purchase or order and consumption. Nowadays, customers often postpone the quality evaluation until after the purchase. They assume that products comply with common practices based on the criteria included in rights *enforced* by the supervisory authorities. The fact is that it is a status control.

This is the binding text of definition of Quality *Act no. 110/1997 Coll.* on foodstuffs and tobacco products:

- *Quality* is set of characteristics of individual types, groups and subgroups of food and tobacco products, the limits of which are set by this law, through the implementing legislation or directly applicable regulation of the European Community.

Despite its accuracy in context with contemporary production and marketing of food, the wording is a little different from the notion of consumers regarding the definitions of quality product.

Quality is the set of characteristics that a product has, or should have, to *fulfil the functions for which it is intended*. Quality product thus meets all the requirements that we have in order to be satisfied. Still, the consumer decides whether to buy a particular product, mainly on the basis of price and advertising. It is usually presented on television, on the Internet, or through flyers. Consumers build their awareness of the product, and if satisfied, repeat their purchase. In case of dissatisfaction, they rarely return to the disappointing product. So it is a valid notion that a quality brand can lose its lustre even a single scandal, which can be unleashed by the mass media. But often the whole production segment suffers. Another factor in decision making is brand name. Under it, we can imagine a specific product, manufacturer, or mark of quality on the product packaging.

2.2. Quality marks and schemes

Producers also try to present their products to customers using different signs, notices, and assertions. Logotypes are placed on products, documents, and promotional materials of the company and help to identify product and promote brand awareness. But consumers are often confused about food labels. Manufacturers and sellers often include on food labels or on packaging numerous warnings about what the product contains or does not. They attach seals of quality and awards from various competitions. Therefore, the European Union and some EU countries advocate Union schemes or national quality marks.

Within the EU, some entities support a model through quality schemes, such as Protected Designation of Origin, which differ from the usual trademarks (hereafter TM). They are non-exclusive, which means that such designations may be used by any economic subject who brings agricultural products or food to the market, if they are in accordance with the appropriate specifications. The advantage over the TM is in particular the continuing validity, as TM is valid for 10 years and may be managed financially. European Parliament and Council Regulation no. 1151/2012 on quality schemes for agricultural products and foodstuffs govern the use of the names *Protected Designation of Origin* (PDO), *Protected Geographical Indication* (PGI) and *Traditional Specialty Guaranteed* (TSG). In addition, it also allows the use of the designation *Mountain Product* or *Product of Island Farming*. As of November 30, 2014, 584 products have been registered as PDO, 617 as PGI, and 49 as TSG. This designation does not apply only to the EU countries, but also to third countries importing its products into the EU, such as China, India, Thailand, Vietnam, Colombia, and Turkey.

2.2.1. National and regional quality marks

Each country is obviously trying to promote domestic food products through national quality marks. In the Czech Republic it is the KLASA mark. It has been awarded by the Czech Ministry of Agriculture since 2003. Familiar logotypes will help customers in better orientation and encourage the purchase of these foods.

The designation *Regional Foodstuff* in an effort of the Czech Ministry of Agriculture to support our market for regional producers in terms of production and employment. It also promotes food that due to shorter distribution routes is fresher than food that arrives from

afar, and when being transported, they put less stress on the environment. In addition, it unifies regional organizers of various events in identical purpose. They include for example the *Taste of South Moravia*, *Pearl of Zlín*, and so on, due to the regional administrative unit.

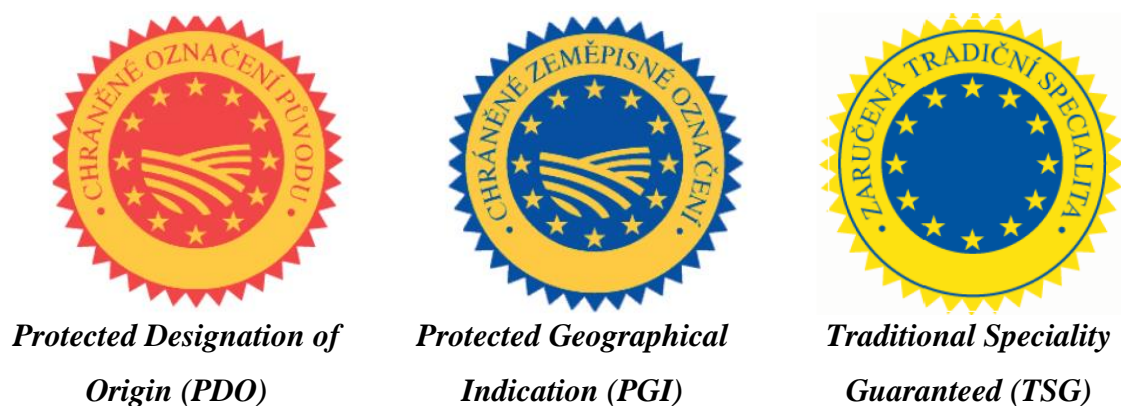


Figure 2: Logotypes PDO, PGI, and TSG (EU <http://ec.europa.eu/>).

2.2.2. Protected Designations of Origin and Protected Geographical Indications

These quality schemes are established in order to assist makers of products linked to a specific geographical area in that the mark should be clear information to consumers as to the characteristics of the product representing added value. *Protected Designation of Origin (PDO)* is awarded to products originating from a particular place or region or, in exceptional cases, from certain countries and whose quality or characteristics are essentially or exclusively due to a particular geographical environment with its own natural and human factors. In contrast to PGI, all stages of production take place in a particular geographic area. As of November 30, 2014, the Czech Republic has so far six products in this class. In the category food of animal origin, it is the *Pohořelický kapr (Carp from Pohořelice)*.

Protected Geographical Indication (PGI) is awarded to products originating in a specific place, region or country, whose given quality, reputation or other characteristics can be attributed mainly to its geographical origin. In contrast to PDO, at least one phase of production takes place in the defined geographical area. As of November 30, 2014, the Czech Republic has so far 23 products in the field of food of animal origin, including *Třeboňský kapr (Třeboň Carp)*, *Jihočeská Niva (South Bohemian Niva Cheese)*, *Jihočeská Zlatá Niva (South Bohemian Golden Niva Cheese)*, and *Olomoucké tvarůžky (Olomoucké tvarůžky Cheese)*.

2.2.3. Traditional Speciality Guaranteed

Traditional Speciality Guaranteed (TSG) is a product with a specific character. The traditional nature of the product is given through the main physical, chemical, microbiological, and organoleptic properties. The request must include a description of the production method that the producers must follow. It must also include, where appropriate, the nature and characteristics of the raw materials or ingredients used and the way the product is made, and the main elements constituting the traditional character. Therefore, they include only products of a particular character, which clearly distinguishes them from other similar products. Minimum time production, which constitutes tradition in the original Regulation, was at least 25 years. However the amended Regulation no. 1151/2012 about the quality schemes for agricultural products and foodstuffs, Article 3, states that a **traditional product** has a proven use in the domestic market for a period allowing transmission between generations. This time should represent at least 30 years. As of November 30, 2014, the Czech Republic along with Slovakia has entered so far four recognized traditional products (all sausages), namely the *Špekáček*, *Lovecký Salám*, *Spišské Párky*, and *Liptovský Salám*. In 2012, an application for the registration of *Pražská šunka (Prague Ham)* has been registered.

2.2.4. Competitions and awards

Big role in the evaluation of food have independent institutions, associations, or unions, such as the Consumer Protection Association. They are often presented to a wide range of consumers through the mass media. The products are evaluated at various competitions and exhibitions, such as *Golden Salima*, and others. Since 1885, German foods have been evaluated by the German Agricultural Society - *Deutsche Landwirtschafts-Gesellschaft (DLG)*. Manufacturers from around the world enter their products into commission evaluation. We can also find different export marks on the food packaging.

2.3. Levels of Food Quality

Quality products meet the general quality criteria, as well as specific quality requirements, which are derived from the individual demands of the human organism.

Quality products:

- Will not negatively affect food safety for customers,
- Are appealing, or at least acceptable to consumers (sensorial aspects),
- Therefore they must be nutritious and must not be faked,
- Meet the criteria for technological and culinary use.

We can view the quality of any product from several points. We may divide it in order to describe the context and impact of potential deviations from the desired standard.

The overall quality is made up of different **characteristics of quality** linking a set of requirements that we have about the product from a certain aspect. These aspects may be for some kind of assessment more significant for others less so. These characteristics are then made up of the basic **quality aspects**. That can be any variable that we can identify or describe. Aspects may include several characteristics of quality (Figure 3).



Figure 3: Levels of food quality.

For example, in meat we can summarize individual features as quality characteristics:

- **Chemical composition**, such as net muscle protein content, fat content, muscle pH, vitamin B12, amounts of fatty acids, and so on,
- **Physical properties**, such as remission of meat, colour, density, meat temperature, and so on,

- **Biochemical status**, such as degree of post-mortem processes, meat pH, and so on,
- **Microbial contamination**, such as the total number of microorganisms, the presence of pathogenic microorganisms, and others.
- **Hygienic value**, such as the presence of pathogenic organisms, parasites, level of radionuclides, and so on,
- **Technological properties**, such as water retention, share of lean tissue, colour, oxidative stability, and so on,
- **Sensorial properties**, such as muscle colour, the colour of cooked meat, muscle texture, juiciness, the smell of muscles, the taste of cooked meat, and so on.
- **Culinary properties**, such as muscle colour, share of lean tissue, net muscle protein, and so on.



Figure 4: Examples of aspects and quality characteristics affecting the overall quality of meat.

2.4. Impacts on food quality

In general, we can divide impacts on food into internal and external. *Internal factors* are determined by the composition of food, thus their main raw materials, but also additives, and so on. *External factors* may include the occurrence of microorganisms, degree of heat treatment, choice of packaging material, rough handling, exceeded minimum shelf life, storage conditions, transport, food for sale offer, and so on. Manufacturers are trying to limit all factors that could affect the partial and overall quality of food. The most serious are effects on food safety. Manufacturers are striving to maintain a consistent quality of their products. Inappropriate technological properties of the product are reflected in the overall quality through various defects. Any changes in the quality of the raw material are reflected in the product. Consumers might be disappointed and suspicious whether the product is not harmful to their health, whether it is altered or forged.

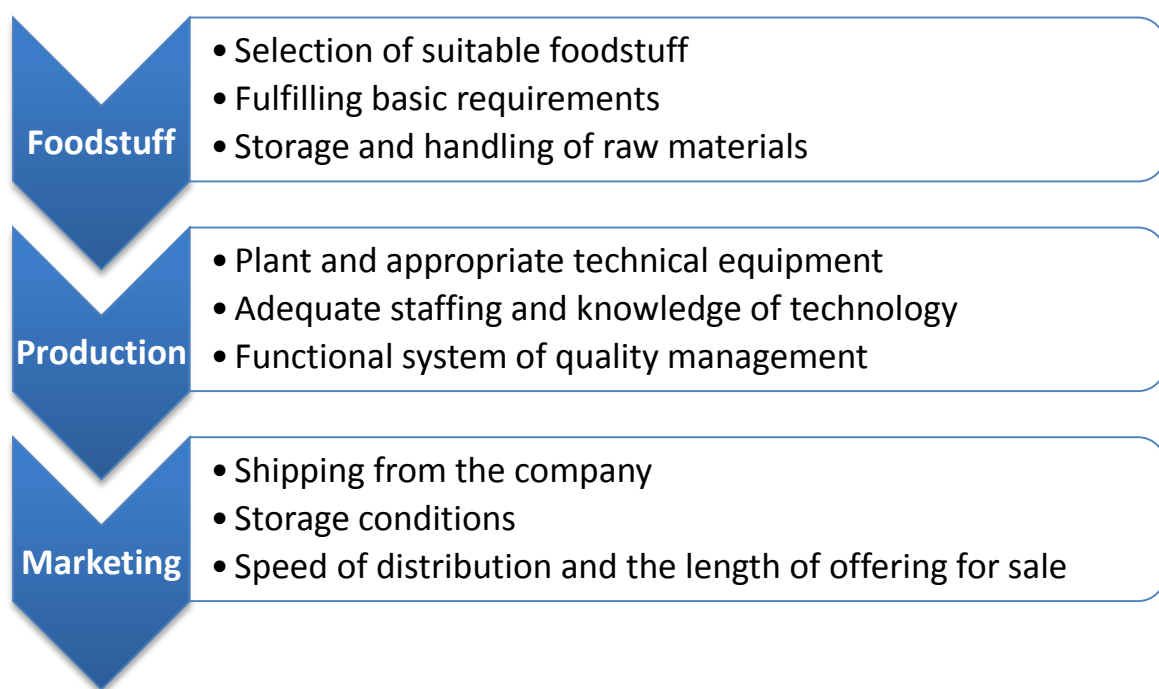


Figure 5: Effects on the overall quality of food.

Individual factors affecting the quality of the raw materials of animal origin are mentioned in the relevant chapters. In the case of food of animal origin, which is the raw material for the food industry and will be primarily processed into the final product to be marketed, it is essential, that the main raw materials meet the specified quality. The manufacturer determines that based on an agreement with the supplier in the purchase contract. Requirements are based on or referred to by the current legislation, different norms, such as *ČSN, ISO, HACCP*,

GHC, BRC, or company standards, as well as the company know-how including recipes, experience, and technology. The requirements derived from legislation are vital. They are mainly concerned with food safety, such as animal health, contamination of the trophic chain, as well as with storage and handling, including temperature conditions, and contamination. Some requirements are fixed directly by the manufacturer. They may differ from the usual demands of other customers, and may include know-how and the specifics of the product or recipe. However, it also depends on the means of the supplier (Figure 6).

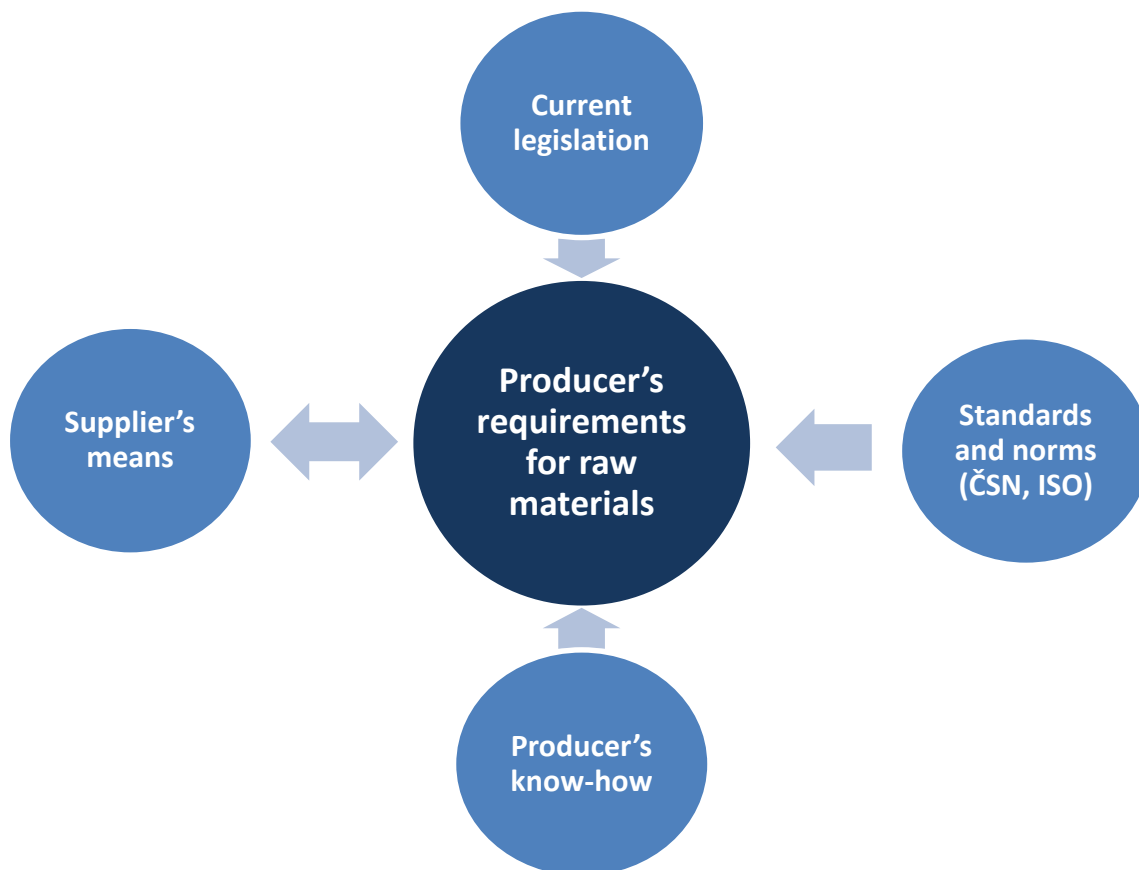


Figure 6: Requirements for animal products as feedstock.

In the case of a deviation from the standard for raw materials, the technological process may limit any adverse effects only to a certain extent. The manufacturer must indeed produce a standard product. Therefore, these requirements are part of the contract between the supplier and the buyer. In an ideal situation, there should be the closest possible cooperation and openness which the situation permits.

2.5. Questions and assignments

- a. Explain the concept of quality and write a short essay on food quality in the Czech Republic.
- b. Which foods of animal origin spread beyond the original boundaries and are available worldwide?
- c. Which foods from the Czech Republic, which have a protected designation of EU you do not know or have never consumed?
- d. Select other food produced in the Czech Republic, which in your opinion should get a Protected designation of origin, Protected geographical indication or Traditional specialty guaranteed.
- e. Which three countries in the EU register have the most listed foods with protected designation?
- f. Browse the Web <http://ec.europa.eu/> for request for the PDO “PARMIGIANO REGGIANO”, “POHOŘELICKÝ KAPR” and "SZEGEDI SZALÁMI".
- g. Which foods imported into the EU from China, India, Thailand, Vietnam, Colombia, and Turkey have the aforementioned protected designation?
- h. Which foods of animal origin and their manufacturers won awards in the current year of the competition in Regional foodstuff in the district of your residence?
- i. Find the name and location of any international food fair.
- j. Describe the influences on food quality. Which are most important and why?

3. LEGISLATION, FOODSTUFF LABELING, AND REGULATIONS

International trade in foodstuffs has existed for thousands of years, but most raw materials were produced and processed locally. In today's world it is not unusual, that an agricultural raw material is produced in one part of the world, then transported thousands of kilometres for processing, and then marketed almost worldwide. In contrast to the past, production volumes and marketing methods have completely changed and so did the requirements of manufacturers and buyers. Most often it is in the sense of automatic guarantee of food safety, declared composition, and shelf life. It is therefore necessary to have the same standards for the production, handling, storage, as well as for the quality evaluation of the final products. This contributes to safety, quality, and integrity in international foodstuff trade. Consumers can trust the safety and quality of foods they buy and importers can trust that the food they ordered, will comply with their specifications.

According to the *Codex Alimentarius*, which is a set of internationally recognized food standards, protection of consumer health and ensuring transparency in international foodstuff trade should be the first priority. It was initiated in 1963 by the Food and Agriculture Organisation (FAO), a specialized agency of the United Nations (UN) based in Rome, and the World Health Organization (WHO), another UN agency, which is a coordinating authority on international public health protection with headquarters in Geneva, Switzerland. The *Codex Alimentarius* Commission develops harmonized international food standards, guidelines and codes of good practice in terms of protecting the health of consumers and ensuring fair practices in the foodstuff trade, which are taken into the regulations of individual countries.

The aim of the Food law under Regulation (no. 178/2002) is protection consumer interests and to provide a basis for consumers to make informed choices with the foods they consume. It also seeks to prevent:

- fraudulent or deceptive practices,
- food falsifying and
- any other practices that could mislead consumers

3.1. Basic legislative regulations

Legislation covering the conditions and requirements for the production, marketing, and food safety involves several levels. Basic legislation defining the production and processing of agricultural materials and products is called National Rights. This includes the laws and regulations of the Czech Republic, and the Community Rights, which is EU legislation.

3.1.1. National legislation on food

Czech Republic rights are mainly composed of food laws and regulations, or generally binding regional regulations. Laws are generally binding legal regulations adopted by Parliament. They are superior to legislative rules, such as decrees and government regulations, but are subjects to the Constitution and constitutional laws, and they rank equal to international treaties. According to the laws of the Czech Republic only law can impose obligations on individuals and legal entities. Regulations can do it only if there is a specific statutory authorization, such as one according to which the law is carried out, that is if specific realities and requirements are announced. Table 1 lists selected laws that are important in dealing with this subject.

Table 1: Selected decrees on livestock production and food control

Numbers of original rules	Short title
Decree no. 246/1992 Coll.	Protecting animals against cruelty
Decree no. 634/1992 Coll.	Consumer Protection
Decree no. 110/1997 Coll.	Food and tobacco products
Decree no. 166/1999 Coll.	Veterinary Decree
Decree no. 154/2000 Coll.	Breeding and registration of farm animals (Breeding Decree)
Decree no. 242/2000 Coll.	Ecological farming
Decree no. 258/2000 Coll.	Public Health Protection

Implementing regulations of the Decree no. 110/1997 Coll. on food and tobacco products are subsequently given two ordinances that are very significant for the evaluation for quality and labelling of food of animal origin and their circulation (Table 2).

Table 2: Selected implementing Decrees for Act no. 110/1997 Coll.

Number of original rule and title

Decree no. 326/2001 Coll., of August 30, 2001, which implements § 18 points a), d), g), h), i) and j) of the Decree no. 110/1997 Coll., on foodstuffs and tobacco products and for meat, meat products, fish, other aquatic animals and their products, eggs, and egg products.

Decree no. 77/2003 Coll. of March 6, 2003 laying down requirements for milk and milk products, ice creams and edible fats and oils.

3.1.2. European legislation on food

The objectives are set out in their contracts by the European Union prescribes using several kinds of acts. Some of them are legally binding, others are not. **Regulation** is a legally binding act and is valid in its entirety throughout the EU even without incorporation into national legislation. They are accepted either by the Council of the European Union together with the European Parliament, or only by the European Commission itself. Unlike **directives**, which are addressed to member countries, and the decisions which are also envisaged to whom they are addressed, regulations are addressed to all. A regulation is directly applicable, which means that its provisions are in the member countries immediately in force as national legislation, without further intervention by the national authorities.

Example: *Regulation of the European Parliament and the Council (EC) no. 178/2002 of January 28, 2002 lays down the general principles and requirements of food law, establishes the European Food Safety Authority, and lays down procedures in matters of food safety.*

Directive is a legislative act that establishes goals, which all EU member countries must meet, but each country can decide in which way. For these to become binding principles laid down in the directive, able to affect citizens' lives, the legal authorities of the country must adopt national transposition act that will adapt such national legislation to the objectives laid down in the directive. Laws and regulations that refer to the directive are amended or adopted in this manner. It is not by itself binding for the citizen. The directive sets a final date for its implementation in national law, so that for its implementation, member countries would have

sufficient autonomy to allow them to take into account national specifics. Directives are used to harmonize national legislations.

***Example:** Directive of the European Parliament and Council Directive 2001/18/EC of March 12, 2001 on the deliberate release of GMOs into the environment and repealing Council Directive 90/220/EEC.*

Decision is an individual legal act binding upon those to whom it is intended, which can be a certain EU country or a specific company. It is directly applicable and through it European institutions decide on specific cases. It is accepted either by the Council of the European Union or by the Council of the European Union together with the European Parliament and the European Commission. Through the decision, institutions may require the member country or a citizen of the European Union refrain from acting, they can grant rights or impose obligations.

***Example:** Council Decision of December 14, 1987 on Community arrangements for a timely exchange of information in the event of a radiation emergency.*

Recommendation is not binding and through it the EU institutions may express their views or to propose certain steps, without having to draw any legal obligation upon those to whom it is addressed.

***Example:** Recommendation for a Council decision in accordance with Article 104 paragraph 8, that the actions taken by the Czech Republic, based on the Council recommendation under Article 104, paragraph 7 of the Treaty on establishing the European Community, are inadequate.*

Opinions are issued by the main EU institutions (Commission, Council and European Parliament) or committees (Committee of the Regions and the European Economic and Social Committee) during the legislative process.

It may be opinions, opinions based on its own initiative, or additional exploratory opinions on the proposals from the perspective of regions or economy and social areas. Through them, the EU authority can directly comment on certain issues. Therefore, they do not constitute legal obligations upon those to whom the opinions are addressed.

***Example:** Opinion of the European Economic and Social Committee on "Future strategy for the EU dairy industry for the period 2010-2015 and beyond." Official Journal p. C 347, December 18, 2010, pages 34 to 40. Form: Own-initiative Economic and Social Committee, Document dated: February 17, 2010.*

3.1.3. Selected legislation on animal products

The most important regulations are the laws no. 166/1999 Coll. on veterinary care (Veterinary Act) and no. 110/1997 Coll. on foodstuffs and tobacco products and its relevant decrees.

According to the Community law, the regulation of European Parliament and the Council (EC) no. 178/2002 lays down the general principles and requirements of food law, establishes the European Food Safety Authority, and lays down procedures in matters of food safety. A further regulation is contained in the so-called Hygiene Package.

3.1.3.1. Veterinary Act

Act no. 166/1999 Coll., of July 13, 1999, on veterinary care and amending certain related laws (Veterinary Act).

This Act incorporates the relevant regulations of the European Union. In relationship with the directly applicable legislation of the European Union, it lays down requirements for veterinary care and husbandry, animal health, and animal products. It regulates the rights and obligations of individuals and legal entities, framework, powers, and responsibilities of government administration bodies in the area of veterinary care, as well as some professional veterinary activities and their performance.

Veterinary care under this Act includes:

- **Health care** and protection of animals, especially the prevention and spread of diseases transmissible directly or indirectly between animals of susceptible species, (hereafter infection) and other animal diseases and their control, protecting human health against diseases transmitted from animals to humans,
- **Attention** to the safety of animal products and animal feed as well as protection of human health against damage or threat from animal products,
- **Protection** of the territory of the Czech Republic against the introduction of animal diseases and diseases transmissible from animals to humans, prior to importation of unsafe animal products and animal feed from abroad,

- **Protection** of the environment against adverse effects associated with animal husbandry, production and processing of animal products, as well as animals and their products from the risks of environmental pollution,
- **Veterinary** decontamination,
- **Supervision** of compliance with obligations and requirements set up to ensure these tasks through this Act, via special laws and regulations of the European Union (government veterinary supervision).

Selected basic terms of Act no. 166/1999 Coll.:

- **Breeder** - anyone who owns or holds animal or animals, or is entrusted to care for them, whether for payment or not, even temporarily,
- **Farm** - any structure, facility or place where animals or farm animals are bred or kept, including outdoors breeding. If the farm breeds or keeps more than one herd, or more than one group of livestock that can become ill with the same disease or diseases transmitted from animals to humans (susceptible animals), each of these herds or each of these groups are separate epidemiological units having the same health status,
- **Livestock animals** - animals used primarily for breeding, fattening, labour and other economic purposes, particularly cattle, pigs, sheep, goats, horses, donkeys and their hybrids, poultry, ratites, rabbits, fur animals, farmed game, fish and other aquatic animals and bees,
- **Slaughter animals** - farm animals, which are destined for slaughter and slaughterhouse processing and whose meat is intended for human consumption,
- **Animal products** - raw materials of animal origin, all parts of animals, especially meat, offal, fat, skin, bones, blood, endocrine glands, horns, antlers, hooves, wool, fur, feathers, also milk, eggs, honey and beeswax, as well as products made from these materials, which are intended for human or animal consumption,
- **Safe animal products** - animal products that meet public health requirements established by this Act, special laws, and regulations of the European Union,

- **Slaughter** - killing an animal for slaughter in order to use its products in a way that is not in conflict with the provisions on the protection of animals against cruelty,
- **Destruction** - killing an animal, unless it is a slaughter, in a manner that does is not in conflict with the provisions on the protection of animals against cruelty,
- **Veterinary goods** - animals, animal products, feed of animal origin, and other products and items, if they could be carriers of diseases,
- **Marketing** - offering for sale, sale or any other form of offering for consumption, including storage and transportation for the needs of sale or other offer for consumption.

This Code generally defines responsibilities for breeders of farm animals and hobby breeders. It defines the conditions for the transfer and domestic transportation of animals as well as marshalling and assembling of animals. It also addresses the control of the diseases, epidemiological monitoring network, and others.

Title III addresses the basic health requirements for animal products (§ 18).

Animal products must:

- **Meet** the requirements for their production, processing, storage, transportation, and marketing, as laid down by this law, special legal regulations, and regulations of the European Union,
- **Be healthy** and safe for both humans and animals, in particular, they must not be a source of the risk of spreading infections and diseases transmissible from animals to humans,
- **Meet** microbiological criteria and must not contain residues and contaminants in quantities, that according to scientific assessment pose a risk to human health,
- **Unless** specified by this Act or the regulations of the European Union otherwise, carry a specified food safety mark, or if the food safety mark is not prescribed, to carry an identification mark.

Animal products intended for human consumption must be obtained from animals that:

- **Satisfy** veterinary health requirements for animals of a particular species specified in this Act, via special laws and regulations of the European Union,

- ***Do not come*** from a farm, company, territory or part of territory which are subject to limiting or forbidding veterinary measures, which apply to animals and their products under the rules established by law or by special legislation because of outbreaks of diseases. These diseases include foot-and-mouth disease, classical swine fever, swine vesicular disease, African swine fever, rinderpest, Newcastle disease, avian influenza and peste des petits ruminants, or due to the occurrence of diseases in aquatic animals, fish and shellfish, those mentioned in special legislation,
- ***Have not*** been slaughtered, in the case of meat and meat products, in a facility in which during the slaughter and production process there were animals present that were infected or suspected of being infected (listed above), or carcasses or parts of carcasses of such animals until such suspicion was rejected,
- ***Comply***, in case of aquatic animals and aquaculture animals, with the requirements laid down by special legislation.

The Act among others specifies that:

- ***Animal products***, where justified doubts arise regarding compliance with the obligations or requirements to ensure their safety, and food of animal origin which were therefore returned from a commercial network can be used or further processed only with the consent of the regional health authorities and conditions it sets,
- ***Foodstuffs of animal origin***, which are harmless, are regarded as edible or edible after specific treatment or further processing. Foodstuffs of animal origin which do not meet health requirements are regarded as unfit for human consumption;
- ***Veterinary inspection*** of animal products is a prerequisite for their marketing, and describes the slaughter of animals and veterinary inspection, as well as the so-called home slaughter.

It further defines and describes the responsibilities of persons producing, processing, or marketing livestock products.

