An example of successful practice of pig rearing: Cinta Senese

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Workshop
"Fattening pigs on higher weights in relation to high quality meat products"
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Department of Agrifood Production and Environmental Sciences
- Animal Science Section -
Universita' degli Studi di Firenze
The activity of the Animal Science Section of the Department of Agricultural Biotechnology is mainly focussed on the following areas:

• Extensive animal breeding and sustainability
• Animal biotechnology
• Management and breeding of wildlife
• Aquaculture and fishing
• Lipid metabolism and nutraceutic
• Conservation and exploitation of animal germplasm
• Traceability and characterization of feed of animal origin
• Quality of animal products
Local breeds of some Mediterranean countries listed by Domestic Animal Diversity Information System of FAO (http://dad.fao.org/)

<table>
<thead>
<tr>
<th>Croatia</th>
<th>France</th>
<th>Greece</th>
<th>Italy</th>
<th>Portugal</th>
<th>Slovenia</th>
<th>Spain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Slavonian</td>
<td>Bayeux</td>
<td>Greek</td>
<td>Apulo-Calabrese</td>
<td>Alentejana</td>
<td>Krskopolje</td>
<td>Iberico</td>
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<tr>
<td>Turopolje</td>
<td>Blanc del'Ouest</td>
<td>Casertana</td>
<td>Bisaro</td>
<td>Iberico (Dorado Gaditano)</td>
<td>Chato Murciano</td>
<td></td>
</tr>
<tr>
<td>Basque</td>
<td>Cinta Senese</td>
<td></td>
<td></td>
<td>Iberico (Mamellado)</td>
<td>Gochu Asturcelta</td>
<td></td>
</tr>
<tr>
<td>Corse (Nustrale)</td>
<td>Mora Romagnola</td>
<td></td>
<td></td>
<td>Iberico (Negro Entrepelado)</td>
<td>Negra Mallorquina</td>
<td></td>
</tr>
<tr>
<td>Cul noir de Limousine</td>
<td>Nero Siciliano</td>
<td></td>
<td></td>
<td>Iberico (Negro Lampiño)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasconne</td>
<td>Sarda</td>
<td></td>
<td></td>
<td>Iberico (Retinto)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Siciliano</td>
<td></td>
<td></td>
<td>Iberico (Torbiscal)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Manchada de Jabugo</td>
<td>Negra Canaria</td>
<td></td>
</tr>
</tbody>
</table>
http://www.anas.it

Cinta Senese

Mora Romagnola

Sarda

Casertana

Nero Siciliano

Apulo Calabrese
Products from Cinta Senese

lardo

Prosciutto crudo

capocollo

salame

None, among these, have the PDO label!

pancetta
PDO label only for fresh meat

2000: “Consorzio di Tutela del Suino Cinto Toscano” was born and the application for the PDO label at fresh meat of Suino Cinto toscano was made (the name of the breed “Cinta Senese” can’t be used).

2006: The Consorzio obtained the “transitory protection” at national level.

2007: The Istituto Nord Est Qualità (INEQ) started to make the controls.

2009: The European Commission accepts the request but reject the name “Cinto Toscano”, due to the absence of historical relevance of this name.

2012: The Consorzio obtain the permission by the EU to call the PDO fresh meat with the name of the breeds: “Cinta Senese”

2014: The Consortio obtained the DOP label
Cinta Senese pig reaches the slaughter weight of 150 kg at age variable from 12 to 24 months.
Strategies for feeding in pigs have a great importance in the determination of chemical, physical and sensorial characteristics of meat and of processed products.

The literature refers largely to conventional and improved breeds.
chemical, physical and sensorial traits, considered to define the quality of pig products, are largely influenced by the fat component.
<table>
<thead>
<tr>
<th>Authors</th>
<th>Breeds</th>
<th>IMF (% on w.b.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labroue et al. (2000)</td>
<td>Basque</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>Gascon</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>Limousine</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td>Blanc de l’Oueste (on LL)</td>
<td>2.9</td>
</tr>
<tr>
<td>Karolyi D. et al. (2007)</td>
<td>Black Slavonian</td>
<td>~ 6</td>
</tr>
<tr>
<td>Zullo et al., (2003)</td>
<td>Casertana (means of several muscles)</td>
<td>~ 4</td>
</tr>
<tr>
<td>Salvatori et al., (2008)</td>
<td>Casertana (on LL)</td>
<td>~ 2</td>
</tr>
<tr>
<td>Fortina et al., (2005)</td>
<td>Casertana (on LT)</td>
<td>~ 5</td>
</tr>
<tr>
<td>Poto et al., (2007)</td>
<td>Chato Murchano (on LL)</td>
<td>~ 10</td>
</tr>
<tr>
<td>Franci et al. (2005)</td>
<td>Cinta Senese (on LL)</td>
<td>~ 3</td>
</tr>
<tr>
<td>Coutron-Gambotti et al., (1998)</td>
<td>Corsican (on BF)</td>
<td>8.2</td>
</tr>
<tr>
<td>Fernández et al., (2007)</td>
<td>Iberico (on LL of 2664 pigs)</td>
<td>~ 10 (minimum 3.27-maximum 29.21)</td>
</tr>
<tr>
<td>Fortina et al., (2005)</td>
<td>Mora Romagnola (on LT)</td>
<td>~ 6</td>
</tr>
<tr>
<td>Pugliese et al. (2004)</td>
<td>Nero Siciliano (on LT)</td>
<td>&gt; 3</td>
</tr>
</tbody>
</table>
Chemical parameter: lipids

