Cledwyn Thomas (EAAP) and John Wallace (Univ of Aberdeen)

Collaborative project
www.ruminomics.eu
The rumen microbiota is essential for ruminants effectively to utilise dietary material.
Rumen fermentation

1 mole hexose

\[ \begin{align*}
2 \text{ acetate} + 2 \text{ CO}_2 + 8 \text{ H} \\
\rightarrow 1 \text{ butyrate} + 2 \text{ CO}_2 + 4 \text{ H} \\
\rightarrow 2 \text{ propionates} - 4 \text{ H}
\end{align*} \]

Hydrogen liberated by acetate and butyrate production and utilized in propionate production.
Technologies to Reduce Enteric Methane Emissions

Animal Manipulation
- Animal Breeding
  - Residual Feed Intake
  - Efficiency
- Management Systems
  - Alternative Livestock Systems
  - Unproductive Animals

Diet Manipulation
- Forage Quality
  - Plant Breeding
- Dietary Supplements
  - Dietary Oils
  - Probiotics
  - Enzymes
  - Dicarboxylic Acids

Rumen Manipulation
- Biological Control
  - Bacteriophages
  - Bacteriocins
  - Reductive Acetogenesis
- Vaccination
- Chemical Defaunation

Genetics/Genomics

• Variation in Milk Yield/Growth Rate and Efficiency – conventional breeding strategies.
• New information suggests also animal variation in Methane emission
• BUT Methane arises from the rumen microbiome
RuminOmics
Connecting the animal genome, the intestinal microbiome and nutrition to enhance the efficiency of ruminant digestion and to mitigate the environmental impacts of ruminant livestock production

Collaborative project
www.ruminomics.eu
RuminOmics - Aims of project

- Does the animal itself determine its ruminal microbiome?
- If so, is this a heritable trait?
- How does nutrition affect this relationship?
Work Package Structure

WP 1
Management

WP 2
Methods development & SOPs

WP 3
Animal phenotypes

WP 4
Host-microbiome

WP 5
Nutrition

WP 6
Molecular analysis

WP 7
Data management and analysis

WP 8
Novel tools for end-users

WP 9
Dissemination and training

WP 10
Industry participation and technology transfer
Workpackages

The work plan comprises 9 interlinked work packages (WP 2 to 10) supported by a Coordination and Management WP.

• WP 2 will establish best approaches for metagenomics and microbiomics and will establish a common set of Standard Operating Procedures (SOPs) to apply across research sites.
Workpackages

• WPs 3-5 are data-generating in relation to animal phenotypes, host-microbiome relationships and nutritional strategies.
• Samples will be subjected to molecular analysis in WP 6 and data will be modelled in WP 7 by a combination of advanced statistical approaches, bioinformatics and systems biology.
• Outcomes from these analyses will feed into the tools for end users in WP8
• WP9 will disseminate project outputs and enhance capacity
RuminOmics - Partners

<table>
<thead>
<tr>
<th>Participant no.</th>
<th>Participant organisation name</th>
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<tbody>
<tr>
<td>1 (Coordinator)</td>
<td>University of Aberdeen</td>
</tr>
<tr>
<td>2</td>
<td>Parco Tecnologico Padano</td>
</tr>
<tr>
<td>3</td>
<td>Agrifood Research Finland</td>
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<tr>
<td>4</td>
<td>Swedish University of Agricultural Sciences</td>
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<tr>
<td>5</td>
<td>University of Nottingham</td>
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<tr>
<td>6</td>
<td>Institute of Animal Physiology &amp; Genetics</td>
</tr>
<tr>
<td>7</td>
<td>Università Cattolica del Sacro Cuore, Piacenza</td>
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<tr>
<td>8</td>
<td>Centre National de la Recherche Scientifique</td>
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<td>9</td>
<td>European Association of Animal Production</td>
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<tr>
<td>10</td>
<td>European Forum of Farm Animal Breeders</td>
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<td>11</td>
<td>Quality Meat Scotland</td>
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</tbody>
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RuminOmics - Experiments

• 1000 cows in UK, Italy, Sweden, Finland
  - Methane
  - N emissions
  - FCE
  - Milk quality

• 20 cows in Sweden, Finland
  - Impact of N, CHO, lipid nutrition

• 50 cows in UK, Italy, Sweden, Finland
  - Full metagenome analysis

Ruminal microbiome
Animal genotype
RuminOmics - Experiments II

Bovine single-egg twins

Interspecies digesta transfer
RuminOmics - Aspirations

• The answer to the animal-microbe conundrum
• Bioinformatics legacy
• Trained & more efficient industry
• Environment legacy
Collaborative workshops

● Joint RuminOmics/Rumen Microbial Genomics Network workshop - *Harmonization of techniques associated with ruminal microbiome and metagenome analysis*, Dublin June 2013


You can find the presentations on the RuminOmics website: http://www.ruminomics.eu
Training and ELearning

• Summer School for young scientists in Piacenza 2014

• Elearning courses being developed in
  – Environmental Impact of Livestock
  – Rumen Microbial Ecology
  – Next Generation Sequencing (Metabarcoding and Metagenomics)
  – Developing tools for end users
Regional Workshops

- Warsaw (see later)
- Budapest (28 and 29 September)
- Lodi (5 and 6 October)
- Edinburgh (10 and 11 November)

Information on
www.ruminomics.eu
For further information and discussion

Come to our workshop tomorrow at the WESTIN HOTEL in central Warsaw (10.00h – 18.30h).
Free registration (lunch & dinner included)

www.ruminomics.eu
Sustainable Organic and Low Input Dairying (SOLID)
European Project n° 266367

www.solidairy.eu