According to this Section (§ 22) persons who as entrepreneurs acquire, produce, process, treat, pack, store, transport, and market animal products in an enterprise, plant or other facilities, which are under government veterinary supervision, consistent with European Union regulations, have

the responsibility to ensure that during the various stages of the food handling the safety of animal products is not jeopardized, and shall:

- ***In accordance*** with the regulations of the European Union, ask the regional veterinary administration for approval and registration, or a registration of an enterprise, business, or other facility, notify the regional veterinary administration about start date of business activity and commence only until after approval or registration, and notify the regional veterinary administration about any changes in facts decisive in terms of approval or registration,
- ***Ensure*** in all stages of production, processing and marketing of animal products prevention of spread of infections and diseases transmissible from animals to humans, and taking into account the nature of the activity and the type of animal products:
 - ***Abide*** by veterinary and sanitary requirements for the production, processing, and marketing of animal products, as well as technological procedures,
 - ***Apply*** the principles of effective hygiene practices and procedures based on Hazard Analysis and Critical Control Points (HACCP), carry out preventative control of safety of raw materials, accessories, additives and finished products and utilize the lessons learned from the manuals of effective hygiene practices and guidelines for implementation of HACCP principles approved by the European Union institutions, or processed by professional interest associations,
 - ***Develop*** and adhere to the principles of production organization, measures to ensure production of safe ingredients and foods of animal origin and to its own control of the sanitary conditions of production, as well as technical, technological and human conditions of sanitation (operating and sanitation rules), and present operational and sanitizing procedure, including relevant changes for the approval by the regional veterinary administration,
 - ***Conduct*** in accordance with the operating and sanitation regulations regular clean-up, cleansing, disinfection, deratisation and desinsection of production premises and facilities and to use approved products,

- **Keep** appropriate documentation of the process and results of controls of compliance with sanitation requirements and principles and to retain it for at least one year, unless otherwise stated, and present it upon request to the official veterinarian,
- **Label** foods of animal origin as specified,
- **Employ** only qualified staff for dealing with animal products, pay attention to their qualifications and vocational training, encourage them to comply with sanitary requirements for the production, processing and marketing of animal products, and to comply with the requirements of personal hygiene,
- **Systematically** carry out your own control of sanitary conditions of production, including established microbiological criteria, sampling and control checkups, record the results of these checkups, and keep these records for at least two years and on request, along with lab protocols, provide them to the official veterinarian. In the case of laboratory tests to confirm the safety of animal products, they must be carried out in the laboratory, which was issued an accreditation certificate for that type of investigation,
- **Create conditions** conducive to the implementation of specialized veterinary tasks required by this Act and the regulations of the European Union to monitor the safety of livestock products and the compliance with sanitary requirements for the production, processing and marketing of animal products, and provide the official veterinarian with information on the origin of the raw materials from which foods were prepared,
- **Provide** the necessary cooperation with authorities carrying out sampling and investigation in connection with the fulfillment of the plan for monitoring certain substances and their residues, and comply with the measures taken in accordance with this investigation,
- **In a facility** with low volume of production, observe the production capacity,
- **If the facility** processes aquaculture animals, keep records of all shipments of these animals and their products, which arrive or leave this facility,
- **If the facility** processes and markets honey from different breeders, ask the regional veterinary administration for approval and registration of business;

- *If the facility* processes and markets honey coming entirely from its own beekeeping, ask for registration of business,
- *If the facility* processes animal products originating from crocodiles, ask the regional veterinary administration for approval and registration of business.

Yard Sale

The so-called yard sale is included in the Section (§ 27a) of the Act, as a so-called sale of small quantities of primary products to the final consumer. They are further regulated by Decree no. 289/2007 Coll. on veterinary and sanitary requirements for animal products that are not directly applicable by regulations of European Community and Decree no. 128/2009 Coll., on the adaptation of veterinary and sanitary requirements for certain food businesses, which process animal products.

Contemporary food production is limited by very strict rules on the hygiene of food of animal origin (Regulation 852/2004). They apply to the operators of food enterprises, but these restrictions would be overwhelming for small regional producers. Therefore, it is necessary to distinguish between the importance given by the volume of production and marketing. In the overall context, both of them do not constitute a large health risk of affecting a large number of consumers. And so they shall not apply to primary production for private domestic use, or the domestic food preparation, or handling or storage for private domestic consumption. The implementing regulation in relation to European law specifies small amounts (Table 3), which can be delivered directly to the final consumer. They may be delivered to the market, marketplace, or a local retail store. It protects public health through national law, in particular due to the close relationship between the producers and consumers, without restricting local producers.

Table 3: Small amounts under Decree no. 289/2007 Coll. (as no. 61/2009 Coll.)

Product	Definition of small quantities supplied directly to the final consumer in the market or marketplace, or local retail stores
Fresh poultry meat	A maximum of 10 pieces within 1 week
Fresh rabbit meat	A maximum of 10 pieces within 1 week
Fish and other aquaculture animals	Corresponding to the usual daily consumption of these live fish and other aquaculture animals in the home of the consumer
Hunted wild game in skin or feathers	Maximum 30 % of the game the hunter actually caught per year
Raw, untreated dairy milk and raw cream	Corresponding to the usual daily consumption of milk in the consumer's home
Fresh eggs	A maximum of 60 eggs (in local retail stores within 1 week)
Honey	Not exceeding 2 tonnes per year

Government authorities in matters of veterinary care

Government administration in matters of veterinary care is carried out by ministries, including Ministry of Agriculture, Ministry of Defence, and Ministry of Interior, as well as municipalities and veterinary authorities. These include NVA and INCVBD.

- **National Veterinary Administration (NVA)** is a veterinary administration and administrative office nationwide subordinated to the Ministry of Agriculture, and is formed by the Central Veterinary Authority, the regional veterinary administrations and the Municipal Veterinary Administration in Prague.
- **Institute for National Control of Veterinary Biopreparations and Drugs (INCVBD)** is a veterinary administration in the area of veterinary products and veterinary technical resources, a government department and entity.

3.1.3.2. Act on Food and Tobacco Products

Act no. 110/1997 Coll., of April 24, 1997, on food and tobacco products and amending and supplementing some related laws.

This Act transposes EU regulations (relevant directives) and provides, in relation to the directly applicable regulations (applicable regulations) of the European Union obligations of the food business operator as well as entrepreneur, as is evident from the title, which manufactures or markets tobacco products. This Regulation provides government supervision over compliance with obligations under this Act and under directly applicable legislation of the European Union.

The latest amendment (no. 139/2014 Coll.) abolished some of the concepts covered earlier in the law on food (as no. 279/2013 Coll.), with aim to eliminate duplication with EU regulations. For example, the very definition of *foodstuff*, which is regulated by Regulation (EC) no. 178/2002, which incorporates the concept of *raw material* and the term raw material is now in its law replaced by the term *foodstuff*.

Selected basic concepts of Act no. 110/1997 Coll.:

- *Name* - the product name, type, group or subgroup of food prescribed by another law or an implementing regulation;
- *Destination* - location of the first entry of food in the Czech Republic,
- *Quality* – set of characteristics of individual kinds, groups, and subgroups of food and tobacco products, whose limits are established by law, the implementing legislation, or directly applicable EU regulation,
- *Net quantity* - quantity of the food without packaging or the average amount of packaged foods prescribed by the implementing legislation or directly applicable legislation of the European Union,
- *Food production* - cleaning, sorting, treating, processing, and producing, including packaging and other food handling for the purpose of marketing,
- *Food supplement* - foodstuff for supplementing the normal diet and which is a concentrated source of vitamins and minerals or other substances with a nutritional or physiological effect,

contained in the food alone, or in combination, intended for direct consumption in small measured quantities,

- **Original use of food** - use specified by the manufacturer,
- **Foodstuffs applicable to other than the primary use** - safe food, but does not meet the requirements for their original use,
- **Batch** - quantity generically identical units, which were manufactured under the same conditions,
- **Classification of carcasses** – method of assigning the carcasses to quality classes in a manner prescribed by applicable regulations of the European Union and the implementing regulation;
- **Foodstuff of unknown origin** - the foodstuff, which cannot be identified by the operator of food processing facility who produced that food or a component thereof or who delivered it to another food business operator,
- **Foodstuffs of animal origin** - the food, where the main raw material in the production were the bodies or parts of animals, milk, colostrum, eggs, or bee products.

The amendment newly introduced, among others, terms of net quantity and food production, so now it does not include slicing or the process of packaging. It clarifies the concept of the name in an attempt to mention the importance of implementing regulations (decrees). Originally the term *commissioning/putting into circulation* was united with European legislation, as the term *marketing*.

Everything compelled the alignment of terminology with Regulation no. 178/2002.

This Code generally defines **responsibilities of food business operators**, such as:

- **Complying** with sensory, physical, chemical, and microbiological requirements for food quality,
- **Observe** in all stages of production and marketing of foodstuffs technological and sanitary requirements, methods and conditions of transport, storage and handling of foodstuff.

In the event that these terms are not defined by law, they must comply with the requirements set by the food business operator who produced the food.

- *If the foodstuff* is being marketed in the Czech Republic, the producer must provide mandatory food information specified in the legislation in the Czech language;
- *For the production* of heat-untreated foodstuffs, with the exception of meals, use only heat-treated egg contents.

Foodstuffs that are forbidden to be marketed

According to this law (§ 10), it is forbidden to market those foods:

- *Falsely labelled* or offered for consumption in a misleading manner,
- *Food with lapsed expiry date*, marked as 'use by'.
- *Food of unknown origin*,
- *Food exceeding* the maximum permitted levels of radionuclide contamination determined in accordance with the Atomic Act,
- *Irradiated* in conflict with the requirements established by this Act and the implementing legislation.

The food business operator is also obliged apart from the above mentioned foods to promptly take out of circulation additional food:

- *Packaged* in containers that do not comply with EU regulations on materials and articles intended to come into contact with food or decrees on hygienic requirements for products intended for contact with food and meals,
- *Incompletely* or incorrectly labelled,
- *Not complying* with quality requirements stipulated by decree or declared by the manufacturer,
- *Smelly* if the smell is not characteristic of the product, or otherwise damaged, distorted, polluted, or obviously chemically or microbiologically disturbed.

Food with expired shelf life (labelled *best before*) may be put into circulation if they are identified as such and if they are safe. There is no requirement for reducing the price.

However the vendor should have an interest to sell them quickly. Such products should be placed separately from standard products.

Food usable for other than its original use can be marketed only if it is safe or if it includes a label that clearly identifies the recommended method of use.

3.1.3.3. Regulation of the European Parliament and Council on foodstuffs

The most important regulations in the production and marketing of foodstuffs of animal origin are sometimes described as so-called *Hygiene Package* (Table 4).

Table 4: Regulations of the hygiene package

Number and Title
Regulation of the European Parliament and the Council (EC) no. 178/2002 of January 28, 2002 that lays down the general principles and requirements of food law, establishing the European Food Safety Authority, and laying down procedures in matters of food safety.
➤ Regulation of the European Parliament and the Council (EC) no. 852/2004 of April 29, 2004 on the hygiene of foodstuffs
➤ Regulation of the European Parliament and the Council (EC) no. 853/2004 of April 29, 2004 on laying down specific hygiene rules for food of animal origin
➤ Regulation of the European Parliament and the Council (EC) no. 854/2004 of April 29, 2004 on laying down specific rules for the organization of official controls on products of animal origin intended for human consumption
➤ Regulation of the European Parliament and the Council (EC) no. 882/2004 of April 29, 2004 on the official control of foodstuffs and animal feed, animal health and welfare.

Also important is the implementation of Commission Regulation (EC) no. 2073/2005 of November 15, 2005 on microbiological criteria for foodstuffs (as amended) laying down particular food safety criteria, hygiene of the production process, as well as the rules for sampling and preparation of test samples.

3.2. Supervisory authorities

Government supervision over compliance with obligations under the *Act no. 110/1997 Coll.* on foodstuffs and tobacco products as amended, perform:

a) Public health authorities:

- *Exercise government* supervision over compliance with obligations under this Act and the special legislation for the provision of catering services,
- *Exercise government* supervision over compliance with obligations under this Act by special legislation to determine the causes of damage or threat to health and prevent the spread of infectious diseases or other damage to food safety,

b) Veterinary authorities (VA) - exercise government supervision:

- *Over compliance with obligations* under this Act and special regulations in the manufacture, storage, transport, import and export of raw materials and foodstuffs of animal origin,
- *Of the sale of raw materials* and foods of animal origin in markets and marketplaces, of the sale of foods of animal origin in stores and retailing divisions, which carry out modification of meat, milk, fish, poultry, eggs or selling game, and in food stores, if they are destinations of arrival of raw materials and foods of animal origin from the EU member countries,
- *Of the implementation* of the classification (SEUROP) of carcass and by the directly applicable European Communities regulations governing the classification of animals for slaughter,

c) Government Agriculture and Food Inspection Authority (GAFIA) carries out government supervision:

- *Of production and marketing of foodstuffs*, unless this is done through supervision of the Veterinary Administration,
- *Of production and marketing of tobacco products*,
- *Over the declaring of inventories*,

- *Of entry and imports* of food and raw materials from third countries, if such supervision is not carried out by the Veterinary Authority.

Priorities are based on the principles of risk assessment according to commodity status in the consumer basket. That means how often consumers buy or consume it, risk linked to the commodity, production volume of the controlled entity, and whether a novel food appeared on the market.

Specific criteria for deciding on control can be findings from previous inspections, data analysis in an information system, the current findings of inspectors in the field, and findings of other government authorities. These may include public health services, veterinary services, police, customs, trade office, suggestions of consumers or mass media (press, radio, and television), finding partner organizations abroad, and recommendations of the European Commission and information from the rapid alert system RASFF (See Chapter 3.3).

Most consumers believe that the Czech Trade Inspectorate (CTI) supervises foodstuffs. They do not control food, but only deceiving of consumers. This government administration body is subordinated to the Ministry of Industry and Trade. The CTI was established by *Act no. 64/1986 Coll.*, about the Czech Trade Inspection. It is the successor organization of the former Government Trade Inspection. It consists of a Central Inspectorate and subordinated inspectorates seats in regional cities. It inspects and supervises legal and physical persons who sell or supply goods and products to the internal market, provide services or carry out other similar activities on the domestic market, provide consumer credit or operate a marketplace, unless under special legislation this oversight is carried out by another administrative authority (VA, GAFIA, or public health authorities).

Sanctions

When deficiencies are identified, the supervisory authority will describe their condition and requests their removal. In more serious cases, it will carry out measures such as prohibition of manufacturing or marketing, confiscation and destruction of unsafe food, prohibition of the use of faulty packaging, equipment or facilities for production. Sanctions are fines, which become part of the state budget. It can be imposed on site or in administrative proceedings. Set limits sanctions make it possible to impose fines in administrative proceedings according to the severity of the law broken in the amount of up to CZK 1 million, CZK 3 million, CZK 10 million, and in very serious cases up to CZK 50 million.

The guiding principle is that penalties should be dissuasive, effective, but also reasonable. Supervisory authority imposing the fine for an administrative offense takes into account the personal and property situation of the person concerned if it seems that the fine could lead to bankruptcy.

3.3. Rapid Alert System for Food and Feed

The *Rapid Alert System for Food and Feed (RASFF)* is used for notification of a direct or indirect risk to human health deriving from food or feed. It facilitates fast and efficient sharing of information on dangerous food or feed among members of the system. The members include the European Commission, EU member countries, *European Free Trade Association (EFTA)*, as well as Iceland, Liechtenstein, and Norway, and the *European Food Safety Authority (EFSA)*.

The RASFF system was established on the basis of Article 50 of the European Parliament and Council Regulation (EC) no. 178/2002.

All member countries and the European Commission created contact points (*GAFIA in CR*), which they share information on dangerous food or feed. If any member of RASFF has information about a serious health risk from food or feed, it must through the RASFF immediately inform the European Commission. The Commission evaluates all incoming messages and forwards them to all members of RASFF through one of four types of notification:

- **Warnings** - are sent when the food or feed present a serious risk when offered to consumers to buy, and therefore it is necessary to act quickly.
- **Information** - used in cases where the risk food or feed are no longer on the market or the risk is not considered serious, therefore rapid action of other members is not required.
- **Rejection at the border** - concerns food and feed consignments that have been tested and rejected at the external borders of the EU and EEA, if they were found to pose health hazard.
- **News** - all information relating to the safety of food and feed which are not communicated through warnings or information, but they are considered important for regulators.

- **Supervisory authorities** during their control activity immediately notify the occurrence of foodstuffs that pose risks to the health of the national contact point. They designate cases where the health risk may extend beyond the territory of the Czech Republic and send to the National Focal Point (GAFIA) information on adopted steps or measures based on received notifications and additional knowledge.

Information flowing in such system may include cases of unsafe animal products, toxic substances in fish products, the occurrence of pathogenic microorganisms in meat, or undeclared allergens or particles or fragments in food.

A similar system is the **Rapid Alert System for Non-Food Products (RAPEX)** of the European Union on dangerous non-food consumer products, such as napkins, toys, lamps, and so on.

3.4. Questions and assignments

- What is *Codex Alimentarius*? What is its significance for manufacturers?
- What is the FAO, and where is it located? Find the so-called "Hunger Map".
- Explain the difference between the EU act and regulation.
- Name three legislative regulations of the Czech Republic in the field of animal production.
- Which supervisory authority has the responsibility of monitoring catering services?
- Which foods are forbidden to put into circulation?
- What is the difference between the expiry date and shelf life? What will you do as a retailer or manufacturer, when the end of these periods is approaching, and what will you do as a consumer?
- What is RASFF? Find current messages in this system from last week.
- How do consumers learn about unsafe foods?
- What is the difference between the wholesome and safe food? Give an example.

4. GENERAL CHARACTERISTICS OF FOOD OF ANIMAL ORIGIN

Food is an essential condition for human life. It includes plant and animal products. Food is made from raw materials of plant or animal origin suitable for human consumption. Raw materials are processed by the food industry. Those of animal origin include all parts of carcasses of animals, birds, wildlife, marine and freshwater organisms, as well as milk, eggs, and bee products (Figure 7).

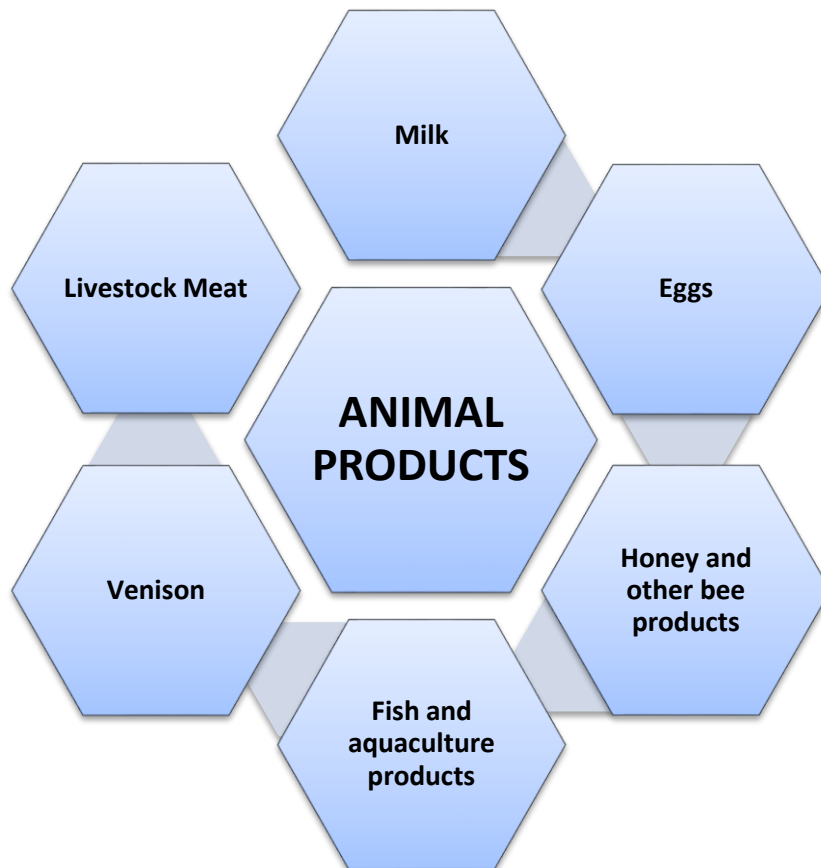


Figure 7: Types of animal products.

All substances which humans receive as food (diet) are sometimes referred to as the so-called eatables. These can be further divided into food, such as meat, milk, eggs, potatoes, and so on, as well as stimulants, including coffee, tea, spices, and others. The main function of food is to provide energy and nutrients in the required quantity and adequate quality for human body. Secondary function of food is a significant psychosocial function. Legislation includes among food also drinks, chewing gum, and any substance, including water, intentionally incorporated into the food during its manufacture, preparation or treatment. It does not

include, however, feed, live animals unless they are prepared to be marketed for human consumption, plants prior to harvesting, medicinal products, cosmetics, tobacco and tobacco products, narcotic drugs and psychotropic substances or residues and contaminants. [Regulation (EC) of the European Parliament and of the Council no. 178/2002].

The amendment to the Food Act also newly addresses requiring of mandatory information on meals (pokrm in Czech). The term *pokrm (meal)* is specific to the Czech legislation (Figure 8). In *Act no. 258/2000 Coll.* on public health protection, meal is food, including beverages, kitchen prepared cold or hot or treated so that it can be directly or after heating served for consumption within the restaurant business. In the context of European law, it is a non-pre-packaged food, or food wrapped without the presence of the consumer, that is offered by caterers.

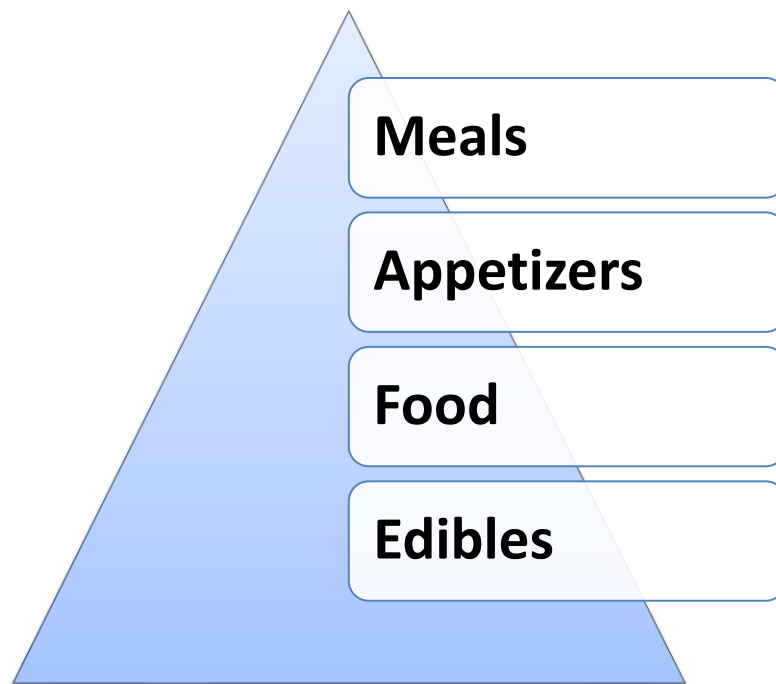


Figure 8: Common hierarchic terms used for food.

In the field of human nutrition, we can encounter other terms such as *meals* (set meals at certain times), *diet* (system of selected meals) or *delicatessen* (high sensorial, energetic and usually nutritional value).

4.1. Livestock

Farm animals or livestock are the results of purposeful domestication, breeding, and refining to the final state to meet conditions of man. They are part of an agricultural system and are bred not only for obtaining raw material products of animal origin, but they also provide intangible benefits, such as labour, pets, and agro-tourism. They also have a great and irreplaceable significance due to the cycle of organic matter in nature, including agricultural activities, landscaping, and ecological function.

At first, people held creatures captive for direct acquisition of their products. Later, they began a targeted taming where the economic-economic aspect has led to the domestication of the species that we now use. We speak about usefulness, which indicates the main and targeted benefits of farm animal breeding. During the domestication, significant morpho-physiological changes in animals took place.

The basic zoological unit is **animal species**, which is a collection of individuals of common origin, the same reproduction characteristics and properties in individual generations, and the same system of adaptation to external conditions (Figure 9).

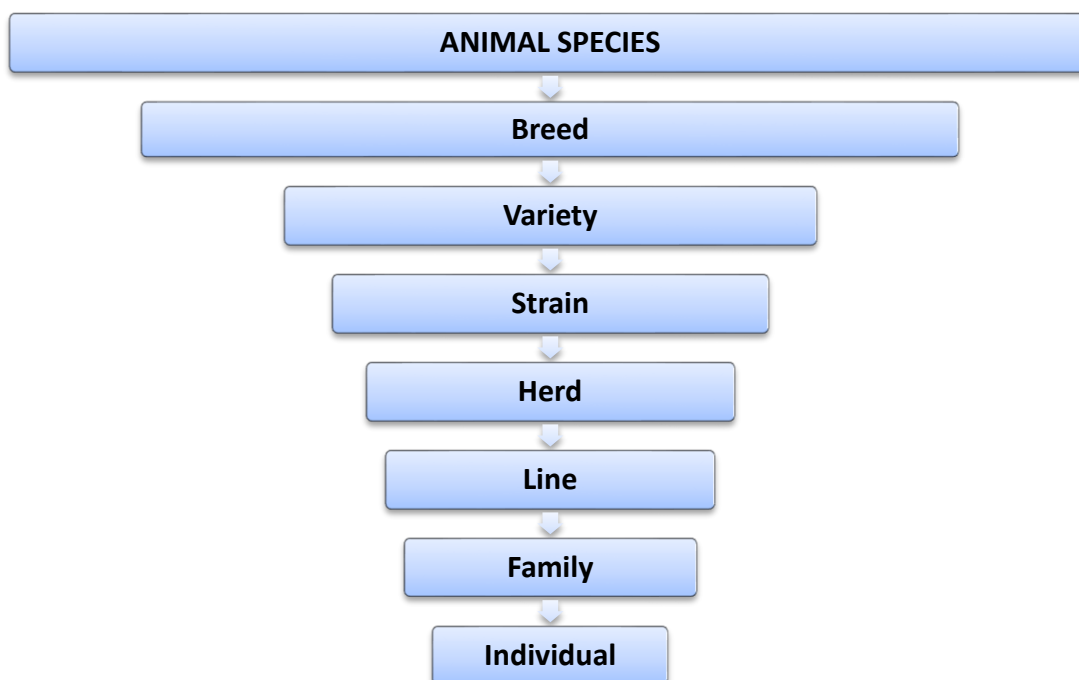


Figure 9: Taxonomic units for livestock.

Breed is a group of animals created by humans in certain conditions, which shows common quantitative traits. These traits include body shape, indicators of fertility, such as number of births, also composition such as back fat thickness, the amount of protein in milk, or fleece, as well as the amount of obtained products, such as milk production, or carcass yield. They also include qualitative characteristics and properties, such as colour, horns, or coat types, which are different from other breeds. The differences that distinguish breeds are known as breed characteristics and qualities, referred to as the so-called breeding type. Breed standard is a set of requirements, which we realize in the breeding objectives. In the past, many breeds have been reduced while some are within gene reserves. Nowadays, economic factors significantly influence animal breeding.

Utility type is mutual relationship of shape and functional properties characterizing the type of breed. In cattle, we differentiate between breeds for dairy, meat or combined utility type. Pigs, include meat types and lard-meat types. In poultry (chickens), there are the egg-laying breeds and broiler (meat) breeds. Farm breeds grow to adulthood that is in sexual, physical or breeding terms of varying length.

4.1.1. Cattle

The most important properties of cattle are milk and beef production.

Breeds of the dairy (milking) utility type include mainly Holstein cattle, also known as black-mottled or *Holstein-Friesian*, that is bred in very productive farms for their high milk production, with milk yield over 10,000 kg. The *Ayrshire* and *Jersey* breeds are known for their high milk fat content of over 5 %.

Meat breeds represent primarily animals with large body frames, originally from France and Italy. They have a good ability to convert feed into lean muscle. They include breeds such as *Charolais*, *Limousin*, *Blonde d'Aquitaine*, *Belgian Blue (Blue Blanc Belge)* with so-called double muscling, also *Piemontese*, and *Chianina*, with bulls weighing up to 1,800 kg. Breeds of small to medium body size framework come from the British Isles and are bred worldwide. They include hardy breeds suitable for extensive farming conditions, such as *Hereford*, *Shorthorn*, and *Aberdeen Angus* with well-marbled meat. The Scottish breeds *Highland Cattle* and *Galloway* are also very undemanding for breeding. The *Simmental Cattle* breed

comes from Switzerland. The Japanese breed *Wagyu* is extremely expensive for its marbled meat.

Mixed breeds are used for their ability to provide in regional conditions and needs an adequate milk production, all with good muscling and meat yield. In our conditions, it is primarily the *Czech Pied Cattle*. The *Montbéliarde Cattle* are bred in the mountain areas of France.

In 2012, according to data of the Ministry of Agriculture of the Czech Republic, a total of 227,553 head of cattle were slaughtered, which represents an annual decline of 8.4 %. Of this amount within the different monitored categories were 106,087 carcasses of cows (46.6 %), 88,782 carcasses of bulls and oxen (39.0 %), 23,062 carcasses of heifers (10.1 %) and 9,622 carcasses of calves and young cattle (4.2 %).

4.1.2. Pigs

For pigs for slaughter, the meat utility type with an emphasis on very high levels of muscle content in carcass weight dominated. Breeding in this area has gone so far, that breeds have been bred with double muscling and thus extreme values (over 60 %) of muscle proportion. This led to the introduction of the category S in pig carcass grading (*system SEUROP*). One such breed is *Pietrain (PN)*, but it has an undesirable mark of quality, namely sensitivity to stress, which can lead to so-called poor quality PSE meat, which is pale, soft, and watery.

Top breeding countries include primarily Denmark, Germany, and the Netherlands. The most common breeds is Landrace (L), which often include the attribute according to the country where it was well selected, such as Danish, Belgian, Swedish, Dutch, and so on. Other breeds include the English *Large White* or *Yorkshire (Y)*, *Duroc (DU)*, or *Hampshire (H)*. In the Czech Republic, the Czech national breeds include the *Czech Distinctly Meaty (CDM)* and *Noble White (NW)*. The already mentioned breeds bred in small quantities include *Preštice Black Pied (PC)*.

The breeding work consists of selection and breeding programs based on hybridization, combination of breeds along maternal and paternal lines for the production of final slaughter hybrids of the required quality. Paternal breeds include for example *Pietrain*, *Czech Distinctly Meaty*, *Duroc*, or *Hampshire*. Maternal breeds are *Noble White* or *Landrace*.

Position of breeds in hybrids are represented by letters, such as (AxB)xC or (AxB)x(CxD).

One of the meat-lard breeds is the *Mangalica* bred especially and originally in Hungary. It provides quality back fat, which is the raw material for the Hungarian meat products, such as, salami - *Szegedi Szalámi*, *Budapesti Téliszalámi*, and cooked smoked sausages - *Gyulai Kolbász* and *Csabai Kolbász*.

The total count of pigs in the Czech Republic as of April 1, 2013 reached 1,586,627 heads according to the Livestock Census published annually on that date by the Czech Statistical Office, including 102,351 sows. Unfortunately in ten years, pig breeding declined by almost 50 %.

4.1.3. Sheep, goats, horses

Sheep and goats in our country belong to the minority livestock in terms of number of animals and meat consumption. As a long-term trend, the numbers of sheep and goats in the Czech Republic continue to grow.