By quantitative point of view

Increased amount of IMF -> more tasty meat (within certain limits)
Chemical parameter: lipids

By qualitative point of view

Aroma

- Aldehydes
- Ketones
- Esters
- Alcohols
- Acids
- Hydrocarbons

glycerol

- Oleic acid
- Linoleic acid

Ni za razpečevanje
Rearing systems in the Cinta Senese fattening = outdoor

But ...what we talk about when we talk about... outdoor...

- Outdoor in confined area mixture only
- Outdoor Pasture on wood + mixture
- Pasture on wood

High characterization of products
How to increase the quantity of IMF

Growing
limiting the earliest fat depots + stimulating the skeletal and muscle growth = feeding restriction -> 70% of ad libitum consumption

Fattening
Promoting compensatory growth

++ IMF
According to Lebret (2008), the nutritional strategies to improve the quality of the products, are:

-- feeding restriction
-- feeding restriction and re-alimentation
-- protein level and quality

**Feeding restriction - improved breeds**

feeding restriction vs *ad libitum* reduces the growth rate and leads to leaner carcasses (Quiniou et al. 1995; Lebret et al., 2001)

The growth rate of adipose tissue increases with the age, whereas the protein deposition remains constant. The fat deposition is more sensitive to a reduction of energy intake during the fattening period.
in the extensive conditions, the reduction of growth rate is consequence both of feeding allowance and use of natural resources so, it is not possible to evaluate the true effect of feeding restriction on the quality of the products.

In Cinta Senese the 15% decreasing in growing rate determines a lower percentages of fat cuts and IMF and also lower WHC (Franci et al., 2005; Pugliese et al., 2003; Sirtori et al. 2011)

Ni za razpečevanje
Feeding restriction and re-alimentation applied to produce the **compensatory growth**, an accelerated rate of weight gain due to *ad libitum* feeding subsequent to a period of limited food supplied.

This strategy allows to locate the high energy supply when the pig is older and, because of the limited growth in the previous phase, it favours the fat deposition, both in the subcutaneous and muscular depots.
Trend of growth and meat quality traits in Cinta Senese pig according two rearing systems (Acciaioli et al., 2002; Pugliese et al., 2005)

<table>
<thead>
<tr>
<th></th>
<th>Indoor</th>
<th>Outdoor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slaughter weight kg</td>
<td>136.2a</td>
<td>127.7b</td>
</tr>
<tr>
<td>Age d</td>
<td>312 a</td>
<td>510 b</td>
</tr>
<tr>
<td>Total fat cuts %</td>
<td>36.7 a</td>
<td>41.0 b</td>
</tr>
<tr>
<td>IMF %</td>
<td>3.3 a</td>
<td>4.0 b</td>
</tr>
<tr>
<td>Cooking loss %</td>
<td>26.6 a</td>
<td>30.3 b</td>
</tr>
<tr>
<td>Shear force on cooked meat N</td>
<td>105 a</td>
<td>151 b</td>
</tr>
<tr>
<td>L*</td>
<td>50.13 a</td>
<td>45.78 b</td>
</tr>
<tr>
<td>a*</td>
<td>11.77 a</td>
<td>14.95 b</td>
</tr>
<tr>
<td>On subcutaneous fat (% of FAs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MUFA</td>
<td>53.3 a</td>
<td>55.08 b</td>
</tr>
<tr>
<td>PUFA n-3</td>
<td>0.39 a</td>
<td>1.02 b</td>
</tr>
<tr>
<td>PUFA n-6</td>
<td>10.05 a</td>
<td>12.30 b</td>
</tr>
</tbody>
</table>
How to increase the quality of IMF

行政，在肥育期间，使用化学组成（特别是酸性）合适的饲料

例子：

户外，在有限的区域内
混合物仅

在这一阶段，原料的特性分析过程

使用向日葵“高油酸”来改善新鲜肉的感官特性

“高油酸”杂交种可含有高达92-93%的油酸！
The pasture, if well managed, imparts a strong characterization of the product. It acts, mainly, on the lipid content.

