The contribution of mountain pastures to the link to terroir in dairy and meat products

B. Martin¹, M. Coppa², I. Verdier-Metz³, M.C. Montel³, I. Casasús⁴, M. Joy⁴, M. Blanco⁴

¹ INRA, Joint Research Unit on Herbivores, Theix, France
² DISAFA, University of Turin, Italy
³ INRA, Cheese Research Unit, Aurillac, France
⁴ CITA-Aragón, Zaragoza, Spain
Mountain areas in the EU-27

- 18% of the farms
- permanent grasslands: 58% of the mountain AA
- Mountain products
  -cattle: 10% of the milk & 14% of the meat
  -sheep/goats: 32% of milk & 23% of the meat
- Higher production costs (about +10%)
- Richness of traditions and knowhow: an opportunity to add value to the products
- Numerous Geographical Indications
  - 45% of the total number
  - share in agricultural turnover:
    23% for milk and 6% for meat sectors (< 5% in average)

Santini et al., 2013

19th Meeting of the FAO-CIHEAM Mountain Pastures sub-network
14-16 June 2016 – Zaragoza, Spain
Preserved mountain landscapes and culture

Some emblematic success stories do exist

- efficient specific public policies since 1970
- initiatives of local leaders who protected (Geographical Indications) and developed their traditional products...
Geographical Indication

**PDO:** Protected Designation of Origin  
**PGI:** Protected Geographical Indication

Regulation (EC) 628/2008

Separate type of **intellectual property** based on the link to terroir

“A **PDO** is a product that originates from a territory and **whose characteristics are linked** mainly to the geographical environment including **human and natural factors**”

Definition of Terroir

“A geographical limited area where a human community generates and accumulates along its history a set of cultural distinctive features, knowledge and practices based on a system of interactions between biophysical and human factors.”

Casabianca et al., 2006

Natural factors
Geographical area

Human factors
Historical practices

Original production systems and practices

“typical products”
The link to terroir for animal products

- Soil, climate
- Grassland
- Diet
- Animal
- Milk, carcass
- Cheese, meat
- Breeds and animal management
- Farming system and practices
- Direct or indirect flows of molecules and microbes
- Regulation factors
- Social organisation
- Collective knowhow

Specific botanical composition of mountain permanent grasslands
Specific breeds

Adapted from Dorioz et al., 2000
Dairy products

Meat products
Botanical composition of forages and cheese sensory characteristics

On-farm conditions

- Cheese sensory properties are modified when the botanical composition of the pasture changes

Grasslands from lowland rich grasses and legumes

- Intense taste and cabbage or pungent flavours

Abondance cheese

Grasslands rich in a wide variety of highland dicot.

- Fruit, hazelnut and cooked milk flavours

Buchin et al., 1999
Bugaud et al., 2001
Martin et al 2005
Botanical composition of forages and cheese sensory characteristics

Experimental conditions

- the effect of the biodiversity of pastures on cheese flavour is weaker; it is revealed during ripening... and varies during summer.

Coppa et al., 2011
Mountain pastures and plant secondary metabolites

Terpenes of aromatic plants:
- Transferred to cheese
- Influence on cheese sensory still controversial: no effect or slow ripening

Phenolic compounds:
- Highly variable according to the botanical composition of grasslands
- Direct and indirect transfer to milk... influence on cheese sensory properties?
Mountain pasture and milk fatty acids

Specific composition of mountain milk fat...

- Higher milk concentration in $\omega-3$ fatty acids...
- ...due to a limitation of rumen biohydrogenation by plant secondary metabolites

... highly variable according to:

- Proportion of grazed grass in the diet
- Phenological stage of the grasslands
- ... grazing management...