Sheep are bred for meat, such as *Texel*, *Suffolk*, *Oxford Down*, *Hampshire*, *Charollais*, or *Berrichon du Cher*, and others. They are also bred for milk, such as *East Friesian*, or for combined reasons, such as *Wallachian*, *Bohemian Forest*, *Improved Wallachian*, *Cameroon*, *Merino*, *Merinolandschaf*, or *Tsigai*. Finally, some are bred for prolificacy, such as *Romanov*, *Olkuska*, or *Booroola*. Combined utility may be up to tripartite, namely for meat, milk, and wool. The numbers of sheep in the Czech Republic since 2000, when there were only 84,108 heads, increased to 220,521 heads in 2013, representing an increase of over 160 %.

In the Czech Republic, goats are bred primarily for milk and thus dairy products. Breeds for meat include the South African *Boer*. Dairy goats comprise *White Shorthair*, *Brown Shorthair*, and the *Anglo-Nubian* goat. Goats bred for hides include *Mohair (Angora)* and *Cashmere*. In 2013, in the CR, there were 24,042 heads of sheep, which in comparison to 2004, which was the lowest total of goats, represents an increase of more than 105 %.

Czech Republic is one of the countries known for traditional horse breeding. The number of horses in the CR since 1996 is still increasing. Currently, we have over twenty recognized horse breeds. Their population reached almost 80,000 heads. Czech breeds include *Old Kladruby*, *Czech Warmblood*, *Czech-Moravian Belgian*, *Silesian Noriker*, *Czech Sports*

Pony, Moravian Warmblood, and Kinsky Horse. During 2013, a scandal took place in Europe with undeclared horse meat in ready-to-cook food and meat products. It was a deception of consumers (adulteration of food) due to the fact that horse meat is cheaper. In the Czech Republic, horses are not bred for meat, but can be slaughtered if they pass veterinary inspection. In several cases, some food was supplemented with horse meat with trace amounts of forbidden veterinary drug - phenylbutazone. Horsemeat is part of some meat products where under the legislation on labelling must contain at least 50 % of the meat, so it may be indicated in the name. In the event that it is not part of the name, it must be mentioned in descending order of ingredients on the product label.

4.2. Terms describing livestock production

Animal Growth

Growth is the multiplication of cells in tissues associated with the increase of their size. After reaching sexual maturity, sex cells form in an animal and a full sexual cycle begins. Physically, it appears as the so-called sexual dimorphism, which is difference between males and females. Breeding maturity is reaching the age and weight for use in animal breeding (reproduction).

Fattening, fattening capacity, fleshiness, feed conversion to weight, gain

Fattening is the length of feeding an animal from birth to its transport to the slaughterhouse. *Fattening capacity* is the animals' ability to increase their body weight due to feed. It is rated by a daily average gain and feed conversion to weight for the formation of tissues (per kg). *Fleshiness* is then the production level of muscle after finalization of fattening. It may be evaluated during animal's life using butcher's grasp or through different instrumental methods, such as ultrasound or x-ray, or biochemically.

Slaughter maturity, carcass value, and yield

Slaughter maturity is the age of the animals when reaching the ideal parameters in the muscles and marbling. Ideal carcass value includes criteria required by producers, processors, and consumers. The most significant component of the carcass value is the carcass yield, which is a percentage of the carcass weight against bodyweight. Carcass values are the

highest in poultry, such as for chicken 80 %, ducks 82 %, turkeys up to 84 %, geese up to 85%. This is due to the fact that the slaughtering operation removes the least parts that do not belong to the carcass. This is also true for pigs (80 to 82 %), where unlike in cattle limbs, skin, and head are parts of the carcass. In cattle, there is a big difference between categories, such as in bulls up to 65 % and cows 45 %, while in sheep between 40 % and 50%.

Oestrus, gestation, and natality

Oestrus length in females of livestock is about 21 days. *Gestation period* varies in length and intensity and reflects on the future development of the offspring. For mares, it is on average 330 days, for cows 285 days, for goats and sheep 150 days, for sows 115 days, and for does (female rabbit or hare) 28 days. *Natality* is the number of births of young.

Lactability, milk yield, milking capacity, and lactation

Lactability is the ability of cows to produce milk. *Milk yield* is the actual production of milk while *milking capacity* is the output of the cow's milk from the udder released per unit of time. *Lactation period* is the time from calving after end of gravidity until dry-off, or loss of milk in dairy cows. In cows it is about 305 days. It is expressed to one hundred, two hundred days of lactation per year, per life. The rating indicators include the amount of milk in kilograms or litres, the production of fat, protein or lactose in kilograms. The quantity of milk per lactation period in beef cattle breeds may be 2,000 kg, in combined 7,500 kg and high-yield dairy cows up to 15,000 kg. After giving birth, cows produce the so-called colostrum, for about 5 days after birth. It includes immunologically rich valuable substances for the young, and then slowly, it turns to mature milk. *Milkiness* is milk production for feeding the young, such as for sows.

Egg laying ability, oviposition capacity

Egg-laying ability is the ability of poultry females to lay eggs. *Oviposition capacity (snůška)* is a specific amount of poultry eggs in pieces or kilograms per year. In contrast, source of pollen (*snůška*) is a term in the field of beekeeping. This applies to pollen and other sources bees obtain for food, which serves for the production of honey.

4.3. Nutritional importance of food of animal origin

Animal products are characterized by their high nutritional value, variability of parameters due to internal factors affecting the animal, and especially demands for control of production and marketing in connection with their low shelf life. This is given by the content of nutritionally valuable substances, both for humans and microorganisms. Products are obtained in an environment that is a source of microorganisms that without appropriate structural layout and hygiene measures allows their rapid growth and reproduction. Animal products may pose a risk to human health because they are often reported to present risks, especially microbiological and chemical. Thus they require making of specific sanitation rules.

In 2014, the Food and Agriculture Organisation (FAO) states that an effective fight against malnutrition and hunger requires 20 g of animal protein per person per day, which amounts to 7.3 kg per year, which is about the amount of food the following equations.

Daily requirement of 20 g = 90 g of lean meat = 124 g fish = 164 g eggs = 613 ml milk

Annual requirement 7.3 kg = 33 kg of lean meat = 45 kg fish = 60 kg eggs = 223 kg milk

It is desirable to combine these foods, but in famine-prone areas of the planet these resources are accessible only in part or not at all.

In general, food of animal origin due to the amount and usability of nutritionally valuable substances is of higher quality than plant foods. But it is important to realize that diet should be balanced and varied.

In 2007, the EC Commission adopted a working document about nutrition. Strategy for Europe on health issues related to nutrition, overweight and obesity, the so-called *White Paper*, states that one can assume that 80 % of cases of heart disease, cerebrovascular strokes, type 2 diabetes, and 40 % of cancer cases could be avoided if the risk factors were eliminated from normal lifestyle. According to WHO, most of the key factors which adversely affect human health, are related to diet. Contributing factors include adverse dietary composition based on excess salt and high alcohol intake. It is also unsuitable composition of fats in the diet, a high intake of energy and totally inadequate consumption of fruits and vegetables. Improper nutrition causes a range of human diseases and increases the risk of premature death.

Listed below are principles according to nutritional goals for Europe (WHO) based on the recommendations of professional associations (Society for Nutrition):

- **Adjust the intake** of total energy dose through activity regimen so as to achieve a balance between its intake and output for maintaining optimal body weight *BMI ranging from 18 to 25 in adults, and in children ranging between 10 and 90 percentile of BMI reference values or the weight to height ratio of the child;
- **Reduce fat intake** in the adult population, so that the overall proportion of fat in energy intake does not exceed 30 % of the optimum energy value;
- **Intake of saturated fatty acids**, which are the main component of animal fats, should be lower than 10 % (20 g);
- **Decrease** the intake of cholesterol to maximum 300 mg per day;
- **Reduce** consumption of added simple sugars to a maximum of 10 % of the total energy dose, while increasing the proportion of polysaccharides;
- **Reduce** consumption of table salt (NaCl) to 5 to 6 grams per day and select salt fortified with iodine;
- **Increase** intake of ascorbic acid (vitamin C) to 100 mg daily;
- **Increase** fibre intake to 30 grams per day for adults;
- **Increase** intake of other protective substances both vitamins and minerals as well as other natural nutrients that would ensure adequate antioxidant activity and other protective processes in the organism, in particular **Zn, Se, Ca, I, carotenes, vitamin E**, and **protective substances** contained in vegetables and so on.

(*Note: **BMI** stands for Body Mass Index and is used as an indicator of underweight, normal weight, overweight or obesity. It is calculated by dividing weight in kilograms of a person by the square of the human height in meters.)

4.4. Questions and assignments

- a. Explain and provide an example for the following expressions: foodstuff, meal, diet, food.
- b. What is this usefulness? Give examples of utility-type characteristics of each kind of farm animal.
- c. Where can you find information on the number of bred farm animals?
Locate the latest published figures for cattle, pigs and poultry in the Czech Republic.
- d. Which livestock levels in the Czech Republic most increased or decreased over the last ten years?
- e. Which animals for slaughter have the highest carcass yield and why?
- f. What is calving and dry-off?
- g. What is the difference between the Czech terms snáška a snůška?
- h. Write a brief essay on the nutrition importance of animal products.
What nutrients must take into account someone who refuses animal products?
- i. At present, a large number of nutrition experts appeared in the mass media.
Where do you get information about the so-called proper nutrition?
- j. What is BMI?
- k. Calculate your value and find out to which category you belong.

5. MEAT PROCESSING AND EVALUATION OF QUALITY

Meat is a very important commodity and it is an integral part of people's balanced and varied diet. Meat and meat products contain significant amounts of protein, vitamins, minerals, and trace elements that are essential for its growth and development. It used to be, and still is a sign of people's affluence. Some religions and nutritional guidelines restrict or prohibit the consumption of certain types of meat or meat at all.

Meat quality is influenced by factors that function during the lifetime of an animal, from birth, during breeding, to transport to slaughter house. After death, these factors are given by the slaughter and the entire slaughter processing, handling and end with storage of prepared foodstuff. The resulting foodstuff must be wholesome (safe), of adequate quality and properly labelled. In the local conditions, in this regard a great significance belonged to red meat - pork and beef. These meats are both basic raw material for the production of virtually all Czech traditional meat products, as well as a number of traditional dishes.

Further processing adds value to meat. On one hand, there is the developed world with plenty of food and consumer lifestyle, on the other hand, there are developing countries.

While meat consumption in some developed countries is high, per capita consumption in developing countries does not exceed 10 kg per year. FAO estimates that more than 2 billion people worldwide suffer from a lack of essential vitamins and minerals, especially vitamin A, iodine, iron, and zinc.

Ever-increasing world population and rising incomes create higher demand for meat, but it leaves limited space for expansion of livestock production. Therefore, the maximum utilization of existing food resources becomes even more important. Poultry meat is of growing importance for fulfilling this requirement.

Quality animal products and access to good quality water, along with medical care, are basic requirements in stabilizing vulnerable regions. In contrast, varied diet with a balanced amount of nutrients and physical activity supported by prevention are prerequisites for reducing the incidence of various lifestyle diseases in the developed world.

5.1. Basic definitions about meat

According to the Veterinary Act, a farmer is someone who owns or keeps an animal or animals, or is entrusted to care for them, whether for remuneration or not, even on a temporary basis.

A *farm* is any structure, facility, or place where livestock animals are bred or kept, including outdoors farming. *Livestock animals* are used primarily for breeding, fattening, work, and other economic purposes. They include particularly cattle, pigs, sheep, goats, horses, donkeys and their hybrids, poultry, ratites, rabbits, fur-bearing animals, farmed game, fish and others aquatic animals and bees. If livestock is meant for slaughter and processing and their meat is for human consumption, we talk about *animals for slaughter*.

From the slaughter animals after their slaughter, we can get various products of animal origin. They include all parts of animals, especially meat, viscera, fat, skin, bones, blood, endocrine glands, horns, antlers, hooves, wool, fur, feathers and products made from these materials, which are intended to human and animal nutrition.

Meat (does not include meat for the manufacture of meat products) is all edible parts of the following animals, including blood.

- *Domestic ungulates* are domestic bovines, including the species *Bubalus* and *Bison*, pigs, sheep, goats, and domestic odd-toed ungulates,
- *Poultry* means domestic poultry, including birds that are not considered as domestic but which are farmed as domestic animals, with the exception of ratites,
- *Lagomorphs* include rabbits, hares, and rodents,
- *Wild game* are wild ungulates, lagomorphs, and other land mammals that are hunted for human consumption and are considered to be wild game under the applicable law in the member countries. They also include mammals living in an enclosed area under conditions of free range similar to wild game and wild birds that are hunted for human consumption,
- *Farmed game* are farmed ratites and farmed land mammals other than those domestic ungulates.
- *Small Wild Game* live freely in the wild and include game birds and lagomorphs.
- *Large wildlife* live freely in nature and include terrestrial mammals, not covered by the definition of small wild game.

The main product from the slaughtered animal is called carcass. Formerly, it was called slaughter-house processed body.

Carcass is the whole body of a slaughtered animal after bleeding, evisceration, and skinning. The definition is further specified in the relevant legislation. It has great importance in the monetization of the raw material, as a statistical and accounting item. It is a traded commodity.

Fresh meat means meat, including meat packaged under vacuum or in a controlled atmosphere. For its preservation no other kinds of treatment than chilling, freezing, or quick-freezing were used.

Offal is fresh meat other than that of the carcass, including viscera and blood.

Viscera are the organs of thoracic, abdominal and pelvic cavities, including the trachea, oesophagus and, in birds also the crop.

Minced meat means boned meat that has been minced into fragments and contains less than 1 % salt.

Mechanically Separated Meat (MSM) is the product obtained by removing meat from bones after deboning or poultry carcasses so that the loss or modification of the muscle fibre structure takes place.

Meat preparations is fresh meat, including minced meat, which has had foodstuffs, seasonings or additives added to it or which has undergone processes insufficient to modify the internal muscle fibre structure of the meat and thus to eliminate the characteristics of fresh meat.

5.2. Data on production, processing, and consumption of meat

The inclusion of meat in the diet used to be and still is a symbol of affluence of the population. Each year, the production and consumption of meat increases as living standards of inhabitants of our planet increase as well. Because this is going on in very poor but populous areas, we expect a significant demand for foods of animal origin and therefore meat, especially in *Asia* but also in *South America* and *Africa*. Main commodities of various kinds of livestock meat include beef, pork, poultry, mutton, and goat meat. In statistics, fish are

expressed separately due to economic, technological, and dispositional differences of this commodity.

The world produces about 300 million tonnes of meat on the bone. Meat on the bone is the final product (foodstuff), which leaves the meat-processing business. Pork is the most produced and consumed meat. For example, in the EU, it accounts for half of the meat consumed. This also applies to the Czech Republic. China produces the largest amount of pork. **OECD** sources for 2010 list up to 50 million tonnes of meat on the bone, which is one sixth of the meat produced in the world. Traditional areas of beef production are the *USA, Brazil, China, Argentina, and Australia*, which produce nearly half the world's production. Beef production in Europe for over time is steadily decreasing but there is a worldwide boom, especially in Asian countries. Poultry meat has huge potential. The main producing areas are the *USA, China, the EU, Russia, and Brazil* (Table 5). After 2020, this commodity is expected to outstrip the production volume of pork. It will become the most produced meat mainly due to easier production conditions. It is because a lower price, due to reduced need for farmland, feed consumption, but also of water for every kg of meat produced. The speed of production also helps, and so does absence of restrictive eating habits of religion or psychology of consumers and the ease of cooking.

Table 5: The amount of produced meat on the bone in selected regions of the world

Rank	Beef		Pork		Poultry	
	Country	Amount in millions of tonnes	Country	Amount in millions of tonnes	Country	Amount in millions of tonnes
1.	USA	12.0	China	50.0	USA	19.2
2.	Brazil	6.9	USA	10.5	China	17.1
3.	China	6.2	Germany	5.3	Brazil	13.1
4.	Argentina	2.6	Spain	3.3	EU	12.4
5.	Australia	2.1	Brazil	3.0	Russia	2.4
Sum*	World	57.5	World	107.4	World	90.1

* Estimate USDA-FAS (Ministry of Agriculture, SVZ – pork, 2013)

The *Czech Republic* produces nearly 460,000 tonnes of meat annually, that is 240,000 tonnes of pork, 152,000 tonnes of poultry, and 65,000 tonnes of beef (ČSÚ, 2012). Other species are minor compared to the main types. Our self-sufficiency in pork in 2013 was, according to the Ministry of Agriculture at 53 %, the worst result for all major commodities. The highest share of imports comes from *Germany, Belgium, Austria, and Spain*. For beef, the situation is reversed in the Czech Republic, self-sufficiency was 123 %. Beef production has long been determined primarily by demand in the domestic market and export opportunities for beef and live cattle especially on foreign markets. It was also due to the economy of cattle, namely higher European and national funding measures, including their receiving for use by individual cattle breeders. The demand for poultry is rising again, and that was solved by imports. A substantial competition in the Czech market is pushing down prices and also affects the consumption of other kinds of meat.

Meat production is, due to the fact that the body of a slaughtered animal contains different amounts of processed products, expressed in different units and not all of it is meat. Production values are often reported as the *value of animal live weight* - in tonnes or kilograms of live body weight. Slaughter house statistics express meat as *carcass weight*, in tonnes or kilograms, which means the weight of the unit at the end of the slaughter process. The carcass is then divided into smaller, qualitatively separate parts. Some parts which are not intended for human consumption, such as bones, cartilage, and tendons, and/or are not part of the meat cuts or meat products, are discarded. Some of these by-products are used for the production of pet food and unusable remainder is subject to carcass disposal in veterinary rendering facilities. Meat-processing businesses therefore market mainly meat cuts, after cutting the meat, or range of meat products. Long-term storage currently ensures material reserves. At present, there is a continuous decrease in consumption of meat by the processing industry. The division of beef and pork is strongly in favour of pork.

Statistical reports and yearbooks state meat consumption per inhabitant per year, in kilograms per person per year. This is the so-called consumption of meat on the bone, which is the domestic consumption of meat in carcass weight, divided by the population of that country. *After World War II* in our country, annual meat consumption has grown in 1990 up to 96.5 kg of meat on the bone per capita. Then it declined to the current annual level of less than 80 kg (2012: 77 kg per person), which is below the current EU-27 average of 85 kg. Part of the public linked the decline in meat consumption, to reducing the share of pork in meat products. Consumption fluctuates in the long run due to changes in consumer habits. The purchasing

power of the population and the price of offered goods affect the on-going price volatility. In the 1990s, the consumption of pork and beef gradually declined, but in contrast, the popularity of poultry meat sharply increased. Figure 10 shows the values reported in yearbooks published by the Ministry of Agriculture.

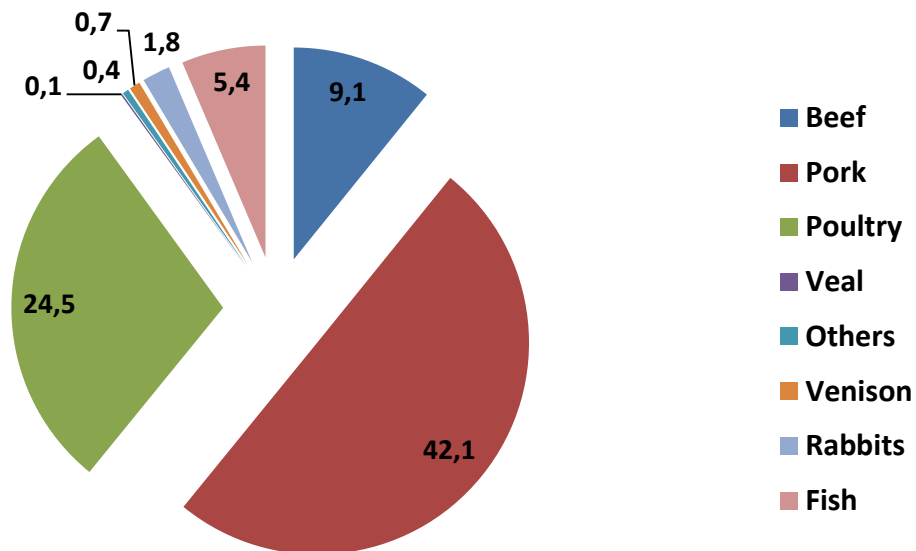


Figure 10: Consumption of meat on the bone, in kg per capita per year, ČSÚ 2011.

5.3. Meat, its composition and properties

Pure cross-striated muscle generally contains 75 % water, 20 % protein, 3 % fat, and 2 % of extractive substances of non-protein origin, which include non-protein nitrogenous compounds, minerals, vitamins, and carbohydrates. Water in terms of volume is the most significant and technologically important ingredient in meat. It varies from different species, breed, animal age, as well as its morphological and anatomical origin. Nutrition and adhering to ideal living conditions of animals affects its content. It occurs in three forms:

- **Bound water** is tied to proteins by hydrogen ions,
- **Hydration water** represents a molecular layer on the surface of biopolymers,
- **Free water** is bound inside the myofibrils and is bound in meat by capillary forces between thick and thin filaments.

Among the most important characteristics of meat is water retention, which is the ability to bind water. Most of the water is bound inside the myofibrils in spaces between the thick and thin filaments. Its release occurs after killing (slaughter) of the animal and mainly due to the effects of *rigor mortis* (post-mortal stiffness), as well as processing and handling (heat treatment) of animal carcass which leads to shrinkage of filaments.

Meat protein can be divided into:

- *Sarcoplasmic* – one third of meat proteins; soluble in water, such as muscle dye myoglobin,
- *Myofibrillar* – one half of the meat protein, contained in the thin and thick fibres, soluble in saline, especially proteins actin and myosin,
- *Stromal* - proteins in intramuscular connective tissues, insoluble in water or salt, such as collagen, or elastin.

Fat is present in the muscle tissues as the so-called intramuscular fat. It was already deposited in younger animals, and plays a role in culinary and sensorial properties of the meat, such as tenderness and succulence. The ideal amount of intramuscular fat in lean muscle is about 2 % to 3 %. The fat in monogastrics, such as pigs, is called *lard*, while in polygastrics, such as cattle and sheep, it is called *suet*. Older animals deposit fat on their bodies and inside the body cavity. Fat is part of the carcass meat, component of meat products or is the main raw material for industrial processing. The monetization system *SEUROPE* evaluates the quality of the carcass according to the level of fleshiness and fatness (cattle, sheep) or it uses measured proportions of muscle at defined positions.

There are three kinds of muscle tissues – skeletal or striated, smooth, and cardiac. Skeletal muscles, but also other organs, such as tongue or oesophagus, are formed by muscle fibres, which are in final form as muscles handled by brain. The basic unit is the muscle fibre, which is a cluster of cells, which originated from small cells (myoblasts) during their differentiation in embryonic development. Cell nuclei are situated under a thick membrane, which forms the fibre surface, called sarcolemma. The fibre length varies according to the length of muscle (up to 30 cm). The average length of thin (actin) filaments ranges from 20 to 40 microns, and of thick (myosin) filaments of about 100 microns. Under the microscope the fibres appear striated (hence the name), with dark (anisotropic) sections alternating with light (isotropic) ones. The striations arise from different refractivity of light, described in 1685 by the Dutch scientist and microscopy pioneer *Antonie van Leeuwenhoek* (1632-1723). Cytoplasm in cells is called as sarcoplasm. In addition

to cellular organelles it also contains contractile fibres called myofibrils that have the ability to shrink. Contraction occurs, put is simply, on the basis of a nerve impulse which occurs by irritation of a motoric plate and brief increase in the permeability of sarcolemma for calcium (Ca^{2+}) from the sarcoplasmic reticulum. Consequently, the process of conformation and insertion of the muscle fibres gets on the way. Here smaller parts of the muscle fibre (myofilaments), play a role. Adenosine triphosphate (ATP) is split into ADP and phosphate to produce the energy required for fibre movement and further interactions of actin and myosin.

Muscle fibres were first classified as red and white. The red ones are typical for their slow contraction, but resistant to fatigue, while the white ones contract rapidly. Type I fibres (red) have the lowest diameter. Motion is based on the oxidative metabolism. They get least exhausted by intense activity. In contrast, the fibres known as IIB (white) are due to the larger amount myofibrils ideal for achieving the greatest performance, but the tire quickly. Another type described in the literature - a transient type of fibre called red with rapid contractions is the Type IIA.

Other scientific terms on this topic are *hypertrophy*, which is enlargement of muscle mass caused by physical stress and *atrophy* or reduction muscles due to physical inactivity.

5.4. Post-mortem processes in meat

The normal course of biochemical processes in the muscle is based on functioning tissues under regular blood circulation, body temperature stable and functional immunity. After the death of the animal the muscle tissue changes into meat. This occurs without blood circulation in an oxygen deficient environment. Temperature of the environment and tissues decreases and these are not directly protected against external and internal threats in the form of microorganisms.

Aging of meat is a somewhat vague concept including the following aspects:

- It is a biochemical conversion process of muscle into meat by enzymes.
- It consists of several phases that immediately follow each other and are not easily distinguishable.
- For various kinds of meat, they vary in length and time.
- It occurs almost immediately after the death of the animal and end with the ultimate breakdown of the meat.
- It is a qualitative process that significantly influences the material.

At first, there is a conversion storage compounds in muscles, which during the life of the animal were a ready source of energy. Glycogenolysis is a breakdown reaction of glycogen, phosphocreatine, and ATP. Glycogen is an energy store in liver and muscles. Muscle glycogen is broken down only for the needs of a specific muscle. The resulting glucose is metabolized as a source of energy for muscle work but does not enter the blood. The waste product during the conversion is lactic acid, which is transported through the bloodstream to the liver for resynthesis. After the death of the animal, functional blood circulation is absent and the lactic acid accumulates through enzymatic action in muscles. The pH drops to a value of about 5.5. Here, near the so-called isoelectric point of proteins occurs the phase of post-mortem meat stiffness. The lowest meat water retention of meat occurs at about pH 5.0. Increased acidity acts as one of the factors of meat shelf life, but because of unsuitable texture of meat it is sensorially unacceptable. This stiffness slowly but gradually recedes, thanks to an on-going biochemical processes (conversion of muscle protein) and the meat gains tenderness. This is accompanied by stronger odour and after heat treatment by improvement of other sensorial parameters, such as juiciness and flavour. This process is then complemented by the for humans destructive, usually proteolytic, activity of microorganisms, then spoilage occurs, which accelerates their exponential growth and proliferation.

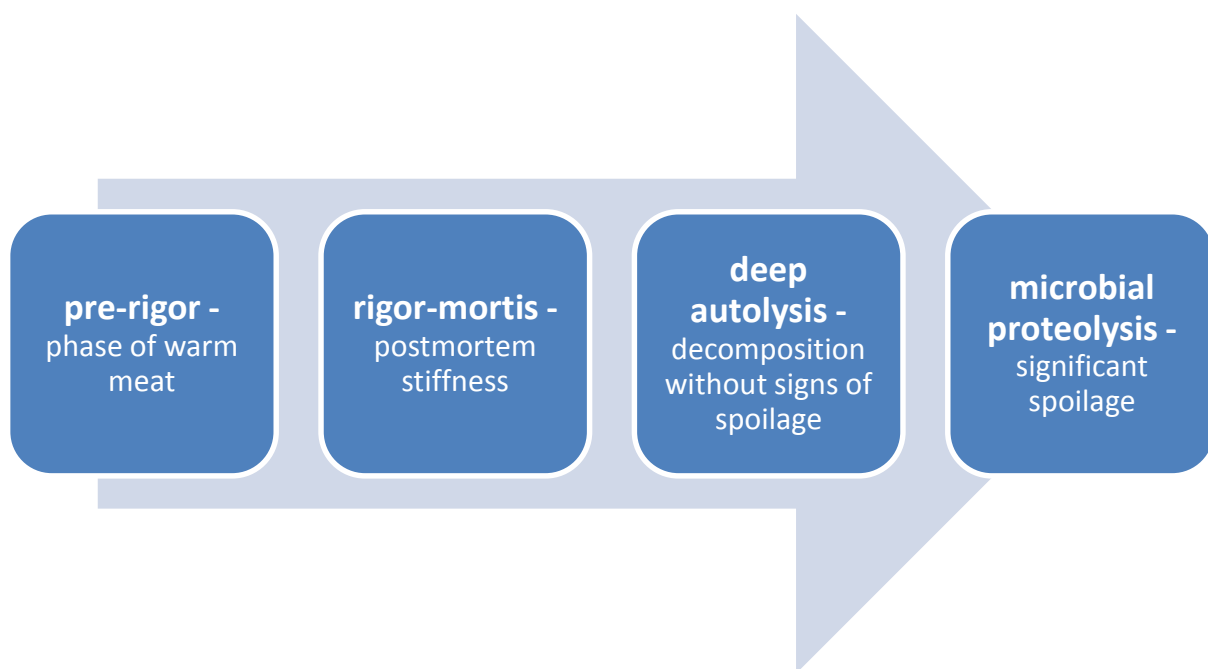


Figure 11: The course of post-mortem processes in meat.

In terms of time, this process can be divided into four phases (Figure 11) which immediately follow each other and are not easily distinguishable. After the slaughter, meat cools first spontaneously, during carcasses hanging, and later forcibly in cold storage, when cooled to storage temperature, which is used as a factor against the growth of microorganisms.

5.4.1. Phases of aging of meat

The meat can be processed during the so-called *pre-rigor* before the decomposition processes described above occur, which is in general within two hours. We can see this at home slaughter. Gradual processes and later increased stiffness in the *rigor mortis* phase slowly shift the meat quality to the desired sensorial properties. This is where we talk about the length of meat aging.

It is desirable to allow beef to age for two to three weeks, depending on the conditions and required quality of the resulting food but it can vary greatly. Meat at slaughterhouses is deliberately not aged. However, there are different ways (dry and wet) how to extend aging, or actually delaying spoilage, in special temperature and humidity conditions and the production of food for catering services.

Pork arrives in the market network around its perfect stage of ripeness after a week. Extension of its aging is, due to the absence of sensorial differences, not required.

In poultry post-mortem processes occur very quickly and as early as within the first few hours, pH will drop to its lowest value.

In fish, despite the diversity of species and weight, no aging is needed. Decomposition processes occur almost immediately and these products must be properly conserved by cooling, freezing, or by thermal treatment.

In venison, due to the typical environment and activities associated with traditional handling after the hunt, the animal is often left in the skin and only innards are removed.

Breakdown of proteins, without detected signs of spoilage, is sometimes referred to as *deep autolysis*. It then passes through the development of microorganisms into the so-called *microbial proteolysis*.

