Animal welfare and meat quality
Animal welfare and quality of meat

After bleeding and stunning of animal there is

- A dead animal
- “Dying muscles“
- Process of „dying“ of the muscles is called process of conversion of muscles to product called “meat”
Conversion of muscles to meat

• Important part of a muscle is glycogen which belongs to biochemical group of sugars and it is a source of energy.

• After death of an animal glycogen is metabolised into lactic acid which “digests” or “converts” muscles into product we call “meat”.
Conversion of muscles to meat

- During 24 hours after death of an animal occurs:
  - Process of breaking up of the glycogen to the lactic acid
  - Decreasing acidity of the muscles from pH 7 to pH 5.6
  - Changing of colour of the muscles to bright red
Acute stress and quality of meat

- Any acute (intensive and short term) pre slaughter stress (e.g. panic, rough handling, etc.) results in to:
  - Fight or Flight reaction
  - Increasing of metabolism
  - Increasing of the body temperature
  - **Utilisation** of the body glycogen and its fast breaking up into the **Lactic Acid**
  - Quick **decreasing of pH** after the slaughter
- Those processes results to changes of maturation of muscles and changes of quality of meat
Acute stress and quality of meat

- Quality of meat is changed mostly because of:
  - Decreasing of level of glycogen in muscles approximately about 40%.
  - Rapid decrease of pH from 7 to 5.1 immediately prior to the slaughter.
  - Decreased water holding capacity of muscle cells when acidity drops to pH 5.1.
Acute stress and quality of meat

- Result of such an unwanted process is pale, soft and exudative meat so called PSE meat.
Four main reasons of formation of PSE meat

- Genetics
- Improper manipulation before stunning and slaughter
- Insufficient time of lairaging of animals after the transport
- Improper technology of maturation of meat

Chronic stress and meat quality

In situation when animal before stunning and slaughter are exposed to long term chronic stress, which may be either

- **physical** - long distance transport
- **physiological** – hunger and thirst
- **behavioural** - constant fights between mixed groups of pigs
- or by combination all above mentioned, glycogen in animal body is dramatically decreasing and results in to the biochemical changes of meat.
Losses due to PSE meat

- 5 dollars per carcass (Murray, 2000)
- 4.5 million dollars per year (Faucitano, 2000)
- 40% of unmarketable product (Grandin, 2003)
DFD meat

- Insufficient level of glycogen (decreased by 70%) causes:
  - Insufficient level of lactic acid
  - Acidity changes
  - Insufficient amount of glycogen – “sugar” results in increasing growth of putrid or putrescent bacteria utilizing meat protein for their growth
  - Formation of DRY FIRM and DARK meat – DFD meat

Due to poor shelf life DFD meat is always mixed to processed products
## PSE A DFD meat

<table>
<thead>
<tr>
<th>Colour</th>
<th>Glycogen (in time of slaughter)</th>
<th>Glycogen 24 h. after slaughter</th>
<th>Production of Lactic acid</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>1,0%</td>
<td>0,1%</td>
<td>high</td>
<td>5,6</td>
</tr>
<tr>
<td>Dark DFD</td>
<td>0,3%</td>
<td>0,1%</td>
<td>low</td>
<td>6,0 - 6,5</td>
</tr>
<tr>
<td>Pale PSE</td>
<td>0,6%</td>
<td>0,1%</td>
<td>very high</td>
<td>5,1</td>
</tr>
</tbody>
</table>
## Mixing of animals and PSE and DFD meat

<table>
<thead>
<tr>
<th></th>
<th>Lairaged pigs unmixed</th>
<th>Lairaged pigs mixed</th>
<th>% difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>% PSE</td>
<td>32</td>
<td>42</td>
<td>10</td>
</tr>
<tr>
<td>% DFD</td>
<td>36</td>
<td>52</td>
<td>16</td>
</tr>
</tbody>
</table>

