Erasmus Mundus Food of Life

Introduction to University of Helsinki

Per Ertbjerg
The Viikki Campus
2007

Downtown Helsinki

‘Old town’ where Helsinki was founded in 1550 by the Swedish King Gustaf Wasa
Helsinki 1550
• founded by Gustaf Wasa, King of Sweden
  • The fields of Viikki for cattle & horses
  • The town was moved 4 km to south around 1640
• In 1812 Helsinki became the capital of the Grand Duchy of Finland, conquered by Russia in 1811
• Academy of Turku, founded in 1640
  • moved to Helsinki in 1827 after a fire in Turku
  • University of Helsinki 1828
Four of the 8 faculties of the University are in Viikki
• Faculty of Pharmacy
• Faculty of Biosciences
• Faculty of Veterinary Medicine
• Faculty of Agriculture and Forestry

Other institutions, such as:
• Finnish Food Safety Authority (Evira)
EMFOL Summer School
Viikki Campus today

Department of Food and Environmental Sciences 2010
- Food Technology
- Human Nutrition
- Food Chemistry
- Soil and Environmental Chemistry
- Food and Environmental Microbiology
Viikin infokeskus Korona
Faculty of Agriculture and Forestry
Departments of
  • Agriculture  • Forestry  • Economics and Management
  • Food and Environmental Sciences

The Faculty in figures (all four departments):

• Personnel ca 500
• Graduate students 2700 (international 170)
• PhD students 480 (international 104)
• 7 international MSc programmes
• DSc degrees 35
• MSc 194
• BSc 247
• Centres of Excellence (SA) 4
• Total budget 2011 42 mio €
http://www.youtube.com/watch?v=rU232NPDVtQ&list=PL89BA3B68F463D809&index=1&feature=plpp_video
Department of Food and Environmental Sciences

Food Science buildings in Viikki (D and EE)
Personnel

- The total number of employees is about 200
- 17 professors
- 23 university lecturers
- 3 other teachers
- 17 in technical support
- 12 in administration
- 75 doctoral students
- 35 post doc and senior researchers
- 25 students doing their theses in research projects
Students

- 500 undergraduate students in total
- 100 students enrolled yearly to BSc/MSc studies
  - 15 to MSc Programme in Food Sciences (MScFood)*
  - 16 to MSc Programme in Environment and Natural Resources (MENVI)*
  - 15 to MSc Programme in Biotechnology (MBIOT)*
- 100 PhD students

* [www.helsinki.fi/internationalprogrammes](http://www.helsinki.fi/internationalprogrammes)
http://www.youtube.com/watch?v=hDPeS5kn_Tc&list=PL5C4C61A7FD0F3B78&index=1&feature=plpp_video
Department of Food and Environmental Sciences

Division of Food Technology

- 5 Main areas
  - General Food Technology
  - Sensory Science
  - Cereal Technology
  - Dairy Technology
  - Meat Technology

EMFOL Theses projects
Students in the Programme

- Edition 1 (2010 - 2012 Finalised)
  - Helsinki 10 (out of 20)
  - Helsinki 9 (out of 17)
  - Helsinki 6; Barcelona 7, Copenhagen 5, Uppsala 1
  - 2nd year: Helsinki 10 out of 14
- Edition 5?
EMFOL at University of Helsinki
MSc Thesis in Meat Technology or in Dairy Science

• 25 Completed Master Thesis
  • 10 in 2012
  • 9 in 2013
  • 6 in 2014 (currently finishing)
• 10 planned in 2015 (about to start)
Students after the EMFOL Programme

• Some go back to work in their home countries
• Many have ambitions for Doctoral Studies
• Of 20 from 1st intake about 9 are Doctoral students
• The 10 from 1st intake who were in Helsinki:
  • 3 are presently PhD-students at our Department
    – Jiao Liu, Meat Technology
    – Paulina Deptula, Dairy Microbiology
    – Abdul Ghafar, Food Chemistry
  • Shah Hasan?
  • 1 PhD-student (Dimitrios Spanos) at DTU in Denmark
  • 1 PhD-student (Andrei Prodan) in The Netherlands
  • 1 (Jorge de Miguel) in industry in Germany
  • 1 (Ruojie Li) in industry in China
  • 2 ?
Summerschool excursion
1st + 2nd intake
Meat Technology group

Eero Puolanne, Professor Emeritus
Per Ertbjerg, University Lecturer
Kaisa Immonen, University Lecturer