5.4.2. Abnormal post-mortem processes

Post-mortem processes in muscle tissues are very important and can sometimes have an abnormal course. We can detect them by various methods. Usually, these methods include pH or electric conductivity of meat in a defined time, colour or remission of meat, determining of water retention, or drip of meat fluid. It is possible to add sensory analysis of the raw and heat-treated meat. The most common expression of quality during post-mortem processes, and thus defect detection, is by using the values of pH. If the process is accelerated by decrease of the pH value due to sensitivity of the animal to stress. This is caused genetically as a symptom of breeding for a high proportion of muscle. We use the so-called **PSE**, which stands for **Pale, Soft, Exudative** meat. The abbreviation refers to meat that is very light and soft that is of texturally poor quality, as well as watery, which means it releases large amounts of meat juice. Due to poor water retention the meat is sensorially unsuitable for meat cuts (consumer sales) as well as for production of certain meat products, such as ham.

- **We measure** it at time 1 (hence sometimes pH1) after carcass processing, about 45 to 60 minutes, after blood draining puncture. In the case of pH1 or pH45 in pork, the measured value higher than 5.8 or below 5.6 is a significant PSE deviation.
- **Some authors** specifically described a deviation called the Hampshire factor (described in section on meat of Hampshire breed). High glycogen content (glycolytic capacity) in muscles, despite slow course of its reduction to lactic acid, caused a defect with identical symptoms as PSE. The problem here was the failure to find this problem by using pH45. Therefore, it was suggested to use measurements at 24 hours post-mortem and the criterion for pH24 was set at above 5.4.
- **Meat loses** more than 5 % of the fluid after the first 24 hours (finding out mass for the so-called dripping after storage in refrigerator). The loss may be much higher.
- **We can measure colour** by a spectrophotometer and compare it with various other criteria (remission, $L^*a^*b^*$, and so on), or within a group of samples among them. Sometimes we see defects described as **RSE** (red, soft, exudative) where the meat is red, but otherwise the same quality as the **PSE**.
- **Such material** involves technological difficulties, and in case of occurrence on large scale, significant economic loss, as well. This is due to the impossibility or difficulty of processing, as well as direct weight loss during handling, processing and marketing, as well as possible complaints from customers.

Quality deviation DFD (dark, firm, dry) was first described as dark cutting beef. Such meat comes from animals physically exhausted prior to slaughter. The animals do not have enough time to replace the broken-down glycogen in the muscles and glycogenolysis then takes place only to an insufficient extent. Lactic acid is absent, the meat does not acidify and is subject to faster decay.

- The values of *pH_{ult}* or *pH_u* are measured in the so-called ultimate (final) time, when it is no longer decreasing. For pork or beef, there can be a different post-mortem time criterion (24 or 48 hours). At this time, this number should not be higher than 6.2.
- *We can measure texture* instrumentally (objective) or express it using sensory analysis (subjective). Despite numerous studies, there is no generally recognized criterion (limit) for texture defects.
- *Such material* carries with it trouble. The main problem, beyond the reduced sensory quality is fast decay of **DFD** meat, which can be confiscated in extreme cases.

Scientific studies also describe other defects, such as **cold shortening** of fibres, and others. For a technologist, more important than their enumeration and creation, which often is not even described, to acknowledge their existence and focus on qualitative sorting of the foodstuffs. Therefore, the definition of required quality parameters of the foodstuffs and the determination of standard are absolutely essential.

5.5. Animal slaughter

Killing of animals takes place during the so-called slaughter, which is the killing of an animal for slaughter in order to use its products in a way that does not conflict with the provisions on the protection of animals against cruelty (*Act no. 246/1992 Coll.*). In contrast, destruction is killing of an animal when it is not for slaughter, but again, in a manner consistent with the provisions on the animal protection against cruelty. In certain cases, we can even carry out the so-called domestic slaughter. This is a definition of animals and situations in which a slaughter can take place in conditions not following the industrial regulations.

The final product is, as defined above, the body of an animal after slaughter and processing, known as *carcass*.

5.5.1. Pre-slaughter treatment, transportation, and handling of livestock

The first phase of slaughter is a set of activities of qualitative and quantitative importance, sometimes grouped under the concept of pre-slaughter treatment of animals. They include the following activities:

- ***Selection of animals*** - the animals must be selected with regard to their health status, maturity given by weight and age, and social conscience of animals in the group.
- ***Preparing animals for transport*** – no feeding of animals due to easier and more hygienic handling and processing of carcasses and paradoxically greater resilience to stress the animal during transport. The recommended fasting time before slaughter of animals to be transported to the slaughterhouse, is 12 to 18 hours. Fasting longer than 24 hours may in fact lead to exhaustion of the animals and the animal defect DFD, and weight loss of 5 %.
- ***Completion and timely dispatch*** of documents (food chain information - i.e. FCI, 24 hours in advance) and the agreement with the slaughterhouse including date, quantity, price, and so on. The FCI lists the disease situation in the breeding place, information about medication animals, results from other slaughter and contact for the attending veterinarian.
- ***Transport of animals*** - includes loading, travel and unloading, which should not in domestic ungulates exceed eight hours, otherwise it is necessary to let them rest and other requirements specified in the legislation.
- ***Receiving and stabling of animals in slaughterhouses*** - currently stabling is not long and it is not appropriate to slaughter animals immediately. Deliveries are contracted in advance in order to avoid operational delays, but considering their rest it should not be more than two hours.

The issues mentioned above must comply with the legal requirements specified in the Act on protection of animals against cruelty, veterinary law, and EU regulations. Livestock animals have different demands on the environment and handling. This should be taken into consideration for example during the transport of pigs susceptible to stress and overheating, or in poultry, which is transported in considerable numbers, or in juveniles.

Handling of animals and especially loading, transporting, and unloading pose a great stress for the animals. Stopping at checkpoints (places of rest), may under certain conditions lead to the spread of infectious diseases. It is absolutely necessary to have specific measures to ensure the health and welfare of animals. Mistreatment of animals is attributable to a cruel behaviour of staff and their lack of education. Therefore, all staff dealing with animals during transport should undergo an essential training.

5.5.2. Livestock Slaughter

During the killing and related operations animals shall be spared any unnecessary pain, distress, or suffering. Slaughter qualitatively speaking is a set of operations directly and indirectly aiming at several objectives already mentioned:

- **Killing** of an animal in a way that does not violate the principles of animal welfare and does not endanger humans,
- **Evaluation** of the health status of the animal or food safety based on a health inspection,
- **Hygienic** removal of organs and tissues, which are subject to rapid deterioration,
- **Obtaining** a certain amount of product (weighing) of standard treatment (carcass), which is to be further processed,
- **Classification** based on standardized methods (SEUROP), ranking the level of carcass quality for fleshiness and fatness (share of lean meat),
- **Facilitating** the extension of carcass shelf-life (cold storage).

The slaughtering facility must be properly designed, including non-slip flooring, necessary lighting and appropriate ventilation, as well as equipped with lashing fixtures, and perhaps with bedding. The animals are stabled and, if not immediately slaughtered, should have access to safe water.

The slaughtering actively begins with stunning, which can be:

- **Mechanical,**
- **Electrical,**
- **Chemical.**

Stunning may be reversible when the animal may regain consciousness, or irreversible when the skull is pierced or cardiac arrest occurs and the animal already does not become conscious. The moment of death is always during the blood draining puncture, which must take place as soon as possible, within one minute after stunning.

Mechanical stunning is based on drawings and descriptions of specified locations on the head of the selected species for applying the stunning blow and location of mechanical stunning device. The most commonly used is captive bolt pistol, which employs a metal rod that pierces after pulling the trigger. It penetrates the animal skull and enters the cranial cavity. Other devices include percussive non-penetrating for animals up to 10 kg and techniques, such as a blunt blow

to the head. Home slaughtering uses various kinds of mallets. The animal must be adequately fixed, or immobilized before stunning. When killing poultry in home slaughter, cutting of the head can be used for bleeding without prior stunning. Mechanical stunning is most commonly used in home slaughter of cattle.

Electric stunning method is based on causing an epileptic seizure via electric shock, followed by unconsciousness. It consists of three phases. In the first (shortest) phase, there is an apparent total body spasm (*tonic phase*), when excitation takes place in the brain nerve cells.

This is followed by a phase of writhes (*clonic phase*), and can even sometimes lead to the third phase (*regaining consciousness*). During the convulsions bruises and fractures may occur.

It uses legislated electrodes, with the minimum current applied to the head or to the head and body (Table 6).

Table 6: Minimum values for electrocution according to Regulation 1099/2009

Minimum current (A)	Cattle over 6 months	Cattle up to 6 months	Pigs	Sheep and goats	Chickens	Turkeys
For head	1.28	1.25	1.3	1.0	0.240	0.400
For head and body	-	-	1.3	1.0	-	-

For poultry, we use mainly water bath, where the animals must remain for at least four seconds. For chickens, we use electric current on average from 100 to 200 mA and turkeys from 250 to 400 mA depending on the frequency, in ducks and geese 130 mA, and for quails 45 mA).

Electrical stunning is demanding for technical equipment, work safety, and accuracy of procedure.

The third method is *stunning with gas*. We use plain carbon dioxide at high concentration (80 % for pigs, weasels, and chinchillas) or in two stages (40 % then higher in poultry), in combination or exclusively with inert gases (argon, helium) or carbon monoxide (only for fur animals). Carbon dioxide is heavier than air. The animals are lowered in groups via an appropriate mechanism into the stunning chamber. The absence of oxygen in the air breathed by animals leads to anoxia. Due to complications and economic costs, it is only suitable for large slaughterhouses.

5.5.2.1. Slaughter of cattle

Cattle are often stunned in a stunning bay, where animals are restrained, using a captive bolt. Next is fastening body in hanging position and **blood draining puncture**, where the animal in the bleeding space loses most blood. If blood is extracted, we use a sanitary sampling method (hollow knife) and collect up to 15 litres of blood. After that comes **skinning** where by using steam slices and cutting calves, the skin is rolled up on a roller. Staff commonly checks the correctness of the process by using a knife. Head of cattle is cut and hung. Next step is the so-called **evisceration** that is opening of the body cavity and removing the organs of the digestive and urogenital tracts and spleen, as well as removing the radicle. The extracted organs and head are the sent to the veterinary inspection. Next, the body is cut in half using various saws and the finally adjusted to form a carcass. After the veterinary inspection, the carcass is subjectively classified into categories SEUROP, which is monetization based on assessment of meatiness and fatness, and then it is hung and cooled.

Dissimilarity and size of cattle is the reason for different carcass processing as compared with pigs. Processing line for cattle slaughter is designed for a larger volume of body and digestive tract, so it can be used for slaughtering of larger slaughter animals, such as boars, sows, and game. Thus, it takes much longer and is more laborious as carcass must be weighted within 60 minutes after the **blood draining puncture**.

Cattle carcass is thus composed of two halves or four quarters in the following commercial manner:

- **Without head** (severed from the carcass at the neck joint),
- **Without legs** (severed at the carpometacarpal or tarsometatarsal joints)
- **Without organs** in thoracic and abdominal cavities, with or without kidneys, with or without the kidney and pelvic fat,
- **Without genital organs** and attached muscles and without the udder or the udder fat.

5.5.2.2. Slaughter of pigs

We stun pigs using electricity or gas. In the first case, we use is electric tongs or forks, or so-called V-type conveyor, combining fixation with animal stunning. In the second case, we most often use carbon dioxide for stunning. Then the body is bled in lying or hanging position. The skin is obtained from pigs' carcass only rarely, when the production of pigskin acquires the dorsal skin referred to as *butts*. Pigs undergo scalding by steam and dehairing. We use water or steam at 65°C, to release the bristles from the skin and then to remove them mechanically from the body. At the end the carcass passes through a zone where a flame burns off the remaining bristles. Next, we open the body cavity and remove innards and radicle. Then the extracted organs and bodies undergo veterinary inspection. Finally, the body is treated to form a carcass. After veterinary inspection, we classify the carcass using SEUROP (monetization of carcass), then weigh it or possibly measure its pH and then hung and cool it. Pig carcasses must be weighted within 45 minutes after the *blood draining puncture*.

Pig carcasses are thus composed of two halves in the following commercial form:

- *Without* tongue, bristles, hooves, genital organs, flare lard, kidneys, and diaphragm.

5.5.2.3. Domestic slaughter, sale at open markets and marketplaces

Domestic slaughter means slaughter of livestock for the purpose of obtaining animal products. Animals for slaughter, except for cattle aged over 24 months, horses, donkeys, and their hybrids, can be slaughtered at the farm, if their meat and organs are intended only for domestic consumption. Domestic slaughter must be reported and it can be carried out assuming that no infections exist in the area. Furthermore, there are fixed rules regarding the treatment of animals, so it should not violate the law for protecting animals against cruelty.

Since 2012, there has been a change, which authorized slaughtering cattle aged up to 24 months of age and cervids from farm breeding (which used to be forbidden), but under the terms of the Veterinary Act and by implementing regulations. The breeder must locally notify the relevant regional veterinary administration about the intent to carry out domestic slaughter of cattle. An essential condition is that the waste, such as intestines, head, and other animal by-products must be passed for the so-called harmless disposal at a rendering company. In case of any pathological or otherwise suspicious findings, the breeder can request a veterinary examination. In special cases under extraordinary veterinary measures, the local relevant

veterinary authority can order an investigation, if there is an unfavourable infection situation. Slaughtered animals must also be deregistered from the central register.

Rabbits, hares, and poultry can be hung before stunning only if measures are taken so that at the moment of stunning, the animals should be in such physical condition that allows an efficient and rapid procedure.

Markets and marketplaces can only sell live piglets, lambs, and kids up to a live weight of 15 kg, as well as poultry, including chickens, turkey, guinea fowl, ducks, and geese, pigeons, rabbits, fish and pet animals, with the exception of hazardous species. Products derived from such animals, with the exception of pet animals, are intended for consumption in the consumer's home. Slaughter and further processing of carcasses that may be sold in a marketplace is possible only when it is allowed by the market rules and that the market has suitable premises and equipment for these purposes. These should include an easy to clean and disinfect catchment area, gravity surface with wastewater sewer drains, sufficient supply of drinking water, if possible warm, appropriate equipment and tools, such as tables for cutting meat, mallets for stunning animals, knives, protective equipment, as well as waterproof, lockable, and labelled containers for animal by-products. The sale of live fish must include evidence about the place of their recent relaying.

Events of mass character, such as municipal pig slaughter, are a different matter. The legislation does not know this term and proceeds according to the above requirements, namely meat and organs intended for consumption by the domestic breeder. Production of so-called domestic slaughter specialties for marketing is possible only in approved areas, such as a slaughterhouse or registered butcher shop.

5.5.2.4. Slaughter of animals for the needs of churches and religious communities

Slaughtering animals on the basis of a religious ceremony must comply with European Union rules governing the protection of animals at slaughter and the Ministry's decision to grant permission for the slaughter of animals for the needs of churches and religious communities whose religious ceremonies specify methods of animal slaughter. Veterinary conditions are established by the regional veterinary administration.

These are the *kosher* and *halal* slaughtering methods. *Kosher* slaughter or *shechita* is in accordance with Jewish faith while *halal* conforms to the Muslim faith. For both religions, there are clean (*kosher or halal*) and forbidden (*treif or haram*) foods. For both religions, the forbidden food includes pork, meat of carnivores, amphibians, and so on, as well as approved animals, but is slaughtered using an unauthorized method. Animals are slaughtered while conscious in presence of a cleric who oversees whether the religious requirements are met. EU law allows member countries to regulate this kind of slaughter, but in some instances such slaughter has been prohibited.

5.6. Monetisation of meat

Monetization is performed using the classification of carcasses by the *SEUROPE* system. In general, the *purchaser* (buyer, meat-processing company, manufacturer, processor, distributor, and so on) receives from the *seller* (supplier, primary producer, producer, farmer, and so on) under contract goods (products), for which he should make a financial payment corresponding to the production cost. This should apart from quantitative terms (amount delivered by seller) also take into account the qualitative aspects (buyer's requirements).

The quality of livestock carcass differs greatly, according to age, weight, breed, sex, level of nutrition and breeding, and so on. The aim of buyers is primarily raw material that meets their requirements, especially if they deal with a company producing meat products.

In earlier times, animals were bought and sold at markets by the head. The quality was assessed only visually or using the so-called butcher's grasp. When selling live animals, they were visually evaluated for meatiness and weight with *empty/full stomach*. The price was reduced due to full stomach and rarely increased due to empty stomach. A subjective evaluation could, however, lead to conflicts. Buying meat as carcass weight eventually solved the problem of targeted overfeeding animals, as the decisive factor was the weight of the body and not the quality of meat (the amount of muscle). Over time, methods were developed for assessing the amount of muscle in the carcass. Currently in the CR, people use subjective (cattle and sheep) and objective methods, which are sometimes referred to as instrument-based methods because they use various devices and accessories (pigs).

5.6.1. Monetisation of cattle

Cattle carcasses are classified into classes based on subjective categorization of cattle (sex and age) and based on the classification of a visual assessment of meatiness and fatness (Figure 12). Trained evaluators carry out this evaluation in slaughterhouses after veterinary control.

Adult cattle carcasses are divided into *body categories* and identified with letters A, B, C, D, and E. **Young bull (A)** is an uncastrated male animal between 12 to 24 months. **Bull (B)** is an uncastrated male animal aged 24 months or older. **Ox (C)**, is a castrated male animal 12 months and older. **Cow (D)** is a female animal over 12 months old that has already borne a calf. **Heifers (E)** is a female animal older than 12 months that has never borne a calf. The reason for this labelling is a significant qualitative difference in the quality of meat in the various categories.

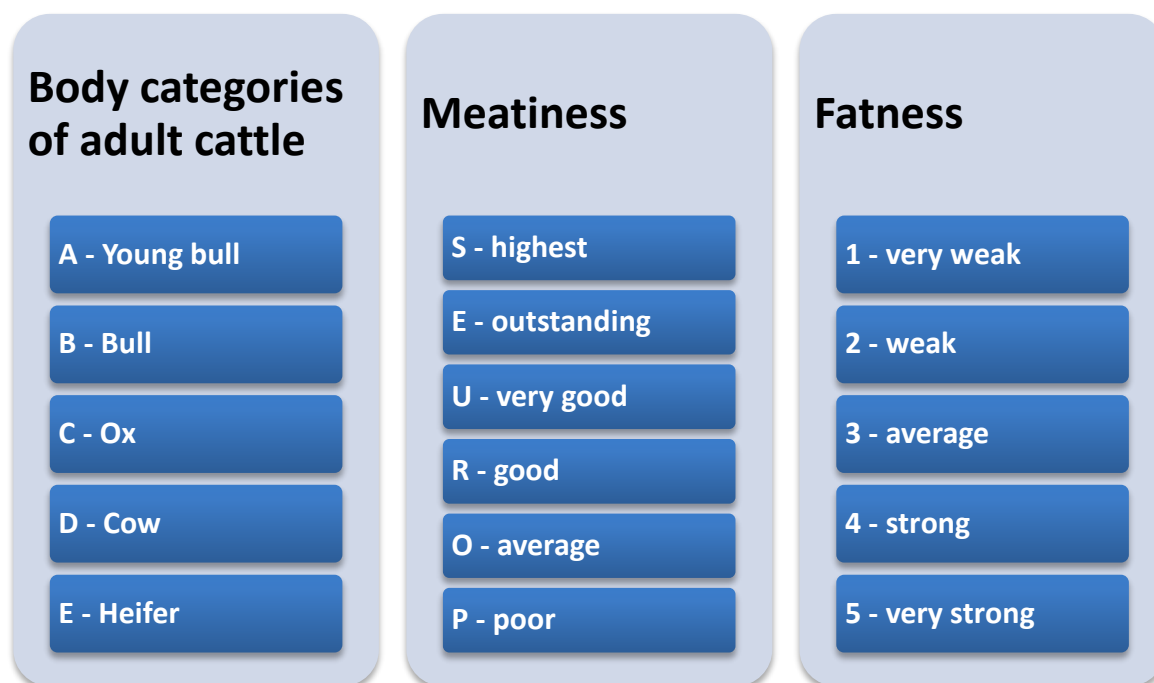


Figure 12: Classification of adult cattle according to SEUROP system.

Meatiness is defined as development of carcass profiles, in particular the essential parts, such as leg, back, and shoulder. The top meatiness (S) includes a profile that is extremely convex (bulging) and exhibits an exceptional muscle development, double-muscled, depending on the animal breed. In contrast, at the level of bad meatiness (P) all profiles are concave to very concave, muscles are poorly developed.

Fatness is the level (amount) of fat on the outside of the carcass and inside the thoracic cavity. It ranges from very weak (1) to very strong (5).

The resulting quality grade is the combination of letters of categories for body, meatiness, and fatness. For example, EU2, dressed weight is calculated from the weight of hot carcass weighed no later than one hour after *blood draining puncture*, with two per cent subtracted for cooling. The dressed weight is given in kilograms on one decimal place. For beef of animals twelve months or younger we use the trade name *beef from young cattle (Z)* or *veal (V)*.

Categories in Regulation (EC) no. 1234/2007 include:

- **Category V:** cattle aged eight months or younger,
- **Category Z:** cattle aged more than eight but not more than twelve months.

Trade name for meat of 12-months-old or younger cattle and its abbreviation letters V and Z has no connection with the classification of adult cattle carcasses and the letters are not recorded in the classification protocols. For classification of animals younger than 12 months and weighing over 300 kg, in the classification protocol, we will indicate the animal gender (A - young bull, C - ox, E - heifers), the class of meatiness and fatness. At the same time, each carcass half, quarter, or wrapped boneless piece of meat will bear the trade name *beef from young cattle*, which can also be indicated by the abbreviation "Z".

5.6.2. Monetisation of pigs

In pigs, the presence and level of fat in the body is scientifically validated by numerous scientific studies. Therefore, it is possible thanks to the attributes and characteristics of the pig carcass quality to use the methods by which we can measure the amount of muscle tissue. Specific method is tested and then approved if in a sufficient number of pig carcass satisfactory results are achieved that are comparable to the control method (dissection). Statistically proven permitted assessment methods are based on the comparison (correlation) of meat levels (muscle thickness - M) and fat (lard thickness - S) and are measured mostly by physical methods at the site of carcass. Lean meat percentage is then the resulting data from the instrument given by the regression equations in the evaluation program.

The methods can be divided according to different criteria, such as whether they penetrate or not into tissues:

- **Invasive:** penetrate tissues (greater health risk), are based on different levels of conductivity of muscle and fat, they include various puncture probes, such as *Fat-O-Meater - FOM, Hennessy Grading Probe - HGP 4, and Needle IS-D-15*).
- **Non-invasive:** do not penetrate into tissues (smaller health risks). Measurements use ultrasound such as *ULTRA-FOM 300, Ultra-sound IS-D-05*, and tables, such as *ZP - Zwei-Punkte* (two-point), and the like.

Lean meat share is recorded in the protocol as a percentage to one decimal place. Data are marked on the pig carcass in a prescribed manner.

Only pigs weighing 60 to 120 kg carcass weight are classified by *SEUROPE*. Table 7 shows the class, represented by the percentage of lean meat (does not apply for classes N and T).

Table 7: Grading classification of pig carcasses by weight

Class	Lean meat (%) in carcass
S	More than 60
E	55 – 59.9
U	50 – 54.9
R	45 – 49.9
O	40 – 44.9
P	Less than 40
N	Carcass up to 59.9 kg.
T	Carcass more than 120 kg.

This classification does apply to sows, boars, and cryptorchids, who served for breeding purposes, or to any slaughterhouse operator, who slaughters an annual average of no more than 100 pigs per week. Neither it applies to pigs born and fattened in their own breeding establishments or those companies who cut all their carcasses, or slaughter pigs, that at the request of the applicant are slaughtered only for their own consumption.

5.6.3. Monetisation of sheep

Sheep carcasses are evaluated in a similar way as the carcasses of cattle. Here again, we carry out a visual assessment. Through combinations of body categories, meatiness, and possibly

other parameters, we determine the quality class. Nevertheless, there are a few odds and ends to mention.

Categories of sheep carcasses are divided by age:

- *Carcasses of lambs*, which are animals younger than twelve months,
- *Carcasses of other sheep*.

EU member countries were allowed, for lambs with a carcass weight less than 13 kg for classification purposes to use the following criteria:

- *Carcass weight*,
- *Colour of meat*,
- *Fatness*.

Carcasses and halves of carcasses of sheep are presented without head, feet, tail, udder, the genitalia, the liver, and innards. Kidneys and kidney fat are part of the carcass.

5.7. Meat cuts

Meat cutting is a qualitative dissection of a carcass into smaller parts corresponding with certain anatomical muscle groups. It takes into account the following objectives:

- **Cutting** the carcass into smaller parts,
- **Removal** of inedible parts (increasing the yield of raw material),
- **Sorting** into like parts by value (financial, nutritional, culinary),
- **Improving** the handling and storage (refrigeration, freezing) of the raw material,
- **Preparation** of raw material for meat production or sale of cuts.

There are different types of meat cuts by purpose, such as for cuts, meat production, and long-term storage. There are also different types of meat cuts by region, such as **Czech Cut**, **Belgian Cut**, **American Cut**, **Argentine Cut**, and so on. Figures 13 and 14 show cuts based on practices in a given area.

Meat packing facility is a place to debone, cut up, and pack meat, while a **Game-processing facility** is a place which prepares venison for marketing.

In slaughterhouses, carcasses of domestic ungulates may be cut into halves or quarters, and half-carcasses into no more than three wholesale cuts. Further cutting and deboning must be carried out in a separate facility, such as meat cutting plant or packaging plant. This phase is carried out under specified conditions, in accordance with hygiene rules (Regulations 852 and 853/2004).

During the cutting, deboning, trimming, slicing, dicing, wrapping, and packaging the temperature of meat is kept low - maximum 3°C for offal and 7°C for other meat - using an ambient temperature of 12°C or an alternative system with the same effect.

5.7.1. Beef cuts

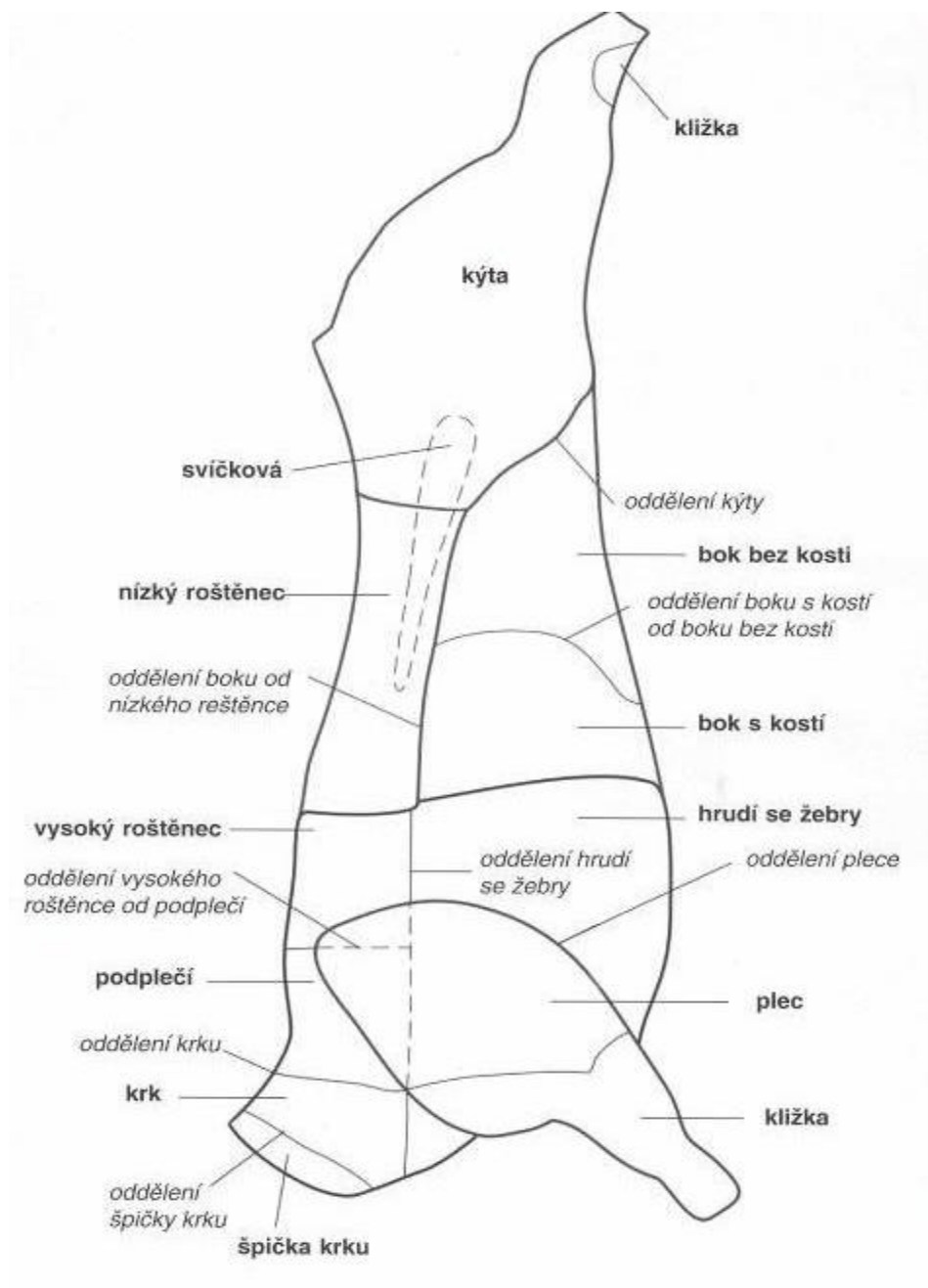
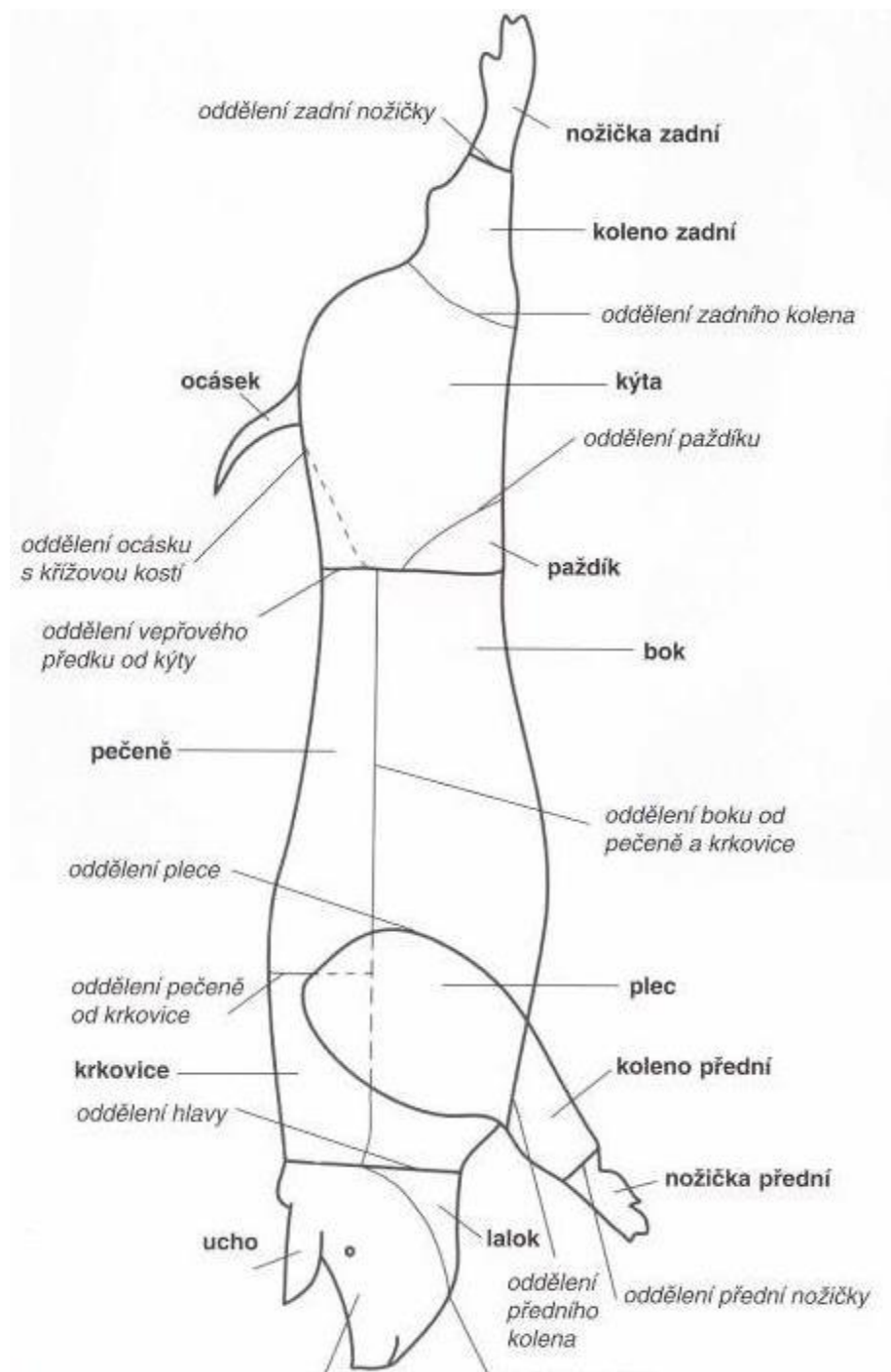


Figure 13: Czech beef cuts (ČSZM, Catalogue VVM, 2004).

