Contemporary development of processing of raw materials of animal origin (meat quality evaluation)

Modul no. 4: Precision Livestock Farming

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Lecture content

- What is raw material?
 - Animal-based raw materials
 - Meat as an example
 - Attributes of meat quality
 - Factors affecting meat quality
 - Carcass evaluation



• Meat quality evaluation – general options and selected techniques





I S A G R E E D

Raw materials

• Any basic material that originates from nature.





Plants, trees - based



Minerals, metals, crude oil, coal



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Animal-based

Erasmus+ project 2021-1-SK01-KA220-HED-000032068

I S A G R E E D

Animal-based raw materials

Any basic material that originates from or is produced by living animals.

For human nutrition



Milk

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• Other animal-based raw materials

Wool

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Feathers



Skin



Silk







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Meat

- Main source of protein
 - Increasing consumption in the world
 - Research shows that meat quality is the most important purchase parameter affecting a consumer's decision



https://www.affinityhealth.co.za/which-meats-are-healthiest/





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Factors affecting meat quality





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Dressing Percentage

the percentage of a carcass weight of an animal relative to its live weight

= (carcass weight/slaughter live weight) x 100

Category	Dressing percentage
Cattle	50 – 60 %
Pig	65 – 80 %
Sheep	45 – 55 %
Goat	45 – 50 %
Chicken (meat broilers)	75 – 80 %
Turkey (meat broilers)	80 – 85 %



Always depends on the nutritional status of an animal.



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SEUROP carcass classification for pigs

6 classes according to lean meat content

S = superior

P = poor

SEUROP - CODE	Description (% of lean meat)
S	60 % or more
E	55 - 60 %
U	50 – 55 %
R	45 – 50 %
0	40 – 45 %
Р	Less than 40 %





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SEUROP carcass classification for bovine

6 classes according to **muscle development**



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5 classes according to **fat cover**





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Evaluation of fat/muscle content



FOM



HENNESSY GRADING PROBE



AUTOFOM



COMPUTED TOMOGRAPHY



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Parts of carcass body



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LEG 4010

RUMP 4130

RIBLETS 4164

COLLAR BUTT

SHOULDER PICNIC

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Marbling

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- Given by a presence of an intramuscular fat
- More marbling means more tender and creamy texture and richness
- More marbling = higher price of meat

THE JAPANESE MARBLE SCORE SCALE



https://wagyu.org/for-consumers/what-is-wagyu-beef



USDA MEAT GRADES



https://www.steaksandgame.com/wagyu-beef-grading-and-marble-scores-15658



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Meat defects

DFD (=dark, firm, dry)

- Predominantly in beef and lamb (sometimes also in pigs).
- Connected with long-term pre-slaughter stress (e.g. transport exhaustion) and depleted level of glycogen.
- High pH value and water holding capacity.
- Dark purple red colour, bland taste and smell undesirable for consumers.
- Reduced shelf life and a greater ability to support microbial growth.

PSE (=pale, soft, exudative)

- Predominantly in pork, also in poultry.
- 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 (Guardia et al., 2004).
- Low pH value shortly after slaughtering and a high temperature within meat (above 37 °C)
 - Reduced proteolysis

Undesirable characteristics (pale colour, unability to hold its own tissue water.





Meat quality evaluation

Sensory attributes

- Coloumear
- Flavor
- Smell

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Physical attributes

- Water holding capacity (WHC)
- Intramuscular fat (marbling)
- Warner-Bratzler shear force results (tenderness)

Microbiological characteristics

- Total viable content (TVC)
- Bacterial contamination

Chemical attributes

composition and nutritional content of meat

- Protein content
- Moisture
- pH



Meat quality assessment methods

OBJECTIVE

Laboratory tests

+ Accurate results

- Often cumbersome, timeconsuming and high-cost procedure (esp. because special equipment is needed)

SUBJECTIVE

Sensory evaluation

- + No need of special equipment
- Dependent on experience of evaluators
- Poor repeatability
- Difficult to quantify



https://www.planautomation.com/blog/7-stages-of-qualitycontrol-checks-for-meat-and-poultry



https://www.dti.dk/specialists/sensory-analysis/31883





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Techniques for the evaluation of meat quality

(Wu et al., 2022)

Spectroscopic Techniques

- Near-Infared Spectroscopy
- Raman Spectroscopy
- Terahertz Spectroscopy

Imaging Techniques

- Hyperspectral Imaging
- X-ray imaging
- Thermal Imaging

Machine vision

 Image Acquisition Method (camera shot, ultrasound imaging, nuclear magnetic resonance, computed tomography)

Electronic Nose

- Electrochemical Sensors
- Piezoelectric Sensors



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Electronic nose



Khaled et al. Comp Rev Food Sci Food Safe, Volume: 20, Issue: 4, Pages: 3438-3463, First published: 20 June 2021, DOI: (10.1111/1541-4337.12781)

- A technique that simulates the human olfactory system.
- A promising technique for meat freshness detection, shows high potential in quality control.
- Provides efficient, rapid, nondestructive, real-time, and environmentally friendly testing.
- Can distinguish among microbiological, chemical, and physical contaminants in food without any sample preparation.
- Inexpensive, simple to use, have good reproducibility and repeatability.



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Computer vision



(a) sample, (b) lighting chamber, (c) light source,(d) CCD camera, (e) wire, and (f) computer

Khaled et al. Comp Rev Food Sci Food Safe, Volume: 20, Issue: 4, Pages: 3438-3463, First published: 20 June 2021, DOI: (10.1111/1541-4337.12781)

- CV collects and analyzes spatial information gained from digital images of samples, such as color, size, and surface structure.
- CV data analysis is composed of two main parts: image processing and image analysis.



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Spectroscopy techniques



(a) sample, (b) lighting chamber, (c) light source,(d) spectrograph camera, (e) wire, (f) detector,and (g) computer

Khaled et al. Comp Rev Food Sci Food Safe, Volume: 20, Issue: 4, Pages: 3438-3463, First published: 20 June 2021, DOI: (10.1111/1541-4337.12781)

- Spectroscopy is considered one of the most promising nondestructive techniques.
- Can be used for monitoring and detecting meat quality and microbial contaminations (e.g. shear force, TVC, IMF (intramuscular fat), TVB-N (total volatile basic nitrogen), and thiobarbituric acid-reactive substances in beef; TVC and TVB-N in pork; and drip loss, moisture, water activity).





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