**+** Quantity of lipids

**+** Quantity and quality of lipids

- > IMF
- > IMF with > MUFA and PUFA

**Indirect effect** > higher age at slaughter (< ADG)

**Direct effect**
Lardo

- Oleic acid
- Linolenic acid
- Omega-3

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th>acido oleico</th>
<th>%</th>
<th>omega -3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chestnut</td>
<td>44,2</td>
<td></td>
<td>1,18</td>
<td></td>
</tr>
<tr>
<td>Acorn</td>
<td>44,9</td>
<td></td>
<td>1,06</td>
<td></td>
</tr>
<tr>
<td>Mixture</td>
<td>42,0</td>
<td></td>
<td>1,03</td>
<td></td>
</tr>
</tbody>
</table>
Oleic acid

Linolenic acid

Omega-3
Acidic composition of feeds

- Castagna: 38.3%
- Ghianda: 48.3%
- Concentrato: 60.7%

MUFA:
- Castagna: 38.3%
- Ghianda: 46.3%
- Concentrato: 46.2%

PUFA:
- Castagna: 20.3%
- Ghianda: 34.2%
- Concentrato: 60.7%
Aromatic compounds in fat tissue of Cinta Senese dry-cured ham
Rearing system effect

Analysis on fresh muscles

The target weight was 130 kg for all pigs

Age at slaughtering

530 d
350 d 370 d 330 d

530 d
350 d 370 d 330 d

Ni za razpečevanje
The protein requirements of the improved pig breeds have been widely studied (Whittemore et al., 2001) in terms of growth and feeding efficiency (Campbell et al., 1984; Hansen and Lewis, 1993).

Lebret (2008) reports that unbalanced diets (with insufficient ratio of protein or lysine to energy content) increased IMF content and improved tenderness and juiciness of meat.
<table>
<thead>
<tr>
<th>Protein content of diet (%)</th>
<th>8</th>
<th>10</th>
<th>13</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dietary Lysine %</td>
<td>0.21</td>
<td>0.37</td>
<td>0.57</td>
<td>0.79</td>
</tr>
<tr>
<td>Total fat cuts</td>
<td>37.16&lt;sup&gt;a&lt;/sup&gt;</td>
<td>32.92&lt;sup&gt;b&lt;/sup&gt;</td>
<td>33.95&lt;sup&gt;b&lt;/sup&gt;</td>
<td>33.30&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cooking loss %</td>
<td>20.90&lt;sup&gt;a&lt;/sup&gt;</td>
<td>16.26&lt;sup&gt;b&lt;/sup&gt;</td>
<td>16.51&lt;sup&gt;b&lt;/sup&gt;</td>
<td>18.32</td>
</tr>
<tr>
<td>WB on cooked meat kg</td>
<td>9.70</td>
<td>10.32</td>
<td>10.93</td>
<td>9.60</td>
</tr>
<tr>
<td>IMF %</td>
<td>6.58&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.18&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.78&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.07&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Protein %</td>
<td>21.36&lt;sup&gt;a&lt;/sup&gt;</td>
<td>22.78&lt;sup&gt;b&lt;/sup&gt;</td>
<td>23.52&lt;sup&gt;b&lt;/sup&gt;</td>
<td>23.23&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Colour parameter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- L*</td>
<td>48.47&lt;sup&gt;a&lt;/sup&gt;</td>
<td>45.75&lt;sup&gt;b&lt;/sup&gt;</td>
<td>44.85&lt;sup&gt;b&lt;/sup&gt;</td>
<td>45.38&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>- a*</td>
<td>11.33</td>
<td>10.55</td>
<td>11.00</td>
<td>10.94</td>
</tr>
<tr>
<td>- b*</td>
<td>3.59&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.90&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.52&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.74&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Low protein limits muscle deposition and the energy which would have been used for muscle synthesis is diverted to fat synthesis. In the later stages of growth, intramuscular fat is particularly affected (Wood et al., 2008).
Conclusion

the feeding strategy, related to quantitative and qualitative modulation of the diet, can affect the quality of meat and cured products.

Cinta Senese and the other local breeds are slaughtered at high weights and ages so they can benefit from the effects of compensatory growth linked to dietary restrictions for energy and/or protein.

However, this tool must be properly calibrated to avoid excessive development of fat.
Hvala lepa!