Kýta - ham, kliška - shank, svičková - tenderloin, nízký roštěnec- sirloin, bok bez kostí - flank without bones, bok s kostí - flank with bones, vysoký roštěnec - rib eye, podplečí - chuck, krk - neck, hrudí se žebry - thick and thin rib, plec - brisket, špička krku - neck end, oddělení – separation.

According to the ČSN 57 6510 norm, cattle carcass is divided into ham, shank, tenderloin, sirloin, flank without bone, flank with bone, chuck, neck, neck end, brisket, ribs, shoulder, shin, neck end.

5.7.2. Pork cuts



hlava oddělení krku

Figure 14: Czech pork cuts (ČSZM, Catalogue VVM, 2004).

Ocásek – tail, pečeně – loin, krkovice - spare ribs, ucho - ear, lalok – cheek, nožička přední - front leg, koleno přední - front hock, plec – shoulder, bok – flank, paždík – side, kýta – ham, koleno zadní - hind hock, nožička zadní - hind leg, hlava – head, oddělení krku – separation of neck.

According to the ČSN 57 6540 norm the pig carcass was divided into front and rear feet, front and rear knees, thigh, flank, tail, loin, hips, shoulders, spare ribs, cheek, head and ear.

In modern butcher and culinary terminology, we can find the names for smaller parts of the aforementioned cuts such as *ořech*, *falešná svíčková*, *karabáček*, *veverka*, *kavalírka*, *husička*, *váleček*, which cannot be translated to English. Currently, gastronomy uses many parts of meat directly from foreign languages, which have become the names of food, such as *rump steak*, *rib eye steak*, *sirloin*, *fillet*, *fillet mignon*, *chateaubriand*, and so on.

Head of cattle is a veterinary problem. It is separated from the carcass as the skull and brain are considered to be so-called specified risk material, which is designed for disposal, due to measures against *Mad Cow Disease (BSE)*. However, it is still possible to obtain the so-called cheeks which are used in gastronomy. If the veterinary inspection at the slaughterhouse found the carcass to be healthy and assessed it as edible without restrictions, it is possible to extract the fleshy part of the face from the head in an appropriate manner. Only the spinal cord of brain must not get into contact with meat. Therefore, after the separation of the head, we must plug the occipital hole and the hole from the entrance wound due to stunner in the frontal bone. This prevents the possibility of contamination of the worktable by cerebrospinal fluid. Obtaining the cheeks can also be done in the so-called hanging position, when cutting does not take place on the table, but the head is hung on a hook (State Veterinary Administration of CR).

5.7.3. Meat cuts for meat processing

Meat production processes currently more than 50 % of meat from slaughterhouses as products from whole or minced meat. Production of mainly minced products requires well-trimmed pork and beef of standardized quality that is categorized according to the composition, without inedible or poor quality parts and parts prepared for a specific recipe.

Beef was formerly divided by the norm into hind beef (*HZV*) and front production meat (*HPV*). *HZV* was the hind (not to be confused with the term hindquarters) meat from young animals after removal of solid and inedible parts, stamps, and excess fat. It is made up of fine-minced mass added to meat products, such as sausages and beef ham. If it was necessary to use top quality raw materials, such as for hard salami, there was a special category designated HSO. This was mainly meat from hams, including *karabáček* (part of ham), shoulders, and possibly strip steak and sirloin (almost always for cuts), without *husička* (part of shoulder) and shanks (*HPV*). It made up filling (finely minced) into high-quality products. Table 8 shows the current classification system according to analytically determined values, including fat, *ČSB*, and others.

Table 8: Production Beef (ČSZM, Catalogue VVM, 2004)

Term	Description of raw material	Typical use	Former name	Laboratory analysis of composition (%)				
				Water	Fat	Protein	Protein ligam.	ČSB
H-1	Meat from hams stripped of fat and fasciae	Beef ham, hard salami of highest quality	HSO	75	4	21	1.5	19.5
H-2	Meat stripped of hard tendons with visible fat content up to 5 %, thin fasciae permissible	Hard salami of medium class additives in medium class products	HZV	72	8	20	3	17
H-3	Meat stripped of hard tendons with visible fat content up to 10 %, beef from heads	Additives in all products	HPV	69	12	19	3.4	15.8
H-4	Fatter trimmings with visible fat content of about 15 %, with tendons	Additives in all products	HPV	64	18	18	4,5	13.5
H-5	Fat trimmings with visible fat content of about 30 %	Additives in all products	HPV	50	35	15	3.8	11.2

In the past, pork after deboning of carcasses was sorted to manufacturing standards according to **VL** (lean pork from ham and loin), **VL II** (lean pork from shoulder and neck), **VV bk** (production pork from skinless flanks, cheeks and sides, edges and meaty cuts when processing backfat), **VV sk** (production pork with skin from heads and knees, bloody cuts), pork skin (with layer of fat up to 0.5 cm soft and hard skin), raw lard (from the back). **Specially processed pork (VSO)** was meat from hams stripped of fat, intended for the production of the highest, export-quality hams. Table 9 shows the current classification system according to analytically determined values, including fat, ČSB, and others.

Professional terminology in the meat production is based on traditional names for raw materials, equipment, and technological operations. We can encounter expressions like **sekánka** (spiced minced meat), **prát** (ripened salted meat), **spojka** (fine-minced meat), **vložka** (pieces of meat and fat), **štes** (coarse-minced salted meat), **prejt** (sausage meat), **vymíchání** (mixing), **kutrování** (cutting and mincing), **mozaika** (sausage texture), **kutr** (meat cutter), **hrachovka** (part of cutter), **narážka** (sausage making tool), and others.

Table 8: Production Pork (ČSZM, Catalogue VVM, 2004)

Term	Description of raw material	Typical use	Former name	Laboratory analysis of composition (%)				
				Water	Fat	Protein	Protein ligam.	ČSB
V-1	Meat from hams without visible fat and fasciae.	Ham of highest quality	VSO	75	5	20	1	19
V-2	Lean meat from hams, lean trimmings, 5 % of visible fat, thin fasciae permissible	Added to ham salami, standard ham and quality sausages	VL-half-ham VL-special	73	8	19	2,9	16.1
V-3	Lean trimmings, higher proportion of fasciae, tendons, visible fat around 5%	Sausages, hard salami	VL	70	11	19	2,9	16.1
V-4	Lean trimming, some tendons and joint capsules, bloody trimmings, visible fat below 25 %, without skin	Fine-minced parts in minced lower-grade products	VL, VVsk	62	22	16	1.7	14.3
V-5	Firm flanks and trimmings visible fat up to 60 %, without skin.	Raw material for hard salami, higher-grade sausages	VVbk	52	40	8	1.2	6.8
V-6	Skinless lobes	Cooked production, added to soft sausages	VVbk	40	60	10	3	7
V-7	Neck meat without skin, firm lard	Hard salami	V lard bk	17	78	5	2.5	2.5
V-8	Back lard without skin	Added to minor products and hard salami	V lard bk	8	90	2	1.7	0.3
V-9	Fat trimmings from hams, shoulders, loins and neck	Added to lower grade products	VVbk	25	70	5	2.5	2.5
V-10	Soft fat from sides and flare	Cooked production, added to low-grade products	V lard bk V flare lard	40	50	10	3	7

5.8. Meat production

Meat products are processed products derived from processing of meat or from further processing of such processed products, so that the cut surface of the product no longer shows the characteristics of fresh meat.

Production of meat products originally served for preservation of meat in order to have this nutritionally valuable raw material available. People could use processed foods if it was not possible or desirable to slaughter animals. The very first processes for meat preservation was drying and possibly smoking. It has often been combined with salting. Historically, people have tried to utilize all the raw materials and thus to minimize waste, but not due to environmental or health reasons, but mainly for practical and economic ones. They later applied culinary and sensory reasons (delicatessen). Locally originated typical meat products combined principles of preservation of raw materials used for their production. Thus the first recipes were born.

After World War II, the Czechoslovak nationalized meat industry, like other centrally managed industries, was building common standards. The country built enterprises, continuous lines in the areas of carcass production, meat-packing and meat processing plants. The overhaul of technical standards from January 1, 1964, was a proclaimed effort to increase productivity, save main and auxiliary raw materials, and achieve better economic results. It has established criteria and procedures that for the next 25 years have established or modified all now well-known recipes for meat products. It was not just about the composition and quantity of basic raw materials in the meat production, but also a system for monitoring and evaluating the quality of meat products.

Table 10 shows how the meat products of that time were divided according to the catalogue of meat products into eleven groups.

The current legislation does not impose recipes. Although the legislation does not address the recipe literally, there are still requirements for basic raw materials and selected quality parameters, such as fat content, net muscle protein, and so on. The relevant commodity decree (no. 326/2001 Coll.) mandates labelling of certain products. Within the EU, some meat products are listed in the register of food quality schemes, such as *PDO, PGI, or TSG*.

Table 10: Classification of products according to technical standards

Group number	Group name	Examples of products
I.	Small meat products	Knackwurst, speckwurst, Frankfurter links, Debrecen links, fine Frankfurter links, Spiš links, Moravian bratwurst, Slovácko home-made bratwurst, mutton bratwurst, Liberec links
II.	Soft sausages	Brno sausage, garlic sausage, cabanossi, točený sausage, Slovak sausage, Prague sausage, fine sausage, Gotha sausage, huntsman sausage, ham sausage, Polish sausage, Paris sausage
III.	Long-life meat products	Common dry sausage, tourist sausage, tourist hard sausage, hunter sausage, Prešov sausage, čabajka sausage, paprika sausage, Spišská sausage
IV.	Special meat products	Teewurst, métský sausage, Gypsy roast, Debrecen roast, roasted roulade, salmon ham, bacon, Moravian smoked pork
V.	Cooked meat products	Home-made liver sausage, fine liver sausage, home groats blood sausage, home bun blood sausage, dark people's headcheese, light headcheese, Silesian headcheese, liver sausage, fine liver sausage, fine sausage, liver cheese, taliány veal sausage, Liberec sausage, cooked pork shoulder, cooked pork flanks on chilli and garlic
VI.	Baked meat products	Home-made meatloaf roast
VII.	Smoked meat raw and cooked	ham on bone and knee, boneless ham, smoked beef, smoked beef tongue, cooked smoked ham on bone, stewed ham
VIII.	Smoked bacon	Smoked bacon
IX.	Other meat products	White sausages, wine sausages, sausages for baking into dough, equine products, uhlíčky pork sausage, aspics, ox muzzle salad
X.	Meat tins/cans	Meat in own juice, hashes and pâté, ready meals
XI.	Rendered lard	Rendered lard

5.8.1. Basic raw materials in meat production

Quite logically meat is the essential ingredient in meat production. The problem may be the understanding the concept of meat in relation to meat production. Even seemingly lean muscle contains some intramuscular fat. For consumers, it is often the meat content in meat products that is one of the basic quality characteristics.

Meat for the production of meat products, as defined in the Appendix to the Decree no. 326/2001 Coll., is the meat with naturally included or connected tissue, where the total fat and connective tissue do not exceed specified values (Table 11). When mentioning the composition of meat products, declaring the proportion of meat is significant. Meat is considered a muscle, the converted amount of which is often less than the amount actually used in the production of meat. For its calculation in the product, there are legislated limits for fat and connective tissue in meat, which are different for different animal muscles.

Table 11: Maximum fat and connective tissue in meat designated as an ingredient in the production of meat products

Species	Fat content (in weight %)	Content of connective tissue (in weight %)
Meat of mammals, with exception of rabbit and pork meat and in mixtures with a predominance of mammalian meat	25	25
Pork	30	25
Poultry and rabbit meat	15	10

All meat, including minced meat and meat preparations, used to produce meat products must meet the requirements for fresh meat. Thus, the main raw material is meat sorted and prepared at a meat cutting plant, such as *H1 to H5, V1 to V10*. Besides meat, we also use water and salt. Other ingredients include spices, vegetables, such as onions and garlic. In an effort to reduce costs and separated meat, potato starch, wheat flour, and soy protein, are also added. For technological reasons, we also add the sugar, nitrites, ascorbic acid, pigments, phosphates, bacteriocins, hydrocolloids, such as carrageenan and alginates extracted from seaweed, and others.

The meat product may come without casing, such as bacon, smoked meat, and so on, or with casing. They come either as natural intestines or artificial casing. Artificial casings have a number of advantages over natural intestines and in industrial production are replacing them. If properly constructed, artificial casings

should have absent or low migration of phthalates. Their advantages include hygienic properties, easy peelability, selectable size according to our wishes, accurate calibration (exact weight), improved product appearance (shrinkage), improved strength in longitudinal and transverse directions, optional permeability for water vapour, gases, UV, and so on. Selection of the intestine with the appropriate parameters for the technological process for the production of meat products is essential, due to sensory and hygienic quality, and shelf life. Natural casings including bovine, porcine, or ovine are used for production of traditional products.

We get spices from plants with higher content of essential oils for sensory reasons. They include ***underground plant parts*** (ginger, turmeric, onion, garlic), ***bark*** (cinnamon), ***leaves or whole plants*** (bay leaf, marjoram, thyme, tarragon, sage), ***flowers*** (cloves, saffron), ***fruits*** (pepper, allspice, cumin, paprika, juniper, coriander, fennel, star anise, anise), and ***seeds and their components*** (mustard, nutmeg, and its flower). Spices are used fresh, minced, or as prepared seasoning blends.

Thanks to various food scandals presented by the media, people often accept the idea that in an effort to reduce the costs, certain meat products use inedible parts as raw materials. Food business operators must comply with regulations applied to them by the so-called ***hygiene package***. They are not just fiscal matters of the company, health requirements for the environment, and handling of raw material, but also they must ensure that for the preparation of meat products not use the following parts:

- ***Genitals*** both female and male, except testes,
- ***Urinary organs***, except kidneys and bladder,
- ***Cartilage*** of the larynx, trachea and extralobular bronchi,
- ***Eyes*** and eyelids,
- ***External auditory canals***,
- ***Horn tissue***,
- ***Head of poultry*** - except the comb and ears, the wattles and caruncle - oesophagus, crop, intestine and reproductive organs.

Diaphragm and masticatory muscles are considered as parts of the skeletal muscles for labelling meat as an ingredient in the meat product.

Meat mechanically separated (MSM) from the bones, called separate meat, does not count as the ladled share of meat. ***The MSM*** is a product we obtain by removing meat left on bones

after deboning or from poultry carcasses so that the muscle fibre structure is lost or modified. Therefore, we cannot expect that the indicated share of meat in meat products was too high. Consumers should know that, for example in soft sausages meat content is usually in the range of 20 % to 60 %. Indicating a higher value would be unlikely. Other ingredients such as fat, innards, mechanically separated meat and skins shall be listed without indicating the amount.

Except for the share of meat the maximum percentage of fat, with the exception of products consisting of one muscle, is also given.

For some *long-life* and *fermented long-life* meat products, such as *Vysočina*, *Herkules*, or *Lovecký* sausages, the decree stipulates the minimum meat content to ensure the standard of quality. The decree specifies the minimum content of *Net Muscle Protein (NMP)* that is without protein from muscles, connective tissues or of plant origin. For these products, the required minimum *NMP* content is 13 %, 14%, and 15 % respectively. At the same time, the maximum fat content must not exceed the specified limit.

In long-life goods, we cannot give the meat content using the above procedure that is the percentage of meat at the time of manufacture. This is because during maturing and drying, the product loses a considerable portion of water. The quantity of the ingredients at the time of production is higher than the weight of the finished product. Therefore, for these products, we indicate the quantity of meat used per 100 g of product, for example per 100 g of product, 134 g of meat was used.

5.8.2. Types of meat products according to Decree

According to Decree 326/2001 Coll. in the current version, meat products are divided into the following groups:

- ***Heat-treated meat product*** – is a product, all parts of which have undergone thermal treatment, corresponding at least to temperature 70°C for 10 minutes,
- ***Heat-untreated meat product*** – is a product intended for direct consumption without further treatment, for which neither the raw material nor the final product have undergone thermal treatment.
- ***Long-life heat-treated meat product*** – is a product all parts of which have undergone thermal treatment, corresponding at least to temperature 70°C for 10 minutes. Due to the

subsequent technological processing, such as aging, smoking, or drying under defined conditions, there was a decrease in water activity with a_w (max) = 0.93, leading to extending the minimum shelf life to 21 days at a storage temperature of 20°C,

- ***Long-life fermented meat product*** – is a heat-untreated product intended for direct consumption, in which in the course of fermentation, aging, drying, or smoking under defined conditions, there was a decrease in water activity value a_w (max) = 0.93, leading to extending the minimum shelf life to 21 days at a storage temperature of 20°C,
- ***Kitchen-ready meat preparation*** – is a partially cooked meat or prepared meat mixture, additives, other ingredients, and flavourings, designed for thermal kitchen preparation,
- ***Canned food*** – is a sterilized product hermetically sealed in a container,
- ***Preserve*** – is a pasteurized product hermetically sealed in packaging.

5.8.3. Technological stages of meat production

We divide meat products by type of production into whole-muscle (solid) and minced. Whole-muscle products are made of solid unminced raw materials, so in the cut its raw material base is obvious. Smoked meats and bacon are produced without packaging. Others may come in a textile mesh (roll) or collagen foils.

Modern industrial meat production is a continuous process with minimum downtime, using machines designed to maximize the amount of processed raw materials with the lowest need for employees. This makes the product competitive and can be sold to the greatest number of consumers. Traditional products and specialties, produced in small quantities in higher labour-intensive process are sold for higher price to consumers, which is offset by the higher added value.

5.8.3.1. Whole-muscle meat products

The basic ingredient for whole-muscle meat products is table salt (NaCl). Salt application can be dry, by immersing pieces of meat in brine, or injecting it directly into the meat by brine injectors. This is followed by a few tens of minutes lasting vacuum tumbling in tumblers at very low temperatures (6°C) for microbiological reasons. The raw material rests in cold storage until the next day, when it is packed in technological packages. Forms filled foil are filled and sealed, and then the product is heat-processed by cooking.

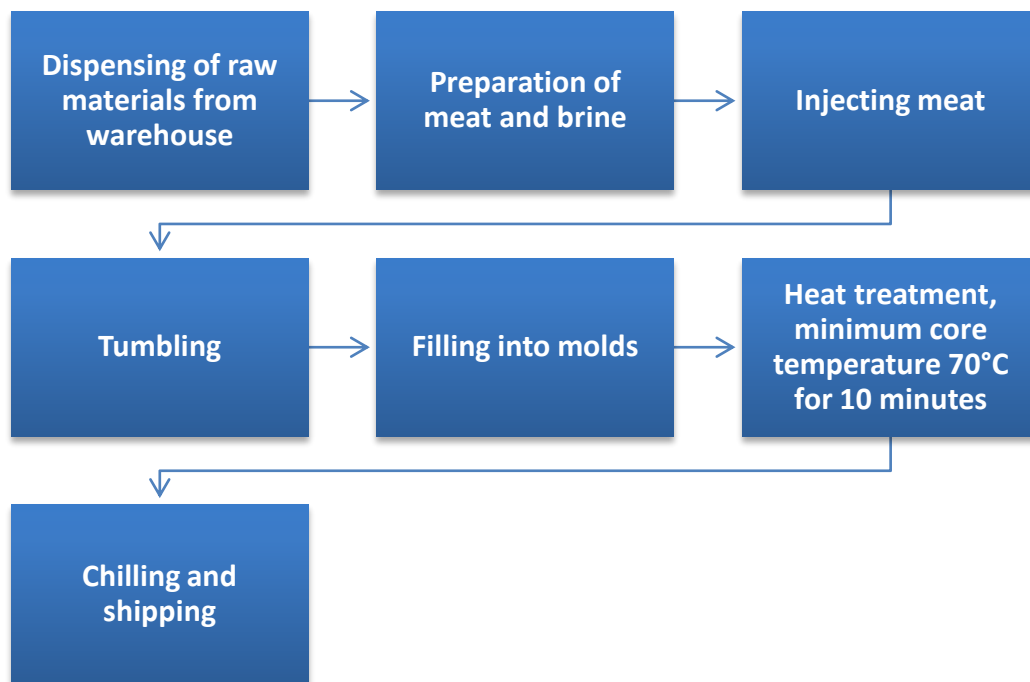


Figure 15: General diagram of production of whole-muscle meat products.

5.8.3.2. Minced meat products

These meat products have a disrupted muscle structure. Their cross section (mosaic) reflects the production method and the degree of mincing.

The first phase of production of minced meat products is dispensing and preparing of ingredients according to the recipe, weighing, slicing and possibly fine or coarse pre-cutting. For mincing or slicing of meat, industrial production uses powerful cutters, with various holes in the plate and blade, running mincers, or dicers.

The devices for meat production of products with a fine texture are often combined. Spiced minced meat or *works* is mixed in mixers or cutters. When using a cutter, mincing and mixing can be carried out in one device in several consecutive stages. The first phase is preparing the finely minced *binder* at high speed with the addition of ice (for cooling the works), salt and spices, and then adding the meat (lean or fat), which make up the *supplement* (for mosaic, product texture). Cutters use often vacuum, to ensure the fineness of the works. If the stirred works are not poured into melds, we can use powerful vacuum fillers, which are devices extruding meat product into the casing. We can adjust it to different speeds of filling. We use different tubes, on which an intestine of a certain size is pulled over, which gives the final diameter or shape of the meat product. Intestines must be soaked and rinsed before use. It is possible to adjust the filling machine for the amount of the works for one piece of product, or for links and sausages provide automatic winding of the packaging intestine. We tie the end of the product with string or metal clip. The products are then hung on poles, which are placed on smoking trolleys.

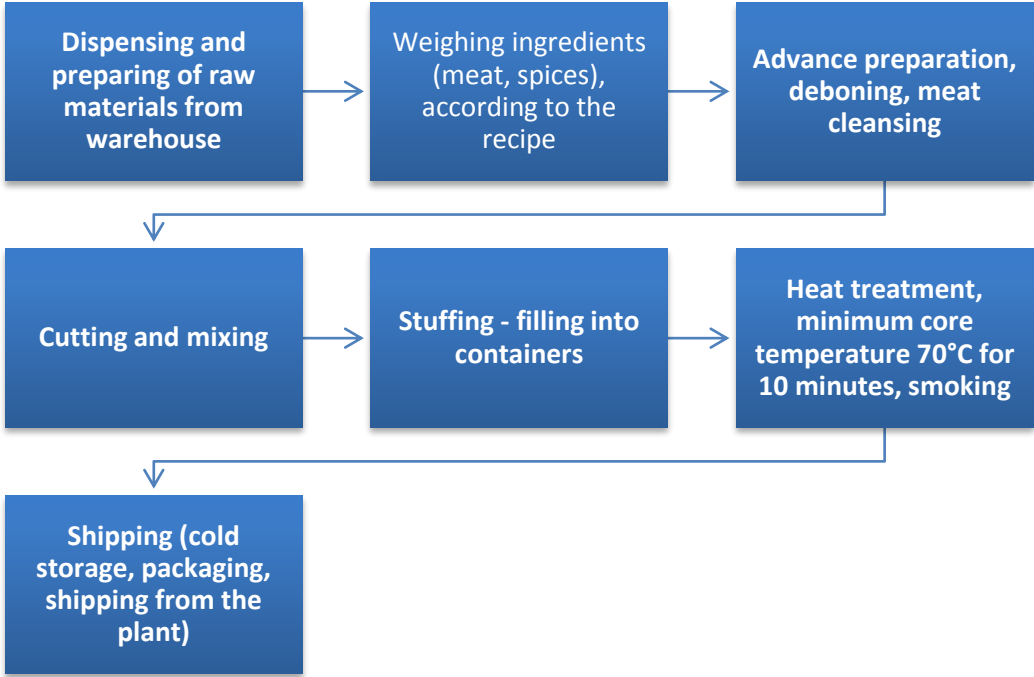


Figure 16: General diagram of production of minced meat products.

Heat treatment takes place in facilities that also allow smoking (*ventricular smokehouse*) or it is possible to use convectomats oven or cooking boilers. For minced meat products we most often encounter smokehouses, which produce smoke from wood chips, or liquid smoke, which is less polluting through controlled content of hazardous substances.

Heat treatment is necessary as it destroys vegetative forms of microorganisms and is an essential element to ensure safety within the framework of the *HACCP system*. Smoke that

develops during smoking can ensure preservation and plays an important role in the development of the sensory characteristics of the product. However, smoke contains carcinogenic substances, such as benzo[a]pyrene. Nevertheless, industrial smoking produces only a fraction of these substances compared to the domestic smoking.

We use either cold smoke at 20°C (long-life fermented products), warm smoke of about 50°C to 60 ° C (smoked meat, bacon), or hot smoke at 90°C. Hot-smoke smoking is used for small meat products or for long-life heat-treated meat products. It consists of four or three stages (Figure 17) depending on whether we use meat pre-salted with nitrite salt mixture (*three-stage*), or use meats salted with nitrates or nitrites used shortly before smoking (*four-stage*).

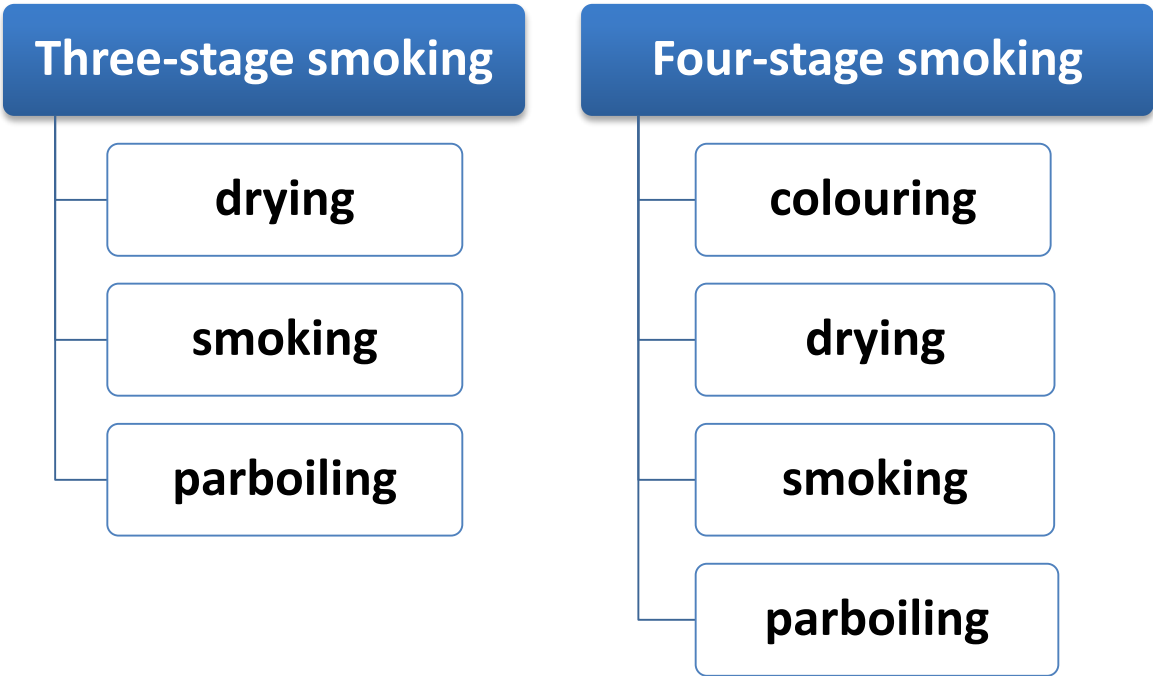


Figure 17: Phases of smoking.

5.8.3.3. Long-life meat products

Long-life meat products keep for long time, and after a long period, if properly stored, they retain and over time develop sensory characteristics. The criterion that we monitor is the water activity - a_w . In these products, the maximum value must not exceed $a_w = 0.93$, which is legislated as an important criterion, namely the threshold value for development of pathogenic microorganisms. Minimum shelf life, according to the decree is 21 days at 20°C, which is data valid for both product types listed here. *In long-life, thermally treated meat products*, such as *Vysočina*, *Turistický*, and *Selský* sausage, heat treatment plays a significant role, which again is specified as a minimum thermal effect of 70°C for 10 minutes at the core. *For long-life fermented products*, such as *Lovecký*, *Herkules*, *Poličan*, *Dunajská klobása* sausages of particular importance is aging through microorganisms added to the works, whose activities result in products, which in turn play a role in shelf life.