*Fariss 1988*
<table>
<thead>
<tr>
<th>Quality class‡</th>
<th>pH&lt;sub&gt;u&lt;/sub&gt;</th>
<th>DL</th>
<th>JCS §</th>
<th>(L^*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSE</td>
<td>&lt;5.5</td>
<td>&gt;5%</td>
<td>1–1.5</td>
<td>&gt;50</td>
</tr>
<tr>
<td>Moderate PSE</td>
<td>5.5–5.6</td>
<td>&gt;5%</td>
<td>2–3</td>
<td>≥50</td>
</tr>
<tr>
<td>PFN</td>
<td>5.5–5.8</td>
<td>&lt;5%</td>
<td>&lt;3</td>
<td>&gt;50</td>
</tr>
<tr>
<td>RSE</td>
<td>5.6–5.8</td>
<td>&gt;5%</td>
<td>3</td>
<td>42–50</td>
</tr>
<tr>
<td>RFN</td>
<td>5.6–5.8</td>
<td>2–5%</td>
<td>3</td>
<td>42–50</td>
</tr>
<tr>
<td>Moderate DFD</td>
<td>5.8–6.1</td>
<td>&lt;5%</td>
<td>3–4</td>
<td>42–45</td>
</tr>
<tr>
<td>DFD</td>
<td>&gt;6.1</td>
<td>&lt;2%</td>
<td>≥4</td>
<td>≤42</td>
</tr>
</tbody>
</table>

† Modified from Warner (1994).
‡ PSE (pale, soft, exudative); PFN (pale, firm, nonexudative); RSE (red, soft, exudative); RFN (red, firm, nonexudative); DFD (dark, firm, dry).
§ Based on Japanese Color Standards (from 1 = pale to 6 = dark; Nakai <i>et al.</i> (1975).
Meat quality classification

PORK QUALITY STANDARDS

Quality of fresh pork varies greatly. The quality levels shown below will appear differently to consumers, taste differently when cooked, and perform differently when converted to processed products. High quality pork has greater monetary value than low quality pork. Quality can be evaluated by simply visual appraisal, or it can be determined more accurately by scientific tests. This chart may be used to help identify variations in pork quality. Color and Marbling Standards cards are also available.

COLOR - TEXTURE - EXUDATION

**PSE** Pale pinkish gray, very soft and exudative. Undesirable appearance and shrinks excessively.

**RFN** Reddish pink, firm and non-exudative. "IDEAL". Desirable color, firmness and water-holding capacity.

**DFD** Dark purplish red, very firm and dry. Firm and sticky surface, high water-holding capacity.

COLOR STANDARDS

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
<th>L Value</th>
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<tbody>
<tr>
<td>1.0</td>
<td>Pale pinkish gray to white</td>
<td>61</td>
</tr>
<tr>
<td>2.0</td>
<td>Grayish pink</td>
<td>55</td>
</tr>
<tr>
<td>3.0</td>
<td>Reddish pink</td>
<td>49</td>
</tr>
<tr>
<td>4.0</td>
<td>Dark reddish pink</td>
<td>43</td>
</tr>
<tr>
<td>5.0</td>
<td>Purplish red</td>
<td>37</td>
</tr>
<tr>
<td>6.0</td>
<td>Dark purplish red</td>
<td>31</td>
</tr>
</tbody>
</table>
Direct losses

Bruises and fractures

HAM BRUISES

ECONOMICAL LOSSES

Foto: Osmar Dalla Costa
World Society for the Protection of Animals

Fotos: Osmar Dalla Costa
Blood splash
SOURCE: National Pork Producers Council (USA).
Carcase damage to be recorded for whole carcase

1. Very slight blemish
2. Slight blemish
3. Moderate blemish
4. Severe blemish
World Society for the Protection of Animals
FOR ANIMALS IT IS NOT IMPORTANT WHAT YOU THINK, BUT WHAT YOU DO!!!
Who Wins ????
Video recap
Questions??
World Society for the Protection of Animals