Innovation in dairy products:
use of donkey's milk as a functional food,
preliminary results.

Magali Peter

Henri TONGLET, Gwenaëlle JARD, Hélène TORMO, Djamila ALI HAIMOUD-LEKHAL
INP Ecole d’Ingénieurs de Purpan
Département d’Enseignement et de Recherche en Sciences Agronomiques et Agroalimentaires
Introduction

- Virtues recognized since antiquity

- Strong resemblance to human milk

- Interesting properties for human health (Salimei and Fantuz 2012)

  - hypoallergenic substitute (Carroci et al., 2000)
  - prevention of atherosclerosis (Chiofalo et al., 2006)
  - stimulation of the immune system of healthy elderly consumers (Jirillo et al., 2010)
  - *in vitro* anti-proliferative and anti-tumour activity (Mao et al., 2009)
  - *in vivo* anti-oxydant and anti-inflammatory effects (Lionetti et al., 2012)
Current use

**Cosmetic**

**Diet**

Donkey’s milk powder

Fermented beverages using bacterial strains

*(Chiavari et al., 2005; Coppola et al., 2002)*
Context of the study

French production:
- under development
- artisanal production
- global competition

Need to increase and diversify products

Natural attributes of donkey’s milk described in the literature

Development of a functional food for human consumption

Evolution of the number of donkey’s farms in France since 1998
(MESNILDREY, 2009)
A global project

1. Microbiological composition
   Check Sanitary quality
   Technological suitability

2. Biochemical composition
   Nutritional quality
   Functional and bioactive components

3. Health effects
   Mice in vivo
   Alleged health claims
   Work in progress

4. Food engineering
   Work in progress

Are there possibility to use French donkey's milk as a functional food?
Materials and methods

2 Farms

Farms
- Farm 1: organic (n=12)
- Farm 2: traditional (n=20)

Biochemical composition characterization

- **Major components** (standard methodology)
  - Dry matter, fat, protein, lactose, ash

- **Functional components**
  - Fatty acids composition (GC)
  - Lysozyme content (RP-HPLC)

Variability of the functional components content: rearing conditions, ANOVA

Involved in potentially human health effects

n = 4

1 time per week over 4 months
Biochemical composition of donkey’s milk
(g.100g-1 of milk)

<table>
<thead>
<tr>
<th>Component</th>
<th>Mean ± SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter</td>
<td>9.29 ± 0.92</td>
<td>7.69</td>
<td>10.9</td>
</tr>
<tr>
<td>Fat</td>
<td>0.86 ± 0.33</td>
<td>0.33</td>
<td>1.59</td>
</tr>
<tr>
<td>Protein</td>
<td>1.42 ± 0.15</td>
<td>1.14</td>
<td>1.65</td>
</tr>
<tr>
<td>Lactose</td>
<td>7.14 ± 0.72</td>
<td>5.87</td>
<td>8.15</td>
</tr>
<tr>
<td>Ash</td>
<td>0.35 ± 0.05</td>
<td>0.24</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Results consistent with data in literature

1: Salimei et al., 2012
2: Hosoi et al., 2005
3: Michel and Wattiaux 2000
Fatty acid composition of donkey’s milk (% of fatty acids)

DHA and EPA were not sought

(n=32)
Fatty acid composition of donkey’s milk: comparison between the two farms (% of fatty acids)

Digestive properties: nutrients directly absorbed by the small intestine
Diets fatty acid composition: comparison between the two farms (% of fatty acids)
## Results

### Functionnal Components: lysozyme

#### Lysozyme content of donkey’s milk (mg.ml⁻¹ of milk)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>lysozyme</td>
<td>3.68</td>
<td>1.13</td>
</tr>
</tbody>
</table>

### Literature

<table>
<thead>
<tr>
<th></th>
<th>Donkey’s milk¹</th>
<th>Human milk²</th>
<th>Cow milk²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>1 - 4</td>
<td>0.04-0.2</td>
<td>traces</td>
</tr>
</tbody>
</table>

2: FAO (1998)

### Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Lysozyme content (mg/ml)</th>
<th>Ratio casein/whey protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chiavari et al., 2005</td>
<td>3.75</td>
<td>1.19</td>
</tr>
<tr>
<td>Polidori and Vincenzetti , 2010</td>
<td>1.00</td>
<td>0.88</td>
</tr>
<tr>
<td>Our study</td>
<td>3.68</td>
<td>1.56</td>
</tr>
</tbody>
</table>
Results  ➤ Functionnal Components : lysozyme

Lysozyme content of donkey’s milk: comparison between the two farms (mg.ml⁻¹ of milk) (n=32)

<table>
<thead>
<tr>
<th>Lysozyme</th>
<th>Mean</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm 1</td>
<td>4.10</td>
<td>1.58</td>
</tr>
<tr>
<td>Farm 2</td>
<td>3.41</td>
<td>0.65</td>
</tr>
</tbody>
</table>

upward trend

No significant difference

LITERATURE
lactation stage (Vincenzetti et al., 2008)
production season (D’Alessandro et al., 2011)
Link with breeding conditions

1 : early stage of lactation
1 : late lactation
2 : late lactation
First results on french milk

- Similar to those of italian or chinese results
- High PUFA n-3 and lysozyme content
- Further studies on the effect of rearing conditions are needed

Promising prospects for valuation of donkey milk as a functional food

Complementary investigations