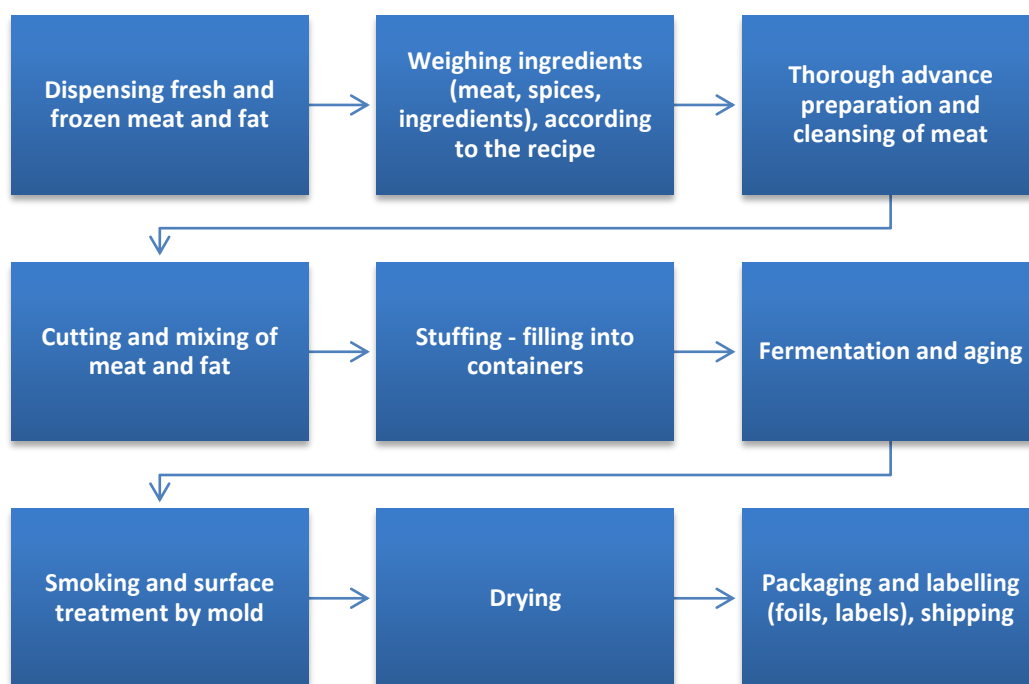


Figure 18: General diagram of production of long-life fermented meat products.

Drying is the loss of water from the meat product by placing it in a specially air-conditioned room by using efficient technology. It affects not only the shelf life, but also the sensory attributes of the product, especially hardness, colour, scent, and taste. Aging include complex biochemical processes due to the activities of microorganisms occurring already during the drying of the product. The main product of fermentation processes is mainly lactic acid,

which acidifies the product. Process control is thus possible by determining the pH of the product through pH-meters.

For long-life, especially fermented, products, it is necessary to use only high quality cured meats. It is absolutely inappropriate to cheapen the input of raw materials, such as using mechanically separated meat. Technology of production of fermented products is very demanding in terms of requirements for microbial quality of raw materials (meat) because there is no final heat treatment. Fermentation is possible, if the cultural microorganisms, we add to the works, survive. Their number (10⁷ per gram of the works) is similar to the legislative requirement for the quantity of microorganisms in yoghurts. Because they must have sufficient substrate, we add sugar to the works. Any deviation from this ideal technology may cause these processes to hinder or cease. In some cases, such as for fungal salami, we use cultural fungi that improve the sanitary and sensory quality of meat products.

The length of drying and aging in long-life meat products is between one and three weeks, for foreign products, it can be several months, such as for the Hungarian *Szegedi szalámi*. Dried hams such as the Spanish *Jamón Serrano* or the Italian *Prosciutto di Parma*, age for years.

Other groups include products that are *cooked*, such as headcheese, *baked*, such as meatloaf, as well as *canned goods* and *preserves*, such as meats in juice, pâtés, or canned links and ham.

5.8.4. Labelling of meat products

Apart from data given by the law and in special legislation for meat products, the label should include:

- **Highest fat content** in weight per cent, with the exception of products consisting of one muscle or muscle group, or with connected bones,
- **Expiry date**, except for canned and preserved meat products,
- **The use of mechanically separated meat (MSM)**, including mechanically separated poultry meat, pork or poultry skins, raw lard or raw tallow. Labelling of mechanically separated meat or poultry meat mechanically separated in the product composition shall bear the words **mechanically separated meat** or **poultry meat mechanically separated**.

Labelling of meat by animal species in name of the meat product may be used, if it contains meat product more than 50 % by weight of the said mass of the total content of the meat. This requirement does not apply to products listed in appendix of the implementing regulations.

Ham made of meat other than pork must be labelled with the name of animal species and parts of the carcass from which it comes. If a meat product uses the name **ham**, it must meet the requirements of the decree, which stipulates what must be added to the product, and must also be labelled with class quality, such as **standard ham**, **choice**, or **highest quality**.

We designate meat products by the name of type and group. The names of meat products, which are listed in the appendix of the implementing decree, specify requirements for composition, sensory requirements, as well as chemical and physical characteristics. They cannot be used for other products that do not meet these requirements in any derived form, including diminutives and various attributes that could mislead consumers. Czech examples would be **šunčička** for šunka (ham), or **Vysočinka** for **Vysočina** sausage, and so on. Efforts by the manufacturer or retailer to offer consumers food that does not directly violate this rule is often difficult to prove the use of non-traditional names such as to mislead the consumer. On the contrary, it should be a signal to the consumer that the product label has been distorted only because of modified recipe. Czech examples would include **buřtík**, **opékáček**, and **vřchovinka**. Yet the overall quality would be different from names commonly used by manufacturers and traditionally perceived by buyers.

5.9. Evaluation of meat and meat product quality

In heat-treated meat products, the entire product must be heat-treated, so as to ensure adequate heat treatment of all components of the product.

For the production of meat products mentioned in the decree, one of the basic raw materials or any combination of the raw materials listed in the appendix of the decree, can be used.

Pork ham must be made of ham. The highest quality class and the choice class should use the whole-muscle ham. The standard class can use a lesser quality ham.

Canned meat products must be heat-treated in all parts of temperature, whose effects correspond to the effects of temperature 121°C, operating for at least 10 minutes.

Preserves must be heat-treated in all parts of temperature, whose effects correspond to the effects of temperature 100°C, operating for at least 10 minutes.

Meat products in technological packages are considered to be food sold in bulk.

Meat products sold in bulk, without packaging technology, which are not intended for further heat treatment before use, especially cooked or smoked meats must be before shipping placed into shipping containers with a solid bottom and protected individually or collectively by packaging which is not intended for consumers.

Sliced meat products without packaging, sold in bulk, must be sold within 24 hours after slicing.

The **FAFIA** staff knows during the control that food business operators do not need to prove the date and time of slicing to make it clear whether or not the sliced meat product was sold within 24 hours from slicing.

The inspectors can verify the decrees:

- **If the food retail operator** alone indicates to consumers the date and time of slicing on packaging material, such as bag, paper, foil, and so on, or at another location in the visual field of consumers where the food is directly offered for sale;
- **Within the existing limits** of traceability, such as using its own HACCP (critical control points) of the food retail sector, if it indicates the date and time of slicing in the documentation.

If the food retailer fails to indicate the date and time of slicing anywhere, then the inspectors cannot enforce that provision, because *date and time slicing* is not mentioned in the implementing regulations (says § 8 section 2 of the *Act no. 110/1997 Coll.* as amended).

In the text of § 15 section 1 of *Act no. 326/2001 Coll.* were inaccuracies in the wording of the second sentence. For marketing food in bulk through a direct offer to consumers, the Food Act does not specify material, such as bag, paper, and foil to be used for food, to include product information on label as specified in this Act for packaging intended for consumers.

Meat products covered with spices or other unstable surface treatment are marketed packaged or wrapped, with the exception of sale and offers for sale to consumers.

General appearance	Texture, consistency	Odour	Flavour
<ul style="list-style-type: none"> • slimy • moldy • smoke stains • damaged packaging • cavities under the cover, • unusually wrinkled, • improperly filled • irregular colouring 	<ul style="list-style-type: none"> • too soft • too firm • rubbery • crumbly • sandy • disintegrating slices • hard edge 	<ul style="list-style-type: none"> • sour • stale • dull • atypical • fishy • ammoniacal • yeasty • chemical • strongly smoky • slightly smoky 	<ul style="list-style-type: none"> • bland • unsalted • too salty • sour • bitter • mismatched spices • too spicy • little spicy • lacking typical aroma • fatty, oily • spoiled • soapy • rancid • tarry

Figure 19: Examples of sensory descriptors and selected defects in meat products.

Figure 19 is a diagram of a sensory evaluation of meat products and examples of possible defects according to the evaluation by the German DLG company (See chapter 2.2.4).

5.10. Animal by-products

After obtaining major products, everything else must be processed or disposed of safely.

Animal by-products arise mainly during the slaughter of animals for human consumption, the production of products of animal origin such as dairy products, the disposal of dead animals, and during disease control measures. We should realize that, regardless of their origin, they pose a potential risk to human and animal health as well as to the environment. Many animal by-products are commonly used in other industries, such as the pharmaceutical, feed and leather industries. They represent a valuable resource for them and for the sake of sustainable development, it is economically desirable to use everything derived from agriculture, and what one considers so-called waste. However this does not involve pet animals. We raise these animals for purposes other than farming, for example as pets. Such products have a significant potential for infection.

Animal by-products in accordance with the lists laid down by the relevant regulation of the EP and R (1069/2009) are classified into specific categories which reflect the level of risk to human and animal health.

Category 1 material includes all bodies and all body parts of animals:

- *Suspicious* or killed in connection with *transmissible spongiform encephalopathy (TSE)*, known in cattle as *bovine spongiform encephalopathy (BSE)*,
- *Other than farmed and wild animals*, especially pets and animals kept in zoos and circuses,
- *Used for experiments* for scientific purposes, posing a risk to humans or animals,
- *Wild animals*, suspected of being infected with diseases communicable to humans or animals, and also:
- *Specified risk material (SRM)* and the bodies of dead animals or their parts containing SRM,
- *Animal by-products* of animals that have been subjected to illegal treatment containing residues of other substances and environmental contaminants at levels exceeding limits or violate specific regulations,

- *Catering waste* generated in the transport operating internationally,
- *Mixtures of Category 1* material with other materials.

Category 2 material includes for example:

- *Manure*, non-mineralized guano and digestive tract content,
- *Animal by-products* collected during the treatment of sewage,
- *Products of animal origin*, which were due to the presence of foreign bodies in those products declared unfit for human consumption,
- *Animals and their parts*, if they died other than by slaughter, or animals killed for disease control purposes,
- *Dead poultry* in the egg.

Category 3 material includes, for example:

- *Carcasses of farm animals* or animals and their parts, although suitable for human consumption but for commercial reasons are not intended for human consumption,
- *Heads of poultry*;
- *Hides and skins*, hooves, feathers, wool, horns, hair and fur originating from dead animals that did not show any signs of contagious disease,
- *One-day-old chicks* killed for commercial reasons,
- *Waste from catering facilities*,
- *Refuse products* of animal origin or foodstuffs containing products of animal origin for that for commercial reasons or due to problems of manufacturing, packaging or other defects, from which there is no risk to public or animal health, but are no longer intended for human consumption.

The materials shall be disposed of safely as waste most frequently directly, or after processing, by burning or talcum sterilization, according to specific conditions and with different constraints. We can bury some products, in an authorized landfill or compost them, or convert them into biogas or use them as fuel for energetic purposes.

5.11. Questions and assignments

- a. Explain the term meat and give an example of domestic ungulates and large wild game.
- b. What is the difference between fresh meat, minced meat, and mechanically separated meat?
- c. Which countries or regions are typical in the production of beef, pork, or poultry?
- d. Which country is the EU's largest producer of pork?
Which country has the EU's largest meat consumption?
- e. What is collagen, what is its significance?
- f. Explain the abbreviations PSE and DFD?
Which animals are susceptible to them?
- g. Which gases are used for stunning an animal for slaughter?
- h. When can an animal be slaughtered without stunning?
- i. What is SEUROP?
What is the significance?
- j. Find out what is kavalírka, karabáček, váleček, veverka, falešná svíčková a husička.
- k. Which cuts are suitable for culinary preparation of goulash?
- l. Name fifteen meat products and divide them into groups according to the Decree no. 326/2001 Coll. in the current version.
- m. In five EU countries of your choice, indicate typical meat product that is produced there.
- n. Which sensory attributes (descriptors) are evaluated in meat products?
- o. Name the ten defects meat products.

6. PROCESSING AND EVALUATION OF POULTRY QUALITY

6.1. Production, consumption, and the importance of poultry meat

In 2013, according to estimates, each inhabitant of the Czech Republic consumed on average less than 80 kg of meat, of which 22.7 kg was poultry. For pork, with 41.6 kg per year, it is the second most popular meat in the country. After joining the EU, the Czech Republic ceased to be self-sufficient in poultry production. Every third chicken on the Czech market is imported, especially from *Poland, Slovakia, and Germany*. The advantages of poultry meat are:

- *Low price,*
- *Relative food safety,*
- *Ease and speed of preparation,*
- *Excellent nutritional properties,*
- *Flexibility* of supply and demand due to fast fattening,
- *Acceptable* to most religions.

Current consumer trends include the increase in consumption of fresh versus frozen poultry, increasing share of separated poultry meat cuts compared to the whole bird, increased interest in higher finalization and increasing variety depending on season and holidays.

6.2. Poultry processing technology

Actual slaughtering is done in specialized facilities that fulfil all the approved veterinary rules for the approval of food plants, poultry slaughterhouses, and related or downstream ventures. The operation of slaughtering poultry is divided into several sections, which are represented by continuous lines and an array of individual machinery. It is a series of devices which in various stages of processing poultry passes to the following sections.

Slaughter comprises the following technological lines:

- *Slaughter line,*
- *Evisceration line,*
- *Cooling line,*
- *Cutting line,*
- *Packaging line.*

Separation of technological lines is also important for hygiene, because it allows a gradual increase of sanitary requirements throughout the entire process of slaughtering poultry and separation of clean and unclean parts of the operation.

The production process must be assessed by manufacturing diagram and verified within the manufacturing facility. We must identify individual steps in the production, which can be a source of biological, chemical, or physical hazards. Specific danger for processing of poultry meat, which might not be obvious from the flow chart is cross-contamination.

6.2.1. Purchase and transport of poultry, preparation for slaughter

The reception area for slaughter poultry and poultry assessment must be clean and disinfected. Loading, transport, unloading, and stunning of poultry must be carried out so that the animals do not get injured or stressed, which could affect their health and wellbeing, as well as animal product safety. In the event of a dangerous infection, we must implement measures to prevent the spread and to control this dangerous disease. Each processing enterprise must develop a contingency plan for dealing with diseases.

Purchase of poultry is coordinated so as to ensure continuity and follow-up treatment without warehousing chickens. Weight of poultry is determined by the difference in weight of full and empty vehicles. Other possibilities include weighing of shipping crates or using weighing scales on the line. When accepting the animals in the slaughterhouse, we check the number of heads, their weight and age according to shipping documents and medical condition with a health certificate. Contracts with suppliers usually include schedule about arrivals and slaughter of poultry, as well as the establishment of quality parameters related to consistency of weight, average weight, and age of poultry. We judge not only age but also the ossification of sternum. In waterfowl, we judge feather maturity, and use deductions for wet feathers of waterfowl and fed animal weight.

During transport, there must not be any possibility of contamination from droppings from the upper floor crates. After the transport of poultry to slaughter the vehicle and empty crates must be cleaned and disinfected in an unclean operation area in designated locations. In winter, when the temperature drops below 1°C it is the duty of drivers to use a protective tarp during transport. In the summer when the temperature rises above 25°C, we reduce the maximum number of animals in the containers. Containers or crates should be constructed so that the poultry's body parts, such as feet, wings, or head cannot stick out.

6.2.2. Kinds of poultry according to species and categories

Domestic fowl (*Gallus domesticus*)

- **Chicken, broiler:** bird with flexible, not ossified sternum,
- **Cock, hen:** bird with rigid, ossified sternum; suitable for broth,
- **Capon:** male fowl castrated surgically before reaching sexual maturity and slaughtered at a minimum age of 140 days. After castration, capons must be fattened for at least 77 days,
- **Poussin, coquelet:** chicken carcass weight of less than 650 g, without giblets, head and feet; chicken of 650 g to 750 g may be called **poussin** if at slaughter is not older than 28 days,
- **Young cock:** male chicken of egg-laying type with rigid but not completely ossified sternum, which can be slaughtered at earliest at the age of 90 days.

Turkeys (*Meleagris gallopavo dom.*)

- **Young turkey:** bird in which the tip of the sternum is flexible, but not ossified,
- **Turkey:** bird with rigid, ossified sternum.

Ducks: (*Anas platyrhynchos dom.*, *Cairina muschata*), Mulard duck hybrids (*Cairina muschata x Anas platyrhynchos*):

- **Young duck or duckling,** young Muscovy duck, young Mulard duck: bird in which the tip of the sternum is flexible and not ossified,
- **Duck, Muscovy duck, Mulard duck hybrid:** bird in which the tip of the sternum is rigid, ossified;

Geese (*Anser anser dom.*).

- **Young goose or gosling:** Bird, in which the tip of the sternum is flexible, not ossified. The fat layer all over the carcass is thin to moderate. The fat of the young goose may have a colour variance reflecting a special diet,
- **Goose:** bird with rigid, ossified tip of the sternum. The whole carcass is covered by a moderate to thick fat layer.

Guinea fowl (*Numida meleagris domesticus*)

- **Young guinea fowl:** bird in which the tip of the sternum is flexible, not ossified,
- **Guinea fowl:** bird with rigid, ossified tip of the sternum.

Variants of the above terms relating to sex shall be regarded as equivalent.

6.2.3. Hanging of poultry

Hanging of live poultry remains a laborious manual act that must be carried out in separate indoor space, equipped with fans. Poultry is hung by both feet on one or two adjacent hooks. Inappropriate hanging may result in bruising and fractures.

6.2.4. Stunning of poultry

Stunning and bleeding must be carried out separately from scalding and plucking. All connections between slaughtering space and space for steaming and plucking, except for a small hole intended only for the passage of poultry for slaughter must be fitted with automatic closing doors. Stunning of poultry is required by law for protection of animals against abuse, but it does not apply for domestic slaughter. In practice, it is performed by electrical stunning or stunning gases. Electrical stunning uses different amounts of voltage depending on technology. The most commonly used is continuous electrical stunning, when the amount of electrical voltage is adjusted according to the type of poultry, its size, and line speed. For poussins, the current we use is 120 mA, for chickens 90 mA, for turkeys 150 mA, and for waterfowl 130 mA. In other countries, they use DC current at 90 V, or AC current at 35 V to 40 V at less than 300 mA at 60 cycles/second or 14 V to 18 V at less than 300 mA at 400 cycles. Another possibility is stunning by gases, such as CO₂ or mixtures thereof. In contrast to electrical stunning, stunning by gas has the advantage of reducing damage to the body and smaller bruising on the breast muscle, femoral muscle, and other quality defects. The concentration of CO₂ stunning gas increases with the depth of the tunnel. At the beginning the concentration ranges from 5 % to 10 % CO₂ and at the bottom of the tunnel, the concentration is up to 50 % CO₂. Argon is used because of its higher density compared with oxygen, which it displaces from the space. The company must regularly check the correct setting of the stunner and correct stunning of poultry. The most common defects arising during stunning are fractures of the sternum for electrical stunning and fracture of wings in stunning by gases.

6.2.5. Bleeding of poultry

Bleeding is done by an automated killing machine which severs the carotid artery and a vein. The length of stunning after bleeding depends on the type of stunning. In case of mechanical stunning, it is within 60 seconds, for electrical stunning, it is within 20 seconds, and for gas stunning within 30 seconds. Bleeding is carried out over bleeding trough or bleeding box. About 80 % of blood is removed from the bodies during the first 40 seconds of bleeding. However, total bleeding for poussins and hens takes a minimum of 2.5 minutes, 3 minutes for ducks, and up to 4 minutes for geese and turkeys. Bad bled bodies are inedible. Quality assessment of bleeding is done visually, pulling the wings from the body, by assessing skin colour of the tips of wings, and areas under thighs. Inedible meat and by-products after slaughter must be promptly removed.

6.2.6. Scalding and plucking

Scalding is carried out to facilitate removal of feathers, due to the coagulation of the feather follicle through temperature treatment. It is carried out in continuous scalding tubs with hot water. The water supply must be in the upstream direction against the advancing poultry so that scalded poultry are exiting the tub at the inlet of hot, clean water. The temperature and duration of poultry scalding varies according to the kind of poultry and ranges from 52 to 65°C for 60 to 180 seconds. When the duration of scalding is too long, it may cause yellow spots on the skin. High scalding temperature causes damage of colour and skin integrity and may even cause shortening muscle fibres. Plucking uses continuous plucking machines that use rotating rubber fingers of various designs mounted on cylinders or disks. Hot water continuously removes feathers. It is necessary to regularly check the condition of the fingers and their regular replacement due to mechanical breaching, which leads to accumulation of dirt and microorganisms. When plucking of waterfowl, we include an additional operation of waxing to remove residual immature plumage. Waxing must be done immediately after plucking by dipping or spraying the poultry using a mixture of paraffin, ceresin, and rosin.

6.2.7. Gutting

Gutting is done on a different line than the slaughtering and surface treatment, in the so-called clean part of the facility. Before gutting, poultry must be completely devoid of feathers and wax and must be thoroughly showered. After the removal of heads and feet, hanging of carcass, release

of cloaca, the release of innards is carried out by gutting machines. After removing the guts, health inspection follows. Inedible poultry is immediately removed from the line and deposited in special containers designed for this purpose. The most frequent causes of confiscation of the entire body, for technological reasons include pollution during the slaughtering, incomplete bleeding, over-scalding and tearing of skin, as well as delayed gutting. The next step is separation of heart and liver, as well as separation of stomach and intestines. Intestines are washed away into the separator of intestines while stomach continues to the next processing. The stomach lining is removed on specially designed devices called chicken stomach processing machines with counter-rotating threaded routers. The final gutting operation includes removal of the gizzard, vacuuming of lungs, trachea, and residues of body fluids, pressure washing of the inside and outside of the poultry, and machine re-hanging. Giblets must be chilled to a temperature of maximum 3°C, the poultry carcass to a temperature below 4°C in the core of material. When the body is soiled by the content of the digestive tract, it must be removed immediately from the line to special containers designed for this purpose and must be labelled. Poultry carcasses must be specified in the following forms: with giblets, without giblets and partially eviscerated. These are carcasses, where the heart, liver, lungs, gizzard, crop, and kidneys were not removed, but are without intestines, and are tied.

6.2.8. Chilling

Chilling carcasses of poultry is carried out in various ways so that the temperature of raw material in the core is maximum 4°C. The best way in terms of hygiene is cooling by air, which is carried out in tunnels or chambers. In this cooling method, there is no contact between carcasses. The temperature of the cooling air is just above freezing, the air velocity is 2 to 3 m/s, while relative humidity should be 85 %. In this chilling method, it is necessary to set the scalding temperature to avoid the colour changes of the skin. Another way is air chilling combined with spraying of water mist. In this method, there is no contact between carcasses and no loss due to desiccation, but water absorption may take place. However, it can be a source of the spread of bacteria via emerging aerosols. A third way is the cooling by water in tanks with counter-flow of water. It is hygienically unsuitable, as carcasses touch each other and water absorption increases. After chilling, carcasses may be deprived of water on a drip line. Poultry chilled by water cannot be sold as chilled, but only as frozen.

Sorting is carried out after proper chilling, and takes place in areas with temperature of maximum 12°C, and this area should be separated from other workplaces. Sorting is done into

two marketable quality grades and raw material to be processed in meat production. Evaluation is done subjectively.

6.2.9. Weighing, packaging, and shipping of poultry

Weighing of poultry is carried out an automatic weighing system that is part of packaging line. On the line, we can choose any weight ranges of carcasses, which can be calibrated or equalized. The bird carcasses are transported on a hook conveyor onto a packaging line. Room temperature around the packaging line may be maximum 12°C. It is necessary to maintain only minimum processing time of meat. A thorough sanitizing of the area as well as the transport pallets which can be made only of plastic is vital. In warehouses packaging materials must be stored in primary or primary and secondary packaging material. The shipping temperature for meat is maximum 4°C, for giblets maximum 3°C. Delivery ramps must be provided with sleeves in order to minimize the risk of contamination, as well as penetration of heat, insects, and rodents. Consumer packaging should include the trade name and category, name and address of the producer or person who is marketing it, minimum shelf life, storage conditions, quality classification of even parts of the carcass and other information under applicable legislation. For the identification of the type of breeding, the following terms may be listed on the label:

- *Fed (with) ...% (of) ... ,*
- *Intensive type – bred in poultry farm,*
- *Free range,*
- *Traditional free range,*
- *Free range - total freedom of movement.*

6.2.10. Carving of poultry

Poultry is then further processed for packaging, production of ready-to-cook products, and for meat production. Sorting of poultry carcass cuts by groups and characteristics, such as poussin, chicken, turkey, duck, goose, or Guinea fowl:

- *Half* – cut by lengthwise incision of the carcass, through the centre of the sternum and the spine,

- **Front quarter, hind quarter** - front and rear quarter arise by cross-cutting a half,
- **Unseparated hindquarters** - both rear quarters are intact,
- **Thigh** - the hind leg including the femur, tibia and fibula, with muscles in natural context, with cuts made in the joint,
- **Upper joint** - the femur including meat tissue in natural context, cuts made at the joint,
- **Lower joint** - the tibia and fibula including meat tissue in natural context, cuts made at the joint,
- **Thigh fillet** - the entire upper or lower joint, deboned,
- **Wing** - humerus, radius, ulna, carpals, metacarpals and phalanges, including attached muscle tissues. For wings it is permissible that humerus includes meat tissue in natural context or that radius and ulna including muscle tissue in natural context are marketed separately,
- **Joined wings** - the two wings in one piece, are connected by part of the back, which can reach a maximum proportion of 45 % by weight of the part,
- **Back** - the caudal, lumbar and thoracic vertebrae with parts of the ribs and pelvic bones including meat tissue in natural context,
- **Breast** - breast bone and ribs on both sides, or parts thereof including meat tissue in natural context, cuts made at the joints,
- **Deboned breast fillet** - whole or half of the deboned breast; turkey breast fillet may include just the inner pectoral muscle,
- **Breast fillet** – includes collarbone with breastbone cartilage, including meat tissue in natural context; the clavicle and cartilage may reach a maximum of 3 % of the weight of the part,
- **Maigret** - breast fillet of ducks and geese skin with subcutaneous fat covering the breast muscle, without the deep pectoral muscle.

6.3. Quality grades of poultry

Poultry carcasses and poultry cuts fall into two classes. For inclusion in classes A and B poultry must meet the following requirements:

- **Intact**, taking into account the category,
- **Clean**, free of foreign matter, dirt, or blood,

- *Free from strange smell,*
- *Free of visible bloodstains* except for small and inconspicuous ones,
- *Free of protruding broken bones,*
- *Free of visible bruises.*

Fresh poultry shall display no traces of prior freezing. For the classification of poultry carcasses and cuts as *class A*, they must apart from the requirements listed above, also meet the following requirements:

- *Poultry must have* good structure and must be plump. Breast must be well developed, broad, rounded and plump; the legs shall be plump as well. In poussins, young ducks, ducklings, and turkeys, the breast, back, and thighs must be covered by thin, even layer of fat. In cocks, hens, ducks and young geese a thicker layer of fat is acceptable. In geese, a moderate to thick layer of fat must cover the entire body,
- *Breast, legs, pygostyle, leg joints and tips of the wings* may have a few small feathers, quill, or hair. Poultry intended for cooking broth, as well as ducks, turkeys and geese, may have remnants of feathers present on other parts as well,
- *Minor damage, contusions and discolouration* are permitted if they are small, inconspicuous, and not present on the breast or legs. The wing tips can be removed. Slight colouration of wings and membranes is also permitted. Frozen or quick-frozen poultry shall include no traces of freezer burns except those that are minor and inconspicuous, and are not present on the breast or legs.

6.4. Quality control in poultry processing

Quality defects in poultry may include:

- *Transport damage* - deaths caused by suffocation or overheating, pollution, stress, hypothermia as well as poor bleeding, scratches, and fractures,
- *Defects from the slaughtering line* - bad bleeding (even after chilling), shoddy scalding causing gluey skin, excessive scalding, and tearing of skin, as well as remnants of feathers, down, and fluff.

- **Defects from the gutting line** - spilling of bile or content of digestive tract, remains of inedible parts, tearing of muscle tissue, limbs, bruises, fractures, deformities,
- **Defects from the chilling line** – frost burns, humidification, imperfect chilling, residues water.

For each method of chilling, there are limits on the amount of water absorbed, which are listed in the Commission Regulation (EC) no. 1538/91, including the determination of methodologies:

- **Determination** of thaw loss (drip test).
- **Determination** of total water content in chickens (chemical test).
- **Determination** of the total water content of poultry cuts (chemical test).
- **Water absorption control** is implemented in the production facilities.

If poultry or parts thereof do not meet the limits quoted in these methods, then it must be indicated on the labels with the term **Water content exceeds EEC limit**.

6.5. Questions and assignments

- a. What is the difference between a goose and a young goose?
- b. What is waxing?
- c. Evaluate in terms of hygiene individual chilling methods for poultry.
- d. What is the difference between upper and lower joint?
- e. What technological defects arise from inappropriate scalding of poultry?

7. PROCESSING AND EVALUATION OF EGG QUALITY

7.1. Production, consumption, and importance of eggs

The basic value of eggs is primarily biological, namely the reproduction of a given species. Eggs contain all the essential nutrients necessary for the development of new organisms. Eggs of turkeys, ducks and geese serve primarily reproductive purposes, that is as hatching eggs. In contrast, chicken and quail eggs also serve as eggs for consumption and are an important part of the human diet. We also use eggs as raw materials in various sectors of the food industry, such as in the baking industry, confectionery, production of biscuits, pasta, meat products, and so on. Even non-food industries use eggs. They include industries, such as pharmaceuticals, leather, textile, chemical, photographic, glass, human and veterinary medicine in production of vaccines, diluents for semen for insemination, and so on. Table 12 shows the egg production.

Table 12: Production and consumption of eggs in the Czech Republic [in million pieces]

Year	Production	Import	Export	Consumption
2001	3,190	45.8	60.6	3,174.2
2002	3,150	64.3	140.7	3,073.6
2003	2,626	117.0	143.0	2,600.0
2004	2,423	290.4	175.6	2,537.8
2005	2,148	409.7	165.9	2,393.8
2006	2,191	497.2	159.9	2,528.3
2007	2,203	519.4	372.1	2,350.3
2008	2,647	421.6	180.1	2,888.5
2009	2,275	527.9	146.3	2,656.6
2010	2,125	615.7	191.7	2,549.0
2011	2,168	647.5	157.5	2,658.0
2012	2,001	650.5	179.5	2,472.0
2013	2,160	614.4	255.2	2,519.2
2014*	2,100	603.2	205.2	2,498.0

**Outlook*

7.2. Sorting technology for shell eggs

7.2.1. Receiving, collection, storage, and transport of unsorted shell eggs

Shell eggs can be sorted on the farm, where there is a continuous supply of eggs from the farm directly to the egg sorting facility. Another possibility is an irregular supply of eggs, where eggs are stored at the farm before sorting, or they can be transported from farms to a sorting contractor. Unsorted eggs must not be stored in the same warehouse together with sorted eggs. In addition, they must not be stored with other food or with substances that could adversely affect the eggs through contamination or odour. They also should not be exposed to direct sunlight.

