Topic 3: Contemporarydevelopment of processingof raw materials of animal origin (meat quality evaluation)
Lecture

The topic of today's lecture is Contemporary development of processing of raw materials of animal origin with emphasis on meat quality evaluation.
As part of the lecture, we will first clarify what we mean by the term raw material and list raw materials of animal origin. We will talk in more detail about one of them, namely meat. We will list the attributes of meat quality and what factors influence meat quality. Next, we will move on to carcass evaluation and the possibilities of evaluating meat quality using selected techniques.
Under the term raw material, we generally include any material of natural origin. These raw materials can be obtained from animals or from plants, or they can also be material of "non-living" origin, such as various minerals, metals, oil or coal.
Raw materials of animal origin include any material originating from or produced by animals. It can serve directly for human nutrition, such as meat, milk, honey or eggs, possibly for further processing and use, e.g. in the textile industry, such as wool, leather, feathers or silk.
Next, we will focus more on one of the essential products of animal origin: meat. Meat is important in human nutrition, mainly because it is one of the main protein sources. From the graph on the right, it can be seen that since 1960, the global production of meat has been continuously increasing; while in 1960, it was approximately 75 million tons per year, today the production is many times higher and is approximately 350 million tons per year. This rise is related to the increase in the global population but also to the improvement of the economic situation in certain regions, where people can afford to consume meat in larger quantities than in the past. The improvement of the economic situation is also related to the fact, confirmed by various research, that meat quality is the main criterion influencing consumer decisions on the market.
Meat quality is a relatively broad term. Meat quality attributes can be divided into several categories, including Nutritional parameters (as protein and fat content, fatty acid profile and mineral content), sensory parameters (as texture, colour, juiciness, aroma or odour, taste and marbling), safety parameters (as microbiological status, drug residues and heavy metal content), technological parameters which are related to meat processing (as shear force, pH values, drip loss, fat content and water content) and last but not least ethical aspects as sustainibility and animal welfare).
Related to this is the fact that there are really many factors, whether internal or external, that can affect the quality of meat in some way. Among the internal factors we can include the genetics of the animals, which is also related to their breed affiliation, slaughter weight and status of animal which includes its age, condition and health. There are many important external factors, as nutrition, lairage condition, climate, animal handling, social environment, transport, pre-slaughter handling, slaughter procedure, post-slaughter handling (e. g. ageing time) and finally culinary aspects.
One of the important parameters of meat performance evaluation is dressing percentage which represents the percentage of a carcass weight of an animal relative to its live weight. The shape of the carcass body depends on the technological processing and is specific depending on the species.
Average values of dressing percentage for selected categories are given in the table. In cattle dressing percentage ranges between 50 – 60 %, in pigs it is bit higher (between 65 – 80 %), in small ruminants on the contrary lower (about 50 %). The highest values of dressing percentage are achieved in poultry, especially in turkey meat broilers, where we reach values up to 85 %.