Coppa et al., 2015

B. Martin et al. 19th Meeting of the FAO-CIHEAM Mountain Pastures sub-network 14-16 June 2016 – Zaragoza, Spain
Microbiota of raw milk: influence on cheese

Comparison of Swiss-type cheeses made with raw (Raw), microfiltered (MF) or pasteurized (Past) milk: microbiology, flavour and volatile compounds

Elimination of raw milk microbiota:

- Decrease metabolic activity during ripening (proteolysis, fermentation)
- Loss of flavour intensity and richness
Microbiota of raw milk: diversity still exists

From 50 Studies

Lactic acid bacteria - 65 species - N 10-100 CFU/ml (cow milk)

300 Bacterial species
74 Yeast species
qualitative & quantitative differences

Gram negative bacteria - 94 species - N : 10_1000 cfu/ml (cow milk)

Ripening bacteria - 94 species - N100-1000 c/fuml (cow milk)

One Milk microbiota = more than 30 microbial species

Montel et al., 2015
Microbiota of raw milk: diversity is fragile

300 Bacterial species
74 Yeast species
qualitative & quantitative Differences

Excessive disinfection (teats & milking machine)

Pasteurisation

Species

<table>
<thead>
<tr>
<th>Pasteur</th>
<th>Hay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactic acid bacteria</td>
<td>80</td>
</tr>
<tr>
<td>Ripening bacteria</td>
<td>70</td>
</tr>
<tr>
<td>Gram negative bacteria</td>
<td>60</td>
</tr>
<tr>
<td>Other (Bacillus)</td>
<td>50</td>
</tr>
</tbody>
</table>

19th Meeting of the FAO-CIHEAM Mountain Pastures sub-network
14-16 June 2016 – Zaragoza, Spain
Dairy products

Meat products
Lamb and beef in Mediterranean countries

production indoors concentrate-feeding

• **Light lambs**
  
  **Suckling phase**
  Ewe: straw/hay + concentrates
  Lamb: dam’s milk

  **Weaning** 1.5 mo

  **Intensive fattening**
  straw/hay + concentrates (indoors)

  **slaughter 10-12 kg**

• **Young bulls** (12-14 months)

  **Suckling phase**
  Cow: indoors / pasture
  Calf: dam’s milk

  **Intensive fattening**
  straw/hay + concentrates (indoors)

  200 kg LW 500 kg LW

  **weaning**

**BUT... nowadays interest for grazing-based systems (image, healthy meat)**

Do the carcass and meat correspond to consumers demand (white fat, pale pink meat)?
Light lambs in mountain areas:

Indoors vs. grazing meadows, alfalfa, ...

- **Performance**: No or minimal effects

- **Subcutaneous fat colour**:
  - Subjective: no effect
  - Instrumental: grazing increased yellowness

  Consumers will not perceive the difference but possibility to trace grazing

- **Meat**: pasture
  - decreased intramuscular fat and
  - improved fatty acid profile
Fattening cattle in mountain areas:

Indoors concentrates vs. grazing meadows, alfalfa, ... 

- Performance: grazing decreased growth rates but ...

depending on the type and quantity of supplement

<table>
<thead>
<tr>
<th></th>
<th>Weight gains, kg/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>pasture + 3 kg conc</td>
<td>1.269</td>
</tr>
<tr>
<td>pasture + ad lib conc</td>
<td>1.495</td>
</tr>
<tr>
<td>alfalfa + 1.8 kg barley</td>
<td>1.359</td>
</tr>
<tr>
<td>concentrate young bulls</td>
<td>1.517</td>
</tr>
<tr>
<td>concentrate</td>
<td>1.77</td>
</tr>
<tr>
<td>pasture + 4 kg corn steer</td>
<td>1.12</td>
</tr>
<tr>
<td>concentrate</td>
<td>1.35</td>
</tr>
</tbody>
</table>
Fattening cattle in mountain areas:

Subcutaneous fat:
- **cover**: scarce in grazing cattle
- **colour**: grazing increased yellowness

Meat quality when similar slaughter weight and fat cover:
- **Toughness & colour**: no effect
- **Fatty acid profile**: improved by grazing
  affected by the finishing period depending on:
  * the type of feed
  * the length of the period
Conclusions

The link to terroir: key role of mountain grasslands on

✓ Product chemical (and microbial) composition
✓ Product sensory properties (sometimes poorly understood)

Link between grassland and product varies

✓ Grassland management
✓ Diet formulation
✓ Milk pasteurisation
✓ ... 

Objective references for mountain food chains labelled with Geographical Indications:

✓ Refine the understanding of the link to terroir
✓ Develop appropriate specifications so that products reflect the best the uniqueness of their terroir

and add value to the production chain!
Thank you for your attention