Before sorting, we should remove all broken eggs, eggs with polluted content, eggs contaminated by blood or faeces, as well as eggs with significant defects of shells, such as eggs with poorly developed shells, or eggs without shells. If the eggs are sorted in a continuous manner, then their sorting takes place immediately on the day of laying. Technical solutions for transport of eggs from the production halls into the sorting facility shall be such as to avoid damage to eggs during their transport. For the identification of critical spots, we can use electronic eggs. Transportation can be implemented even outside the production halls outdoors without temperature control, summer and winter, due to the short duration of transport. Conveyor belts that collect and transport the eggs from the production halls must be cleaned regularly. They cannot be contaminated by broken eggs and their content. They shall not be dusty or covered by stuck remnants of food and faeces. In the discontinuous egg collection, it is advisable to collect eggs at least twice a day. At the same time, we should remove broken eggs, eggs strongly soiled by faeces, bedding, egg contents, or blood as well as abnormal eggs, such as eggs without shells. The collected eggs are placed with the sharp end down into suitable crates, which must be clean, dry and free from foreign odours. Paper crates are used only once. Plastic crates must be cleaned and disinfected before reusing.

Egg sorting facility should include appropriate egg-candling equipment. It can be automatic or one that is continuously staffed the entire time. This allows a separate quality control for each egg. It should also include devices for measuring the height of air bubbles, equipment for sorting eggs by weight, scales approved for weighing eggs, and egg stamping equipment. Unsorted eggs are stored in warehouses with a constant temperature, ranging from 5°C to 18°C, and relative humidity which must be between 70 % and 75 %. Manipulation of stored

eggs should be easy in order to reduce the risk of breakage. Gaps between the egg crates must allow airflow. Under no circumstances, there should be any dew on eggs as well as no water condensation on their surface. Eggs transport to the sorting facility must be implemented so that the eggs can be sorted and packed on time. Vehicles must be clean and eggs must not be exposed to external influences, such as dust, humidity, or direct sunlight.

7.2.2. Sorting of eggs

Visual inspection

Before the actual candling in the egg sorting centers, we carry out an external, visual inspection. We remove eggs that are dirty, broken or otherwise unfit for consumption, but can be used for technical purposes outside the food industry. Eggs with damaged shells, but intact eggshell membranes, eggs with deformed shell, with abnormal size shell, or slightly dirty shell, if they meet the requirements, they can be processed into food purposes, such as manufacture of egg products. Mechanical defects include small cracks and crevices on the shell, but with intact membrane, moving yolk and air bubble, which are not visible during routine inspection, but noticeable only through candling.

Biological defects include bloody ring signifying a fertilized egg with a developing fetus. During the creation of albumen a piece of the fallopian tube lining may break off and is incorporated into the albumen. This results in a defect called meat spot. Blood stain results from rupture of a follicle outside the stigma. The albumen may also include foreign bodies such stones, straw, or feathers. They have penetrated into the fallopian tube by an abnormal change of peristalsis.

Candling

Pre-sorted eggs then continue to the actual candling area. Candling takes place in a candling cubicle or a similar system, which is designed to detect internal defects of eggs. The principle of candling is a system of lamps and mirrors, which allow a thorough control of the egg content. Eggs are usually transported to the candling room by egg conveyor belt in several rows. During backlighting, we can also use other new methods, such as detecting impurities using UV light, detecting meat and blood spots by xenon lamp at a wavelength of haemoglobin, shell fractures by propagation of sound in the shell. In candled eggs, we monitor fracturing of shells. When the eggs are candled, we can clearly see even micro-fractures detected in the previous stage of sorting. Furthermore, we also observe the incidence of foreign bodies, the presence of meat and blood spots, and assessing their size. Depending on the degree and severity of the defects, eggs are discarded as waste. That can be due to the presence of rot, dead foetus, extensive blood and meat spots, larger than 3 mm, and foreign bodies, or they can be further processed into egg products.

In some countries, such as *Canada* and the *United States*, new enacted legislation as an additional quality criterion is the value of *Haugh Units (HU)*, relating to egg weight and the height of the dense albumen. Grade A extra eggs must have HU value greater than 72, grade A eggs HU between 60 and 72. Eggs with HU lower than 60 can be used to produce egg melange. In Europe, people use HU ratings so far only in business transactions.

Quality grading of eggs

Eggs are classified into classes labelled A and B. Substandard eggs without the quality characteristics of class A eggs fall into the class B. The parameters are listed in the current legislation.

Class A eggs shall have the following quality characteristics:

- a) **Shell and membrane** - clean, undamaged, normal shape,
- b) **Air bubble** - immobile, height not exceeding 6 mm; eggs marked **extra** it may not exceed 4 mm,
- c) **Yolk** - visible on candling only as a shadow, without clearly discernible outline, when turning, moves gently and returns to the centre,
- d) **Albumen** - clear, translucent,
- e) **Embryo** - imperceptible development,
- f) **Foreign matter** - not permissible,
- g) **Strange odour** - not permissible.

Class A eggs shall not be preserved or chilled on premises or plants where the temperature is artificially maintained below 5°C. Eggs can be described by an additional term **extra** or **extra fresh** on packs containing class A eggs until the ninth day after laying. The laying date and the time limit of nine days should be marked in a clear and legible manner.

Sorting of eggs by weight

In the sorting room, eggs are also sorted by weight. Grade A eggs are sorted into four weight categories - **XL, L, M, and S**:

- **XL - very large:** weight 73 g or more,
- **L - Large:** weight at least 63 g and less than 73 g,
- **M - Medium:** weight of at least 53 g and less than 63 g,
- **S - Small:** weight less than 53 g.

Number of weight classes in other countries may vary. In the United States and Canada, eggs fall into six weight groups - **Jumbo, XL, L, M, S, and Peewee**. Eggs sorted by weight can contain up to 10 % by weight of eggs from the next higher class, as indicated on the packaging, but not more than 5 % of eggs of the next lower weight.

Stamping the egg shells

Stamps on eggs must be legible and only safe dyes may be used, usually red, green, or black.

After quality and weight grading, eggs are stamped on the shell with the following code, which indicates:

a) *Breeding method*, which is described with an appropriate code:

- "1" for egg-laying hens in *free range*,
- "2" for egg-laying hens in *barns*,
- "3" for egg-laying hens in *cages*,
- "0" for egg-laying hens bred in accordance with the requirements of *organic farming*,

b) *Registration code of the country*,

c) *Four-digit alphanumeric code*, which expresses a numerical component of the registration number of the business.

7.2.3. Packaging of eggs

Egg packaging companies package eggs in small-consumer and large-consumer packages of different sizes. Eggs are always placed into containers and crates with the sharp end down, and one shipping container holds only eggs of one quality class. Fragile egg must be packaged in sufficiently rigid packaging, resistant to deformation and mechanical damage during handling and transport.

Small-consumer packages are placed on pallets or packaged in different sized containers, boxes, or cartons. Packing for eggs must be clean, dry and free of odours and must protect the eggs from damage and the effects that degrade quality. Crates and small-consumer packages (boxes), made of pressed paper, are designed for single use, while plastic and metal packaging must be cleaned and disinfected before next use. Paper packaging is a natural renewable material. They are absorbent as they absorb condensation on eggs which occurs when the temperature changes. They also absorb odours and can withstand the pressure twice greater than plastic. They are noiseless for opening and re-closing and do not have sharp edges. Packages must be stored only in designated areas to prevent damage, contamination, and dampness. Sorted and packaged eggs must be stored only in a warehouse for sorted eggs.

7.2.4. Storage of sorted eggs

At the lower storage temperature, eggs keep their quality parameters such as height of air bubbles and higher HU longer. Also changes in the eggs are slower. The most important factor for egg storage is temperature. The lower limit for the storage of eggs is specified at 5°C. The upper limit is defined for individual countries in their national legislation. In *European countries* it is set at 18°C, while in *Canada* the maximum is 13°C. Another important factor is the humidity during storage of the eggs. It cannot be higher than the dew point to prevent bedewing and subsequent molding of eggs. Minimum shelf life is set at 28 days from the date of laying. The eggs must be sold to the final consumer at the latest within 21 days from the date of laying. Japanese quail eggs in shell, suitable for human consumption or for processing, shall be kept, stored and transported in a dry place, away from direct sunlight, at a stable temperature not exceeding 18°C.

7.2.5. Quality control of shell eggs

In eggs, we can assess cleanliness, integrity and shape of the shell, surface scent and odour, immobility of air bubbles and yolk, transparency and rigidity of albumen, the visibility of yolk, the presence of foreign bodies, meat and blood stains, egg yolk colour, or development of embryo. We can also check the sensorial quality of egg content, integrity of the shell, egg weight and equilibrium, air bubble size, shape indices, stiff albumen index, egg wash proof, eggs oiling proof. Finally, we can also distinguish egg origins and determine individual components in eggs as well as microbiological parameters. Among technological properties of albumen, we can monitor whipping ability of albumen and index of the foam durability.

Sensory evaluation of egg quality

We carry out sensory evaluation of shell eggs in fresh and boiled state. Boiled eggs are evaluated after 3 minutes or 10 minutes of boiling. For shell eggs, we evaluate colour, scent, and taste. The feed affects the colour, so manufacturers try to intensify the colour of the yolk, because although it is a consumer criterion, it has no nutritional significance. The colour of the albumen should be clear with a slight yellowish or greenish tint. The scent of yolk and albumen must be typical, with no foreign substance, which may occur during storage under unfavourable conditions. Therefore eggs should be stored separately from aromatic food. The egg scent also changes during prolonged storage. The taste of eggs must be typical and pleasant. The albumen has no distinctive taste. The yolk has a pleasant, typical taste. Overall,

the diet can affect the taste of eggs. Some foods, such as linseed oil or fish meal, can negatively affect the taste of eggs.

7.3. Egg processing for egg products

The term egg products includes products obtained from eggs, their components or melange after removal of the shell and membranes, and intended for human consumption. They may be partially supplemented by other foodstuffs and additives. They may be liquid, concentrated, dried, crystallized, frozen, deep-frozen or coagulated, such as boiled eggs and long eggs.

7.3.1. Production of egg products

Pasteurized egg products are marketed in the form of liquid, chilled, frozen, dried, or flavoured (concentrated). All products must comply with microbiological criteria. They must be homogeneous, have a typical egg aroma and colour, and must not have any sensory defects, such as odour, discolouration, and consistency.

The term egg breaking includes removing egg shells, including membranes and obtaining albumen, or egg yolk content (melange). Breaking eggs is done either manually or mechanically. Breaking must take place under hygienic conditions. The temperature in the breaking premises should be as low as possible to suppress the development of microorganisms. When separating the yolk and albumen, we must make sure not to contaminate albumen with yolk, which would negatively affect the whipping ability. For fresh eggs and eggs at the beginning of laying, it is more difficult to separate albumen from yolk. This is because part of albumen always goes into the yolk, thereby decreasing its dry mass. In old eggs and eggs from the end of laying time, the yolk membrane is less rigid and the smaller amount of dry mass threatens to spill the yolk. Such eggs are not suitable for separating of yolk and albumen but are better suitable for the production of melange. Dirty eggs must be cleaned before the breaking by washing and disinfecting. Facilities for washing eggs can be part of the breaking line. For washing, we use a combination of brushing and showering. The temperature of the washing solution must be at least 11°C higher than the temperature of the eggs in order to avoid absorption of the washing solution. Washing eggs should be as short as possible as not to increase the temperature inside the eggs. After washing, eggs must be broken immediately. For manufacturing of egg contents, we can use all kinds of eggs, including sorted and unsorted by weight, fresh or refrigerated, non-standard eggs, and eggs with damaged shell and intact membranes. For manufacturing of egg products, we must not

use the eggs that are broken, dirty or unwashed, as well as seeded eggs, where the development of embryo has already begun. The manufacturer must have the equipment and system for immediate storage for eggs and egg shells or egg products unfit for human consumption. Substandard egg contents should be denatured by heating, or chemically.

For the seldom used manual breaking, we use a special knife, below which is a bowl. After the breaking of the shell egg, the egg contents fall there. We separate the albumen and yolk over the edge of the dish. During manual breaking, we must apply simultaneous sensory inspection of the egg contents. We look for biological defects, such as blood and meat spots, the presence of foreign bodies, scent, and appearance. Then then we just pour it into a larger container. We must thoroughly clean and sanitize knives after each contact with harmful egg contents. After gathering of egg contents in containers, we must rapidly transfer them for pasteurization. We should continuously remove waste and eggshells.

Machine-breaking of eggs provides higher productivity than manual breaking under better sanitation conditions. In machine breaking, eggs are initially moved from the prepared crates via a vacuum device onto the conveyor of the breaking machine towards the breaking head. Here shell breaking takes place by breaking the egg shell using a knife of the breaking machine. The shells are separated and egg contents are collected in a special bowl. The bowl has sharp edges to separate yolk from albumen. Dish with egg content is then poured into the collecting grooves. Broken egg contents are checked visually by experienced staff due to breaking speed. In the event of a defective egg, the staff must mark the bowl with such contents. They will do it by pressing the lever and pouring the defective content to be sent to a separate collector path for destruction. Immediately after use, separation bowls are washed. Egg breaking machines must be equipped with devices for removal of shells. It is forbidden to make the egg products by crushing and centrifuge processing of shells. When using eggs of species other than chickens, breaking must be carried out separately and the obtained egg products should not be mixed.

Obtained egg contents are filtered, homogenized, and collected in suitable containers where they might be mixed with additives. Transportation of egg products from collecting vessels takes place via pumps into containers equipped with cooling devices. For the preparation of egg products for pasteurization it is necessary to homogenize the egg products. This is because after breaking, it contains small fragments of shells, membranes, and chalazae, which could cause problems with the flow through the pasteurizer. Therefore, we filter the egg products by pump through a filter,

which captures impurities and also facilitates homogenization. Egg products are allowed to contain a maximum of 100 mg of shells, egg membranes, or other parts per 1 kg of egg product.

Egg products must be heat-treated immediately after breaking. If the heat treatment does not immediately follow the breaking, egg products must be chilled to a temperature lower than 4°C. Then it must be processed within 48 hours or frozen, unless the material is intended for desugaring and mass is stabilized by sugar or salt. The purpose of pasteurization is to inactivate vegetative forms of microorganisms or enzymes. During pasteurization, eggs must not lose their functional, technological properties. Pasteurization is performed in separate rooms or during breaking.

For pasteurisation, we use pasteurisers which may be stationary or flow-through. Stationary pasteurisation is done on a small scale, especially directly on farms, and by small operators. Stationary pasteurisation takes place in duplicator cauldrons. Stationary pasteurisation of egg products is carried out by stirring it at the specified temperature of the entire volume of the mass for specified time, or alternatively using combination of temperature and time to ensure a comparable effect. Because pasteurization must be carried out throughout the entire volume, the egg products must be stirred constantly, in order to facilitate heat transfer. It is very time-consuming. The flow-through pasteurisation may be carried pasteurisers of different kinds, such as tunnel, flash, or combined. Modern pasteurisers allow very short heating at high temperature. In this ultra-pasteurisation, the mass is usually preheated in a plate heat exchanger to about 55°C to 60°C, followed by a short high-temperature heating at 70°C for 90 seconds. The cooling is then carried out in a tubular heat exchanger. To prevent coagulation, we may add citrates or triethyl citrate to the egg products.

The parameters of pasteurisation depend on the structural parameters of the pasteurizer, as well as the type and physical properties of pasteurized egg products. Table 13 lists the examples of used pasteurization modes. Pasteurisers must be equipped with automatic temperature control via recording thermometer and a recorder of the flow time. Pasteurization efficiency is evaluated on the basis of microbiological analysis. For sweetened and salted egg products, we can raise the temperature, according to concentration of solids up to 70°C or higher, because sugar and salt protect proteins from denaturation. Records must be archived and monitoring of parameter values must be part of the *HACCP plan*. Pasteurisers must be designed and equipped so as to prevent insufficient heating of the egg products. This can be

done with automatic signalling which prevents mixing of pasteurized egg products with non-pasteurized or poorly heat-treated material.

Table 13: Example of pasteurization treatment in continuous and stationary pasteurisation

<i>Pasteurisation</i>	Component	Temperature [°C]	Time [min]
<i>Stationary</i>	albumen	56.0	30
	yolk	68.0	30
	melange	65.0	30
<i>Continuous</i>	albumen	57.0	180
	yolk	65.0	180
	melange	64.5	150

Pasteurisers must be equipped with sensors for measurement, inspection, and monitoring of pasteurization temperature and time. With the consent of the district veterinary administration, we can treat egg products using an alternative pasteurisation procedure, which will ensure its safety. Insufficiently heat-treated batch must immediately heat-treated again in the same company so that it is suitable for human consumption. If a batch is not suitable for human consumption, it has to be liquidated through denaturation and removed. After pasteurization of egg products, the products must be cooled immediately to maximum of 4°C, which is again part of the *HACCP plan*.

Refrigerated liquid egg products

Refrigerated liquid egg products must be stored at temperatures up to maximum 4°C, while storage temperature must be monitored with a recording thermometer. Shelf life is specific to each manufacturer according to the method of pasteurization and efficiency, as well as by their packaging and in compliance with the hygienic requirements. The normal shelf life of liquid egg products is about 10 to 21 days. Inferior products have a useful shelf life of 3 to 10 days. For aseptic packaging shelf life increases up to 3 months. Shelf life of liquid egg products can be extended through stabilization by adding organic acids and their salts.

Frozen egg products

Frozen egg products must be frozen as soon as possible after pasteurization. The freezing process must be quick in order to obtain a finely crystalline structure and to prevent degradation of performance. It is necessary to prevent the formation of crystallization nuclei around which grow large crystals that rip the structure, which has a negative impact, as it damages the colloidal properties of egg products. This phenomenon also occurs during slow freezing or temperature variations during storage. This leads to partial thawing and re-freezing of the egg products. Yolk must reach the temperature of -6°C as soon as possible to prevent gelation. The freezing medium is flowing air with a temperature of -35°C to -40°C or liquid nitrogen. The freezing rate should be at least 1 cm/h. Qualitative requirements for frozen egg products are again defined in the legislation. We can also utilize the qualitative requirements specified for liquid egg products. Frozen egg products are stored at constant temperatures in refrigerated chambers at temperatures between -12°C and -18°C . The lower the temperature, the longer the time of storage can be. Storage temperature in the cold storage must be continuously recorded via a recording thermometer, as temperature monitoring is part of a *HACCP plan*. Defrosting of egg products must be as fast as possible, but uniform due to a possible growth of micro-flora in the surface layers of the egg products. The optimal defrosting temperature of egg products is 15°C . After defrosting, the egg products may not be frozen again and must be processed immediately. Figure 24 shows a diagram for processing egg contents for refrigerated and frozen egg products.

Dehydrated egg products

Dehydrating preserves albumen, yolk, and melange, as well as their various customized modifications to improve functional properties. The advantages of dehydrated egg products is small volume, low-cost of storage and transport, availability, easy handling, easy recovery and its standardization. The principle of conservation of egg products via dehydration is based on the reduction of the water content from about 75 % to 5 % and for albumen from 88 % to 8 %. This reduces the growth of microorganisms and slows the progress of chemical reactions during storage. Egg products must be dehydrated as soon as possible after breaking and pasteurization. Frozen egg products may be dehydrated as well.

Prior to drying the albumen, and sometimes melange, are usually desugared. This process removes glucose from the albumen, which at high storage temperatures, reacts with amino groups of proteins and phosphatidylethanolamine to produce Maillard reaction. This negatively affects the final quality of the dried egg products, causing a colour change to

brown, as well as unpleasant taste and odour. Prior to desugaring the albumen, we must adjust the pH value to 7.

For desugaring, we can use either enzymes, such as catalase or microbial fermentation by bacteria or yeast, including *Torulopsis*, *Streptococcus lactis*, *Streptococcus cremoris*, or *Saccharomyces cerevisiae*. Desugaring ends when the glucose content decreases below 0.01 %. If we desugar albumen, we do not have to pasteurize it prior to dehydration. We can pasteurize it later in the dry state at temperatures between 50°C and 90°C for several hours or days, usually at 54°C for 7 days.

We carry out dehydration either in chamber dehydration facilities or most commonly in spray dryers. We can select the dehydration temperature according to the type of egg products and structural parameters of the dryer. The air temperature at the inlet is between 110°C and 215°C, while at the output, the temperature of air and the dehydrated mass is between 50°C and 70°C. The drying air must be filtered to prevent contamination by dust, dirt, and foreign bodies. After dehydration, the dried material must be cooled as quickly as possible to avoid reduction of their sensory and functional properties. Pasteurized dehydrated egg products, manufactured under approved technological procedure, are packaged chilled in suitable containers to prevent dampening and oxidation of products.

The manufacturer specifies the minimum storage life, usually between 9 and 12 months. The minimum shelf life of albumen can be even longer. Storage of dehydrated egg products is possible even at room temperature. The recommended temperature is 15°C, and the lower the storage temperature, the longer the shelf life.

Flavoured egg products

Flavoured egg products are produced in liquid, frozen, or dehydrated form. Such egg products will contain sugar or salt. Adding such materials increases the osmotic pressure, and thus the microbial stability. They can be pasteurized at higher temperatures. Shelf life of flavoured liquid products is longer than unflavoured ones in proportion to the increasing concentration of salt or sugar by up to several months.

7.3.2. Quality control of egg products

Technological properties of eggs and egg products can be evaluated by whipping ability index and the index of foam stability, which are not in legislative documents.

➤ *Whipping ability index* is the ability to form foam:

$$\text{wai} = \frac{V_2}{V_1} \cdot 100 (\%)$$

Where **V1** is the volume of albumen before whipping [ml], **V2** is the volume of albumen after whipping [ml].

➤ *Index of foam stability*:

$$\text{ifs} = \frac{V_2 - V_3}{V_1} \cdot 100 (\%)$$

Where **V1** is the volume of albumen before whipping [ml], **V2** is the volume of albumen after whipping [ml], and **V3** is the volume after standing for 30 minutes or 1 hour [ml] respectively.

In dehydrated egg products, we evaluate sensory properties, physical and chemical properties, as well as microbiological characteristics. Quality parameters for dehydrated egg products are not legally established and for orientation, we can only rely on ČSN 53 23 01 (Czech norm), whose parameters are shown in Table 14.

Table 14: Quality requirements for dehydrated egg products

Component	Moisture [%]	Fat in dry mass [min %]
Albumen	7 – 8	—
Crystalline albumen	10 – 14	—
Yolk	3.5 – 5	58.0
Melange	4 – 5	40.0

Physical and chemical properties shall be assessed according to the requirements listed in Table 15. In the production of dehydrated egg products, we judge *sensory requirements* such as colour, scent, and consistency. *Physical requirements* include the weight of the product, whipping ability, and foam stability. *Chemical requirements* include water content, per cent of fat, and per cent of free fatty acids. *Microbiological requirements* include determination of *Enterobacteriaceae*, *Salmonella*, and *Staphylococcus aureus*.

Table 15: Requirements for physical and chemical properties of dehydrated egg products (ČSN 57 23 01)

Market type	Water max [%]	Fat in dry mass max [%]	Whipping ability min [%]	Foam stability	Free fatty acids max [%]	Titrateable acidity max	Reducing sugars max [%]
Pasteurised dehydrated egg melange	5.0	40	-	-	6.0	25	-
Dehydrated yolk	5.0	58	-	-	6.0	-	-
Dehydrated albumen	8.0	-	400	85	-	-	-
Dehydrated desugared melange	5.0	40	-	-	6.0	25	0.1
Dehydrated desugared yolk	5.0	58	-	-	6.0	-	0.1
Dehydrated desugared albumen	8.0	-	600	85	-	-	0.1

Organoleptic properties of dehydrated egg products are defined in four indicators:

- **Appearance and consistency** – this matter is a slightly granulated powder, lumps may be crushed by a slight push of the finger,
- **Colour of egg products** is described as light yellow to orange, dehydrated yolk is yellow, dehydrated albumen is white to yellowish.
- **Scent** is natural and free from foreign odours,
- **Egg flavour** is natural without foreign aftertaste.

Functional properties of dehydrated albumen are assessed by determining the whipping ability and foam stability. The whipping ability of dehydrated albumen should be at least 400 %, while in desugared, dehydrated albumen and crystalline albumen it should be 600 %. When determining the microbiological requirements, we monitor the total number of microorganisms, as well as *Enterobacteriaceae*, *Salmonella*, and *Staphylococcus aureus*. Qualitative parameters of dehydrated egg products are not determined legislatively. We mostly use the ČSN 53 23 01, whose requirements are listed in Table 16.

Quality and microbiological requirements for chilled and frozen products are described in ČSN 57 23 01, which, despite its non-binding nature is used in supplier-customer relationships.

The norm contains the following organoleptic requirements for egg products:

- **Appearance and consistency** - solid, without shell fragments and foreign materials,
- **Colour** - of egg melange is yellow to orange, of yolk dark orange, albumen pale yellow to light green,
- **Scent** - natural and free from foreign odours,
- **Egg flavour** - natural without foreign aftertaste.

Quality feature in assessing egg products are physical and chemical requirements quoted as the dry mass and fat in egg products.

Table 16: Quality requirements for dehydrated egg products

Component	Moisture [%]	Fat in dry mass [min %]
Albumen	7 – 8	—
Crystalline albumen	10 – 14	—
Yolk	3.5 – 5	58.0
Melange	4 – 5	40.0

7.4. Other egg products

Boiled, peeled, preserved eggs are semi-finished products manufactured industrially for the production of delicacies. Their production is based on boiling of hard-boiled eggs in industrial egg cookers, peeling of shells with water under pressure, and putting them into conserving brine. Factory-made scrambled eggs or omelettes are refrigerated or frozen semi-finished products for use in the catering industry. Egg cans are heat-treated products in which eggs constitute a substantial part. Homogenized powder mixtures are products made by admixing dry components. They include such products as sponge cake powder, pancakes powder, and powdered ice cream mixture. **Long eggs** are a product, which has the constant ratio between yolk and albumen, are suitable for the production of delicatessen.

7.5. Production and quality of mayonnaise

Mayonnaises are cold flavoured, sauces, containing chicken egg yolks, obtained by emulsifying edible vegetable oils in water phase. They contain vinegar and possibly other acidifying, or flavouring agents, and stabilizers, such as starch, guar gum, and xanthan. Other additives depending on the type of product may include vegetables, sugar, tomato paste, ketchup, milk, spice extracts, mustard, citric acid, and drinking water. All the raw materials and ingredients for making mayonnaise must be safe and suitable for use in food. All raw materials of egg origin must be pasteurized. The overall quality of mayonnaise depends in

part on quality of used edible oils. The mostly commonly used include oils from rapeseed, sunflowers, peanuts, and soy. Forming an emulsion and its stability in mayonnaise is secured in emulsifier lecithin and cholesterol in the form of egg yolk. The content of egg yolks in mayonnaises ranges between 2 % and 12 % depending on the used recipes. Technological process of mayonnaise production is based on the preparation of liquid components, such as vinaigrette, mixtures of infusions, oils, egg mixture, and a stabilizer. Then, the raw materials are mixed using a blender or a colloid mill and a pump to form a homogeneous mass. Protection of mayonnaise before their microbial spoilage must be ensured by adherence to technological procedures. These include boiling the vinegar infusion, heat treatment, and decreasing pH. In addition, principles of perfect cleaning and disinfection of equipment, continuity of production, the temperature of the working environment, and personal hygiene, must be maintained.

7.5.1. Quality control of mayonnaise

Sensory requirements for mayonnaise include:

- **Consistency and colour** - depending on the oil content, it is pasty, creamy to semi-homogeneous mass, oil not separated, particles of lumpy ingredients are evenly dispersed, smaller air cavities are permitted; products may not contain remains of eggshells, dirt, foreign objects and lumps of egg products.
- **Scent** - typical of mayonnaise, slightly acidic, possibly due to additives and spices used,
- **Taste** – without foreign aftertaste, sour, due to the ingredients used.

Table 17 shows physical and chemical quality requirements for mayonnaises.

For microbiological requirements for mayonnaise, we determine the total bacterial count, coliform bacteria, *Staphylococcus aureus*, *Salmonella*, and yeast.

Table 17: Physical and chemical quality requirements for mayonnaise

Indicator	Mass %
Fat content	Depending on brand 10.0 % to 85.0 %
Yolk content	At least 2.0 %
pH value	Maximum 4.5

7.6 Questions and assignments

- a. What are Haugh units?
- b. Why do we use desugaring in the manufacturing of egg products?
- c. In a laboratory experiment, you have whipped 150 ml of albumen into 600 ml of foam.
What was the whipping ability of the albumen in %?
- d. What is a *long egg*?
- e. What are the materials from which mayonnaise is made?

8. PROCESSING AND EVALUATION OF MILK QUALITY

Milk has for us as mammals invaluable significance in our nutrition. It is the first food we eat, and in the early stages of life, it is the only one. Over time in addition to mother's milk, we add other foods into the diet of children. Be that as it may, milk is not associated only with childhood, as a considerable part of the population is consuming it with gusto their all whole life. Milk is the secretion of the mammary glands in female mammals. Worldwide, people get it from a variety of livestock due to the regional breeding conditions.

According to research, humans added milk of other mammals to their diet during the era of domestication of animals. When we talk about milk, we mean especially cow's milk. Other kinds of milk people use include mainly milk of goats, sheep, camels, mares, and buffaloes.

Milk is an important commodity, but also the target of various myths and untruths that circulate about its nutritional value or acquisition and processing technology.

8.1. Importance and consumption of milk and milk products

Milk and dairy products are a part of daily diet in particular of the population in developed countries. Globally, their significance and consumption grow, as do other commodities of animal origin. It is in the context of the changes and improving conditions in poorer but very populous regions of the world. Certain limits exist due to intolerance to milk sugar (lactose) or allergy to milk protein (casein), but the food industry is capable of reacting, so there is a wide selection of lactose-free products.

Milk contains all the substances necessary for healthy growth and development in the offspring.

Before 1989, supply of dairy products was limited by the capabilities of the local dairy industry, which tried to manage this commodity in local conditions of government-subsidized products. Currently, everything is a subject to global market conditions where mass production has the advantage, with respect to suitable targeting of consumer needs. The ability of selling products that are somehow distinct from the competitors, but still represent items of daily purchase, depends of course on the price. Still, the consumer is willing to buy a product that has an improved formula, such as unusual flavour in order to try it.

Compared to the past, the overall quality of milk has improved greatly in terms of hygiene of milk production and advanced technologies for its processing and distribution.

Milk production has undoubtedly its social function, such as employment in both primary and subsequent processing of milk. Milk composition varies among species but also among breeds. Overall quality is given mainly by safety, physical, chemical, and sensory properties.