Relatively large ranges even within individual species are related to the fact that dressing percentage always depends on the nutritional status of the slaughtered animal.
The SEUROP system is used in the European Union to assess the quality of slaughtered animal carcasses and their subsequent monetization. The name is derived from the designation of individual quality classes. In the case of pigs, we distinguish a total of 6 classes according to lean meat content, while class S is the best and includes pieces with a lean meat content at least 60%; on the other hand, if the carcass contains less than 40% of lean meat, it is assigned to the worst class P .
In cattle, in addition to 6 classes according to muscle development, denoted by the letters S, E, U, R, O, P, there are also five qualitative classes according to fat cover, where 1 is the best class with the minor proportion of subcutaneous fat, and class 5, on the contrary, represents the highest fatness, which is currently undesirable, as we do not have the same use for animal fat as it was in the past, when animal fat was processed, e.g. for the production of soaps.
Here are presented several methods used nowadays for assessment of fat and muscle content. It is for example „fat o meter“, Henessy grading probe or computed tomography, but which is quite expensive. The advantage is that it is possible to evaluate living animals.
On the processed carcass body, we distinguish parts of different value. In general, the most valuable parts include the muscles located along the back of the animal and in its hind parts.
Depending on their characteristics, the individual parts are then suitable for various culinary treatments, especially the length of the heat treatment – cooking or baking – needs to be adjusted.
The so-called marbling, which is determined by the content of intermuscular fat, is very important for the taste and culinary properties of meat. Marbling positively affects the texture, juiciness, aroma and taste of the meat. Different scales are used to rate marbling; in general, the higher the degree of marbling, the higher the price of the meat. The Japanese breed WAGYU is especially characterized by pronounced marbling.
In certain cases, the quality of the meat can be negatively affected by so-called technological defects. The most common are known as DFD and PSE.
DFD means dark, firm and dry meat. It predominantly occurs in beef and lamb, sometimes also in pigs. It is connected with long-term pre-slaughter stress (e.g. transport exhaustion) and depleted level of glycogen. DFD meat is characterized by high pH value and water holding capacity, dark purple red colour, bland taste and smell undesirable for customers. It has reduced shelf life and a greater ability to support microbial growth, resulting in reduced storability.
On the contrary PSE meat is pale, soft and exudative. This deffect predominantly occurs in pigs and poultry and it is usually connected with accute pre-slaughter stress. A mutation in the ryanodine receptor (RYR1) in pigs (pietrain, landrace), which confers sensitivity to halothane and succinylcholine, has been identified as a major cause of PSE. The typical characteristics of PSE meat are low pH value shortly after slaughtering and a high temperature within muscles (above 37 °C) which leads to reduced proteolysis and undesirable characteristics as pale colour and unability to hold its own tissue water.
There are many parameters assessed in meat quality evaluation, including sensory attributes as colour, flavor and smell; physical attributes as water holding capacity, intramuscular fat content (so called marbling) and Warner-Bratzler shear force results as characteristic of meat tenderness); microbiological characteristics as total viable content and bacterial contamination and chemical attributes which characterize composition and nutritional content of meat as protein content, moisture and pH.
Meat quality assessment methods can generally be divided into objective and subjective ones. Each of these groups has its advantages and disadvantages.

The advantage of objective methods, which include various laboratory tests is especially the accuracy of results, on the contrary these methods are often cumbersome, time-consuming and expensive (esp. because special equipment is needed).
For sensory evaluation, which represents subjective methods, no special equipment is needed, but results often depend on the experience of evaluators; these methods have poor reliability and are difficult to quantify, which can be considered as their disadvantages.
The main techniques used nowadays for the evaluation of meat quality are spectroscopic Techniques (for example Near-Infared Spectroscopy, Raman Spectroscopy and Terahertz Spectroscopy), Imaging Techniques (as Hyperspectral Imaging, X-ray imaging and Thermal Imaging), Machine vision as camera shot, ultrasound imaging, nuclear magnetic resonance, computed tomography and electronic nose based on electrochemical or piezoelectric senzors.
Electronic nose is A technique that simulates the human olfactory system.
It is a promising technique for meat freshness detection, shows high potential in quality control.
This technique provides efficient, rapid, non-destructive, real-time, and environmentally friendly testing.
Can distinguish among microbiological, chemical, and physical contaminants in food without any sample preparation.
It is inexpensive, simple to use method with good reproducibility and repeatability.
Computer vision collects and analyzes spatial information gained from digital images of samples, such as color, size, and surface structure. Data analysis is composed of two main parts: image processing and image analysis.
Spectroscopy is considered one of the most promising nondestructive techniques.
It can be used for monitoring and detecting meat quality and microbial contaminations (e.g. shear force, total viable content, intramuscular fat, total volatile basic nitrogen, and thiobarbituric acid-reactive substances in beef; total viable content and total volatile basic nitrogen in pork; and drip loss, moisture and water activity).