8.2. Basic composition of milk

Milk has different definitions in different legislative regulations. It is due to the purpose of a particular regulation. When we talk about milk without specifying the kind of farm animal, we mean exclusively cow's milk.

Thus under milk, we mean:

- **Product** obtained from milking one or more cows,
- **Exclusively** the normal mammary secretion obtained from one or more milkings without adding anything to it or extracting anything from it,
- **Milk** satisfying the requirements of special laws of the European Community regulation and treated in accordance with special legislation.

During lactation, and in particular after birth, milk does not have the same composition. **Colostrum** is a fluid secreted by mammary glands of milk producing animals 3 to 5 days after birth. It is rich in antibodies and minerals, and precedes the production of raw milk. Colostrum is important for the young due to its content of proteins and antibodies from the mother. After the birth, it provides natural passive immunity against infections from the environment.

Milk of individual species can be classified according to the content of essential protein. These two types include **casein milk** which contains more than 75 % casein of the total amount of protein and **albumine milk**, which does not reach this amount (less than 75%). Casein milk includes especially milk of ruminants, such as cows, sheep, goats, and buffaloes. Albumine milk includes milk of carnivores, omnivores, and herbivores with simple stomach.

Recently, there was an increase in the supply of herbal drinks that are offered as an alternative to milk. This is either due to elimination of animal products by some consumers or health effect reasons marketed to people. They must not be officially labelled as milk because they are not secretions of the mammary glands of livestock. Since 1994, when the EU adopted legislation, we can encounter drinks made of soy, rice, buckwheat, oat, and others. They do not contain cholesterol or lactose, to which some people have intolerance. Sometimes they have even better fatty acid composition of fat, if it is not a partially hydrogenated fat. They are not suitable alternatives to milk, because they have a low natural content of calcium, which is much harder to be used by the body. They also include proteins with low biological value. Certain beverages are then much worse allergens than milk. They also contain other vegetable products such as various naturally antinutritional or toxic substances that must be inactivated by heat treatment.

Table 18: Comparison of basic milk composition

Milk	Human	Cow	Sheep	Goat	Mare	Buffalo
Proteins (%)	0.9 – 1.6	3.2	4.6	3.2	1.7	3.8
Fat (%)	4.5	3.9	7.2	4.5	1.4	6.9
Lactose (%)	7.1	4.6	4.8	4.3	7.6	5.2
Minerals (%)	0.2	0.7	0.9	0.8	0.5	0.8

Milk, under an amendment to the law on foodstuffs, should be indicated on product labels and in the food composition as allergen. Some people are in fact allergic to casein, the basic protein in milk. This manifests itself as skin or intestinal problems, so the affected consumers' only option is to exclude milk from their diet. An allergy is an autoimmune reaction of the body. Sometimes allergy is wrongly confused with lactose intolerance, which affects a much larger group of people, even depending on their origin. In this case, it is a deficiency of the enzyme lactase in the microvilli of the small intestine, which is necessary to digest the milk sugar or lactose. Problems manifest themselves as abdominal pain, bloating, feeling of fullness, abdominal cramps, diarrhoea, and vomiting. In our part of the world, it occurs in 6 % to 20 % of the population, in 80 % of *Africans*, and in almost 98 % of *Asians*. In contrast, it affects only a small part of *Scandinavians* (10 %).

8.3. Hygiene and technology of milk processing

Sanitary conditions on farms and in producing, preserving, and processing of milk aim at maximising the effort to obtain milk free of microorganisms. Many such microorganisms cause diseases transmissible to humans or degrade this raw material for processing into products.

We must obtain raw milk from animals which have no symptoms of infectious diseases transmittable to humans through milk. One such disease often mentioned is *brucellosis tuberculosis*.

Animals must be in good health, show no signs of other diseases, and have no udder injuries, which could affect the milk. In addition, they cannot be fed unauthorized substances or products. In the case of authorized products or substances, withdrawal period must be respected. Such milk is excluded from the sale and a veterinarian decides its use.

Milking equipment and premises where milk is stored, handled or cooled must be located and constructed so as to limit the risk of contamination of milk. Areas for milk storage must be protected against vermin. They must also be well separated from spaces with animals, and if it is necessary to have suitable refrigeration equipment.

Surfaces of equipment that come into contact with milk, such as utensils, containers, tanks, intended for milking, collection, or transport must be easy to clean and, where necessary, disinfected and maintained in proper condition. This requires the use of smooth, washable, and non-toxic materials. After use, such surfaces must be cleaned and possibly disinfected. Containers and tanks used for transporting raw milk must be appropriately cleaned and disinfected before use, and after each trip, or a series of trips, if the time between unloading and subsequent loading is very short, but in any event at least once a day.

Milking must be carried out hygienically, and in particular it must be ensured:

- **That** before milking, teats, udder, and adjacent parts are clean,
- **That** for each individual animal, milk was checked for organoleptic, physical and chemical abnormalities. This is done by the milker or by a method achieving similar results. Milk with such abnormalities must not be used for human consumption,
- **That** milk from animals showing clinical signs of disease of the udder, should not be used for human consumption other than in accordance with the instructions of a veterinarian,
- **That** identification is carried out of animals undergoing medical treatment, which can lead to the transmission of residues into milk, and that milk from such animals before the end of the prescribed withdrawal period is not used for human consumption,
- **That** washing or spraying of teats is used only if approved by the competent authority in a manner that does not lead to unacceptable levels of residues in milk.

Immediately after milking, the milk must be placed in a clean place which is designed and equipped as to prevent its contamination.

It must be cooled immediately:

- **To a temperature of 8°C** or lower in the case of daily collection or
- **To a temperature of 6°C** or lower, if the collection is not daily.

During transport, the cooling process must be maintained and upon delivery the milk temperature must not exceed 10°C.

Food business operators need not comply with the above requirements of the Regulation no. 853/2004 on the temperature, if the milk meets the criteria for hygiene and the milk is processed within 2 hours of milking, or a higher temperature is necessary for technological

reasons related to the manufacture of certain dairy products and the competent authority (SVS) permits it.

8.4. Processing and quality control of milk

Raw milk must meet the following criteria:

- Raw cow's milk:
 - **Microorganism count** at 30°C ≤ 100 000 per ml; rolling geometric mean over a two-month period, at least two samples per month;
 - **Somatic cell count** ≤ 400 000 per ml; rolling geometric mean over a three-month period, at least one sample per month, unless the competent authority specifies another methodology to consider seasonal variations in production levels;

- Raw milk from other species:
 - **Microorganism count** at 30°C ≤ 1 500 000 per ml; rolling geometric mean over a two-month period, at least two samples per month.

If raw milk from species other than cows is intended for the production of products made with raw milk by a process that does not involve any heat treatment, food business operators must take steps to ensure that the raw milk used meets the plate count ≤ 500,000 per ml; rolling geometric mean for the two-month period, at least two samples per month.

On the farm, milk-truck driver collects the milk according to a schedule given by the so-called milk collection plan. It is necessary to record and control not only the collected quantity but also the temperature and sensory properties of milk. We collect the so-called bulk milk samples, either with a ladle in a proportion to size of the milk containers, or with the so-called autosampler.

The milk is transported to the dairy in bulk by road transporters which can have, in the case of a semitrailer, a capacity of 30,000 litres milk. The resulting quality of milk depends on the quality and speed of the collection.

Collecting of milk at the dairy includes not only the transfer of milk to storing reservoirs (tanks). It also includes quality control, including milk temperature, presence of **Residues of Inhibiting Substances (RIS)**, taking the bulk milk samples, and so on. The dairy laboratory also carries out further analysis of milk with respect to hygiene and quality requirements that are imposed on raw materials.

The so-called milk tampering is intentional or unintentional corrupting of milk composition. The most common tampering is adding water or removing fat or possibly adding skim milk, or combined tampering that is adding water and/or skimmed milk, and removing fat. The term tampering of basic milk composition also includes addition or occurrence of antibiotics or other drugs in milk, detergents and disinfectants, preservatives, colostrum or mastitid milk, pesticides or heavy metals, or radioisotopes in breach of legislation. Substances that must not be present in milk include *Residues of Inhibiting Substances (RIS)*, which are substances that inhibit growth of microorganisms (dairy cultures).

8.5. Dairy milk treatment

In the dairy facility it is necessary for milk to get rid of any dirt, gases, and be heat-treated. According to European law, food business operators manufacturing dairy products shall establish procedures to ensure that, immediately prior to heat treatment, has a plate count for raw cow's milk less than 300 000 per ml and heat-treated cow's milk used to prepare dairy products has less than 100 000 per ml.

From storage tanks, milk is pumped to the pasteurization station. Here the milk is spun by centrifuge, heat-treated, and chilled. The next is standardizing fat content of milk, deaeration, which is separation of gases and odours, and homogenizing milk fat to prevent it from rising to the surface (separation of cream) because its lower density. Spinning takes place in centrifuges, which separate milk fat at up to 8000 rpm. Centrifugation also purifies the milk, as it eliminates impurities and a portion of microorganisms, most often at 40°C to 50°C, in the so-called regenerative section of the pasteurizer. The resulting cream has about 40 % of fat.

Heat treatment of milk is a technological process which uses different combinations of temperature and exposure time to temperature, which exhibit equivalent effects. It reduces the number of undesirable microorganisms and ensures safety and extends shelf life of milk and the final milk product.

Decree no. 77/2003 Coll. distinguishes:

- **Thermization** - heat treatment of milk, that corresponds to the effect of being heated to 57°C to 68°C for at least 15 seconds, and dairy products after completion of acidification

and before packaging to suppress or stop the activity of lactic micro-flora present up to a temperature of 80°C,

- **Pasteurization** - heat treatment of milk and milk products by heating the milk to a temperature at least 71.7°C for at least 15 seconds or any other time-temperature combinations to achieve an equivalent effect,
- **High-temperature pasteurization** - heat treatment of milk and milk products by heating the milk to a temperature of at least 85°C, with negative results of peroxidase and phosphatase tests;
- **High-temperature treatment (UHT)** – short-time heat treatment of milk and milk products by uninterrupted flow of milk at high temperature, corresponding to the effect of heating to a temperature of at least 135°C for at least 1 second, followed by aseptic, lightproof packaging so that the chemical, physical, and sensory changes were reduced to a minimum,
- **Sterilization of milk and milk products** - heat treatment of milk and milk products by their indirect heating in airtight containers at a temperature above 100°C to ensure compliance with the requirement for microbiological safety without breaking the seal.

Drinking milk must have:

- **Freezing point** close to the average freezing point for raw milk that was found in the collecting area of origin.
- **Density** of at least 1028 grams per litre for milk containing 3.5 % (m/m) at 20°C or the equivalent weight per litre for milk with different fat content;
- **Content** of at least 2.9 % (m/m) of protein for milk containing 3.5 % (m/m) or an equivalent concentration in the case of milk with different fat content.

In the event of changes in the composition of milk, the only change allowed is the natural fat content. That includes the removal or addition of cream, whole milk, semi-skimmed milk, or skimmed milk in order to meet the fat contents laid down for drinking milk. In the case of enrichment of milk with milk proteins, mineral salts or vitamins, or the reduction of the lactose content by conversion to glucose and galactose are allowed only if they are listed on product packaging and are indelible, visible, and easy to read. In the marketplace, we can also encounter **Extended Shelf Life (ESL)** milk. Compared to fresh milk, the **extended shelf life** of 6 weeks at 4°C to 6°C is given merely by heating from 125°C to 135°C for 0.5 seconds, using a special manufacturing technology of injecting hot steam into the milk.

8.6. Assortment of dairy products

Assortment of dairy products is very broad and is not limited only to milk, yoghurt, and cheese.

Drinking milk is one of the products intended for delivery to the consumer in unchanged state.

Drinking milk includes these products:

- *Raw milk,*
- *Whole milk, non-standardized,*
- *Whole milk, standardized,*
- *Semi-skimmed milk,*
- *Skimmed milk.*

Raw milk means milk produced by secretion of the mammary gland of farmed animals that has not been heated above 40°C or undergone any treatment that has an equivalent effect. It is supplied to the processor or may be marketed directly to the consumer (yard sale) in accordance with the requirements set out in the relevant decree.

Whole milk is heat-treated milk which, with respect to fat content, meets one of the following requirements:

- **Standardized whole milk:** milk with a fat content of at least 3.50 % (m/m). However, member countries may set up an additional category of whole milk with a fat content of 4.00 % (m/m),
- **Non-standardized whole milk:** milk with a fat content that has not changed since the milking stage either by the addition or removal of milk fats or by mixture with milk, in which the natural fat content was changed. However, the fat content may not be less than 3.50 % (m/m);

Low-fat milk is heat-treated milk whose fat content has been reduced to at least 1.50 % (m/m) and a maximum of 1.80 % (m/m)

Skimmed milk: heat-treated milk whose fat content has been reduced to not more than 0.50 % (m/m).

Assortment of milk dairy products, labelling and putting into circulation is regulated by Decree no. 77/2003 Coll. later amended.

According to this Degree:

- **Cream** - liquid milk product, treated under special legislation, with a fat content of at least 10 % by weight of the emulsion (milk fat in plasma) obtained by physical separation from milk,
 - **Whipping cream** - fat content of at least 30 % by weight,
 - **High-fat cream** - fat content of at least 35 % by weight,
- **Sour dairy products** - dairy products obtained by fermentation of milk, cream, buttermilk, or mixtures thereof using microorganisms and thermally untreated after fermentation,
 - **Yoghurt** - fermented milk product obtained by fermentation of milk, cream, buttermilk, or a mixture thereof by microorganisms,
- **Condensed milk or condensed cream** - milk product, sweetened or sweetened, obtained by partial evaporation of water from cream or whole milk, wholly or partly skimmed, or

their mixtures, to which can be added cream or powdered milk or both. The addition of milk powder in the final product must not exceed 25 % of total solids content,

- ***Powdered milk or creamer*** - milk product in powder form obtained by drying of whole milk, skimmed or partly skimmed or cream, or mixtures thereof, with a water content not exceeding 5 % by weight,
- ***Cheese*** - milk product is produced by coagulation of milk protein from milk using rennet or other suitable coagulating agents, turning sour and separating whey,
 - ***Fresh cheese*** - unripened cheese thermally untreated after turning sour,
 - ***Cottage cheese*** - unripened cheese produced by an acidic precipitation, which prevails over precipitation with rennet,
 - ***Blue cheese*** - cheese in which after turning sour, there were other biochemical and physical processes,
 - ***Processed cheese*** - cheese, which has been heat treated with the addition of emulsifying salts,
 - ***Whey*** - a milk product produced as a by-product in the production of cheeses, including cottage cheese and casein,
 - ***Whey cheese*** - a milk product obtained by coagulation of whey or a mixture of whey with milk,
- ***Butter*** - milk product containing only milk fat in the form of an emulsion of water and fat,
 - ***Fresh butter*** - butter within 20 days from the date of manufacture,
 - ***Table butter*** - butter stored up to 24 months from date of manufacture at temperatures of minus 18°C or lower,
 - ***Butter concentrate*** - dairy product having a total milk fat content of more than 90 % by weight, obtained from milk, cream, or butter,
 - ***Butter fat*** - anhydrous milk fat obtained from milk, cream or butter containing more than 99.3 % milk fat,
 - ***Traditional spread*** - milk product from sour cream, with added powdered milk, possibly with enriched with dried whey or dried buttermilk. It contains at least 31 % by weight and not more than 36 % milk fat and at least 42 % by weight of dry mass, which is produced by the traditional technology high pressure homogenization cream mixture, followed by the mixture turning sour and thermization with final homogenization before filling into the packaging,

- **Buttermilk** - a milk product produced as a by-product in the production of butter.

Other products containing milk include frozen creams.

Frozen cream is a product obtained by freezing a mixture, prepared depending on the group from frozen cream, particularly water, milk, cream, fat, sugar and other ingredients, solid or pasty, which is marketed and intended for final consumption in the frozen state: Freezing is a technological process of preservation of products by rapidly reducing the temperature to minus 18°C and lower. Re-freezing thawed products and putting them into circulation is not allowed. These products are divided into six groups including cream, milk (cheese or yogurt), with vegetable oil, water, fruit, and sorbet.

8.7. Labelling and marketing of dairy products

A decree divides milk and milk products in types, groups, and subgroups. We mark the expiry date in liquid milk and liquid creams, which were not **UHT** treated, fermented milk products, heat-treated dairy products after fermentation process or enriched by the addition of microorganisms, fresh butter, curd, and fresh unripened cheese.

We can designate a milk product with the adjective milk in which milk or a milk product constitutes at least 50 % by weight of the product, as well as adjectives cheese, yogurt, cheese.

Milk, cream and **UHT** treated or sterilized milk products, as well as condensed milk, powdered milk, and protein milk products are stored, transported, and marketed at temperatures up to 24°C. All other dairy products are stored, transported and marketed at temperatures between 4°C and 8°C. We store dehydrated milk products at a relative humidity of up to 70 %.

8.8. Questions and assignments

- a. What is milk?
- b. Give examples of the so-called casein and albumine milk.
- c. Why is goat milk chalky white?
- d. Which fundamental factors affect the quality of milk?
- e. May raw milk be sold to consumers?
What danger lies in consumption of raw milk?
- f. What is a tampering with milk?
- g. What is standardization?
- h. How do we classify milk by fat content?
- i. What pasteurization treatments are defined in the ordinance?
- j. Write a one-page essay on the importance of milk for humans.

9. REFERENCES

- Anděl, M. et al. (2010): Mléko a mléčné výrobky ve výživě. Potravinářská komora ČR, 34 p. ISBN 978-80-254-9012-9
- Bell, D. D., Weaver, JR., D. (2001): Commercial Chicken Meat and Egg Production. 5th ed. Massachusetts: Kluwer Academic Press, 1365 p. ISBN 0-7923-7200-X.
- Českomoravský svaz výrobců drůbeže a vajec (2001): Pravidla správné hygienické praxe/výrobní praxe pro producenty a distributory vajec při nákupu, třídění, balení a distribuci vajec, Praha.
- Českomoravský svaz výrobců drůbeže a vajec (2001): Pravidla správné hygienické praxe/výrobní praxe pro zpracovatele vajec, Praha.
- Českomoravský svaz zpracovatelů masa (2004): Katalog výsekových a výrobních mas, Praha, 40 p.
- ČSN 57 01 16 Testing methods of chicken eggs for consumption.
- ČSN 57 21 09 Sorted chicken eggs for consumption.
- ČSN 57 23 01 Egg products.
- ČSN 57 65 10 Cattle carcasses.
- ČSN 57 65 40 Pig carcasses.
- Evropské sdružení zpracovatelů vajec (EEPA) (2012): Guide to good manufacturing practice for “liquid, concentrated, frozen and dried egg products” used as food ingredients (non-ready to eat egg products).
- Ingr, I., Pokorný, J., Valentová, H. (2007): Senzorická analýza potravin. Brno, Mendelova zemědělská a lesnická univerzita v Brně, 101 p. ISBN 978-80-7375-032-9
- Kameník, J., Janštová, B., Saláková, A. (2014): Technologie a hygiena potravin živočišného původu. VFU, Brno, scriptum, 200 p.
- Leffmann, H. (1893): Analysis of milk and milk products. Philadelphia, P. Blakiston's Son & Co. 113 p. ISBN 9781406751680
- Mead, G. C. (2007): Microbiological analysis of red meat, poultry and eggs. Boca Raton, CRC Press, 348 p. ISBN 978-1-4200-4397-6
- Ministerstvo zemědělství (2014): Situační a výhledová zpráva, Vepřové maso 2013, 80 p. ISBN 978-80-7434-113-7
- Nařízení Evropského parlamentu a rady (ES) č. 178/2002 ze dne 28. ledna 2002, kterým se stanoví obecné zásady a požadavky potravinového práva, zřizuje se Evropský úřad pro bezpečnost potravin a stanoví postupy týkající se bezpečnosti potravin.

Regulation of the European Parliament and the Council (EC) no. 178/2002 of 28 January 2002 which lays down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety.

Nařízení Evropského parlamentu a rady (ES) č. 852/2004 ze dne 29. 4. 2004 o hygieně potravin.

Regulation of the European Parliament and the Council (EC) no. 852/2004 of February 29, 2004 on hygiene foods.

Nařízení Evropského parlamentu a rady (ES) č. 853/2004 ze dne 29. 4. 2004, kterým se stanoví zvláštní hygienické předpisy pro potraviny živočišného původu.

Regulation of the European Parliament and the Council (EC) no. 853/2004 of February 29, 2004 which lays down specific hygiene rules for food of animal origin.

Nařízení Evropského parlamentu a rady (ES) č. 854/2004 ze dne 29. 4. 2004, kterým se stanoví zvláštní předpisy pro organizaci úředních kontrol produktů živočišného původu určených k lidské spotřebě.

Regulation of the European Parliament and the Council (EC) no. 854/2004 of February 29, 2004 which lays down specific rules for the organization of official controls on products of animal origin intended for human consumption.

Nařízení Evropského parlamentu a rady (ES) č. 882/2004 ze dne 29. 4. 2004 o úřední kontrole potravin a krmiv, zdraví zvířat a welfare.

Regulation of the European Parliament and the Council (EC) no. 882/2004 of February 29, 2004 on the official control food and feed, animal health and welfare.

Nařízení Evropského parlamentu a Rady (ES) č. 1069/2009 ze dne 21. října 2009 o hygienických pravidlech pro vedlejší produkty živočišného původu a získané produkty, které nejsou určeny k lidské spotřebě, a o zrušení nařízení (ES) č. 1774/2002 (nařízení o vedlejších produktech živočišného původu).

Regulation of the European Parliament and Council Regulation (EC) no. 1069/2009 of October 21, 2009 health rules concerning animal by-products and derived products not intended for human consumption and repealing Regulation (EC) no. 1774/2002 (Regulation on ABP).

Nařízení Rady (ES) č. 1099/2009 ze dne 24. září 2009 o ochraně zvířat při usmrcování.

Council Regulation (EC) no. 1099/2009 of September 24, 2009 on the protection of animals at slaughter.

Nařízení Evropského parlamentu a Rady (EU) č. 1151/2012 ze dne 21. listopadu 2012 o režimech jakosti zemědělských produktů a potravin.

- Regulation of the European Parliament and Council Regulation (EU) no. 1151/2012 of November 21, 2012 on quality schemes for agricultural products and foodstuffs.
- Nařízení Komise (EHS) č. 1538/91 ze dne 5. června 1991, kterým se stanoví prováděcí pravidla k nařízení (EHS) č. 1906/90 o některých obchodních normách pro drůbeží maso.
- Commission Regulation (EEC) No. 1538/91 of June 5, 1991 laying down detailed Regulation (EC) no. 1906/90 on certain marketing standards for poultry meat.
- Nařízení Komise (ES) č. 2073/2005 ze dne 15. 11. 2005 o mikrobiologických kritériích pro potraviny.
- Commission Regulation (EC) no. 2073/2005 of November 15, 2005 on microbiological criteria for food.
- Northcutt, J. K., Scott, M. R. (2010): General Guidelines for Implementation of HACCP in a Poultry Processing Plant. Bulletin 1155, University of Georgia.
- Nys, Y., Bain, M. (2011): Improving the safety and quality of eggs and egg products. Volume 1. Egg chemistry, production and consumption. Oxford Woodhead Publishing, 2011, 632 p. ISBN 978-1-84569-754-9
- Ranken, M. D. (2000): Handbook of meat product technology. Oxford [Eng.], Blackwell Science. 212 p. ISBN 0-632-05377-1
- Samková E., et al (2014): Mlékařství. Edukativní DVD. Moonfilm, Jihočeská univerzita v Českých Budějovicích, ISBN 978-80-7394-393-6.
- Sdružení drůbežářských podniků (2001): Pravidla správné hygienické praxe porážek drůbeže a při výrobě drůbežího masa, 29 p.
- Simeonovová, J., Míková, K., Kubišová, S., Ingr, I. (2003): Technologie drůbeže, vajec a minoritních živočišných produktů, Brno: MZLU, 247 s. ISBN 80-7157-405-8.
- Solomon, S. E. (1997): Egg and Eggshell Quality. 1st ed. Ames: Iowa State University Press, 149 p. ISBN 0-8138-2827-9.
- Songer, J. G., Post, K. W. (2005): Veterinary microbiology : bacterial and fungal agents of animal disease St. Louis, Mo. Elsevier Saunders, 434 p. ISBN 978-0-7216-8717-9
- Stadelman, J. W., Coterill, O. W. (1995): Egg Science and Technology. 4th edit. New York: Food Products Press, 449 p. ISBN 1-56022-003-1.
- Steinhauser, L. et al (2000): Produkce masa. LAST Tišnov, 464 pp, ISBN 80-900-260-7-9.
- Škopek, B., Voldřich, M. (2003): Praktická příručka výrobce a prodejce potravin: označování, posuzování shody, systém kritických bodů, prodej. Praha: Dashöfer. ISBN 80-86229-05-X.

Vyhláška č. 77/2003 Sb. ze dne 6. března 2003, kterou se stanoví požadavky pro mléko a mléčné výrobky, mražené krémy a jedlé tuky a oleje ve znění vyhlášky č. 336/2013 Sb.

Decree no. 77/2003 Coll. of March 6, 2003 laying down requirements for milk and dairy products, frozen creams and edible fats and oils as amended by Decree no. 336/2013 Coll.

Vyhláška č. 128/2009 Sb., o přizpůsobení veterinárních a hygienických požadavků pro některé potravinářské podniky, v nichž se zachází se živočišnými produkty ve znění vyhlášky č. 191/2013 Sb.

Decree no. 128/2009 Coll., On the adaptation of veterinary and sanitary requirements for some food companies, which treat animal products, as amended - Decree no. 191/2013 Coll.

Vyhláška č. 289/2007 Sb. o veterinárních a hygienických požadavcích na živočišné produkty, které nejsou upraveny přímo použitelnými předpisy Evropských společenství ve znění vyhlášky č. 61/2009 Sb.

Decree no. 289/2007 Coll., On veterinary and sanitary requirements for animal products, not directly regulated by the applicable regulations of the European Communities, as amended - Decree no. 61/2009 Coll.

Vyhláška č. 326/2001 Sb., ze dne 30. srpna 2001, kterou se provádí § 18 písm. a), d), g), h), i) a j) zákona č. 110/1997 Sb., o potravinách a tabákových výrobcích pro maso, masné výrobky, ryby, ostatní vodní živočichy a výrobky z nich, vejce a výrobky z nich ve znění vyhlášky č. 169/2009 Sb.

Decree no. 326/2001 Coll., of August 30, 2001, which implements § 18 point. a), d), g), h), i), and j) of the *Act no. 110/1997 Coll.*, on food and tobacco products for meat, meat products, fish, other aquatic animals and their products, eggs and products from them as amended by Decree no. 169/2009 Coll.

Yamamoto, T. (1997): Hen eggs: their basic and applied science. Boca Raton: CRC Press, 204 p. ISBN 0-8493-4005-5.

Zákon č. 110/1997 Sb. o potravinách a tabákových výrobcích ve znění zákona č. 139/2014.

Act no. 110/1997 Coll. On foodstuffs and tobacco products, as amended by *Act no. 139/2014 Coll.*

Zákon č. 154/2000 Sb. o šlechtění, plemenitbě a evidenci hospodářských zvířat (plemenářský zákon) ve znění zákona č. 64/2014 Sb.

Act no. 154/2000 Coll. For breeding and registration of farm animals (Breeding Act), as amended by *Act no. 64/2014 Coll.*

Zákon č. 166/1999 Sb. o veterinární péči (veterinární zákon) ve znění zákona č. 64/2014 Sb.
Act no. 166/1999 Coll. Veterinary Care (Veterinary Act), as amended by **Act no. 64/2014**

Coll.

Zákon č. 246/1992 Sb. na ochranu zvířat proti týrání, ve znění zákona č. 359/2012 Sb.

Act no. 246/1992. On protection of animals against cruelty, as amended by **Act no. 359/2012**

Coll.

List of Tables and Figures

Table 1: Selected decrease on livestock production and food control	20
Table 2: Selected implementing Decrees for Act no. 110/1997 Coll.....	21
Table 3: Small amounts under Decree no. 289/2007 Coll. (as no. 61/2009 Coll.)	30
Table 4: Regulations of the hygiene package.....	34
Table 5: The amount of produced meat on the bone in selected regions of the world	53
Table 6: Minimum values for electrocution according to Regulation 1099/2009	64
Table 7: Grading classification of pig carcasses by weight	71
Table 8: Production Beef (ČSZM, Catalogue VVM, 2004)	77
Table 8: Production Pork (ČSZM, Catalogue VVM, 2004)	78
Table 10: Classification of products according to technical standards	80
Table 11: Maximum fat and connective tissue in meat designated as an ingredient in the production of meat products.....	81
Table 12: Production and consumption of eggs in the Czech Republic [in million pieces]	106
Table 13: Example of pasteurization treatment in continuous and stationary pasteurisation.....	116
Table 14: Quality requirements for dehydrated egg products.....	119
Table 15: Requirements for physical and chemical properties of dehydrated egg products (ČSN 57 23 01)	120
Table 16: Quality requirements for dehydrated egg products.....	121
Table 17: Physical and chemical quality requirements for mayonnaise	122
Table 18: Comparison of basic milk composition	126
Figure 1: Factors in the customer decision-making process	9
Figure 2: Logotypes PDO, PGI, and TSG.....	12
Figure 3: Levels of food quality	14
Figure 4: Examples of aspects and quality characteristics affecting the overall quality of meat.....	15
Figure 5: Effects on the overall quality of food	16
Figure 6: Requirements for animal products as feedstock	17

Figure 7: Types of animal products.....	39
Figure 8: Common hierarchic terms used for food	40
Figure 9: Taxonomic units for livestock	41
Figure 10: Consumption of meat on the bone, in kg per capita per year, ČSÚ 2011	55
Figure 11: The course of post-mortem processes in meat.....	58
Figure 12: Classification of adult cattle according to SEUROP system	69
Figure 13: Czech beef cuts (ČSZM, Catalogue VVM, 2004)	74
Figure 14: Czech pork cuts (ČSZM, Catalogue VVM, 2004)	75
Figure 15: General diagram of production of whole-muscle meat products.....	85
Figure 16: General diagram of production of minced meat products	86
Figure 17: Phases of smoking	87
Figure 18: General diagram of production of long-life fermented meat products	88
Figure 19: Sensory descriptors and selected defects in meat products	92

Title	QUALITY OF ANIMAL PRODUCTS
Author	Miroslav Jůzl Šárka Nedomová
Publisher	Mendel University in Brno Zemědělská 1, 613 00 Brno
Print	ASTRON studio CZ, a.s.; Veselská 699, 199 00 Praha 9
Edition	1 st Edition, 2015
No. of pages	144
No. of copies	50
ISBN	978-80-7509-350-9

This publication is co-financed by the European Social Fund and the state budget of the Czech Republic.

Innovation of studies programmes at Mendel's university for integration between Faculty of Agronomy and Faculty of Horticulture OP VK CZ.1.07/2.2.00/28.0302.



INVESTMENTS IN EDUCATION DEVELOPMENT