Industry funded:
• Pekka Kahila, Pilot plant manager
• Hanna-Kaisa Sihvo, Researcher
• Jiao Liu, PhD student
• Yulong Bao, PhD student

European Commission Funded:
• EMFOL: 6-10 International M.Sc. students in Helsinki per year (Meat or Dairy)
Research focus – Meat Technology

- Muscle and meat biochemistry
  - Beef, pork, poultry
- Broiler breast muscle myopathy
  - Why is it increasing and how can it be prevented
  - Effect on oxidation of proteins and lipids
  - Effect on structure: connective tissue and muscle fibres
- Meat quality
  - Texture, water-holding, chemical composition
  - Processing: salt, marination and sausages
- Stability of raw material
  - Effect of storage, protein degradation, proteases
  - Oxidation of proteins and lipids
Meat as a raw material

- Muscle type
- Glycogen level
- Enzymes in glycogen breakdown
- Proteolytic enzymes
- Effect of animal stress before slaughter
- Temperature after slaughter

The properties of raw meat
- pH,
- Colour,
- Water-holding,
- Tenderness
Protein and lipid oxidation

- Effect of packaging in high oxygen
- Meat from animals fed with unsaturated fat
- Protein oxidation and meat tenderness
  - Protein cross-links
  - Loss of activity of proteolytic enzymes
  - Substrate modification: the muscle proteins
- Indicators
  - Free thiol groups
  - Carbonyls
  - Protein cross-links
  - TBARS
Tenderness determinants

- Connective Tissue (Collagen)
- Sarcomere Length
- Proteolysis
Post-mortem proteolysis: How is it measured?

- Degradation of single proteins

  - Myofibrillar Fragmentation Index (MFI)
Calpain

Ca\(^{2+}\)

activation

Calpastatin

inactivation

Complex

Myofibril structural proteins

Meat tenderisation
Post-mortem proteolysis: How is it measured?

- Degradation of single proteins
- Myofibrillar Fragmentation Index (MFI)
- Calpain - enzyme activity

## Modified atmosphere packaging

<table>
<thead>
<tr>
<th>MAP</th>
<th>MFI</th>
<th>Tenderness</th>
</tr>
</thead>
<tbody>
<tr>
<td>80% O&lt;sub&gt;2&lt;/sub&gt;</td>
<td>123&lt;sup&gt;c&lt;/sup&gt;</td>
<td>8.0&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>30% CO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>153&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8.9&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>20% CO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>164&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>9.1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Vacuum</td>
<td>171&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.6&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Clausen, Jakobsen, Ertbjerg & Madsen (2009)
Packaging Technology and Science 22, 85-96
Meat Technology

Laboratories
Meat Technology

Cutting room
Meat Technology

Meat pilot plant
Dairy technology

Dairy Microbiology
- Functional genomics and proteomics of probiotics - Lb. delbrueckii biology and dairy applications - Bovine mastitis bacteria - Raw milk psychrotrophs

Dairy Technology
- Membrane technology in cheese processing - Ultrasound monitor emmental cheese ripening - Copper in ripening of emmental cheese

The group:

Pekka Varmanen
Kirsi Savijoki
Patricia Munsch-Alatossava
+ Tapani Alatossava
Dairy pilot plant / Food Technology, EE- building, 1st floor)
Research team headed by Alatossava – the major research fields

1) Raw milk microbiology
   • psychrotrophs and their spoilage features
   • antibiotic resistance among psychrotrophs

2) Lactobacillus research
   • Lb. delbrueckii biology and dairy applications
   • phage-host interactions in dairy systems

Microbial population analysis from raw milk samples with DGGE

\[ Lb. \text{ delbrueckii phage LL-H} \text{ (the bar length corresponds 100 nm)} \]
Research team headed by Varmanen – the major research fields

1) Probiotic dairy bacteria
   • *Lactobacillus* and *Propionibacterium*
   • Probiotic mechanisms and stress response

2) Bovine mastitis bacteria
   • *Streptococcus* and *Staphylococcus*
   • Drug resistance, biofilm formation, host-interaction

Proteomics with 2D-DIGE

Biofilm formation analyzed by AFM
Department of Agricultural Sciences
Research and Education

- Four main subjects
- 11 professors, 17 university lecturers

Biology of Plant Production (40)
- Agroecology
- Plant breeding
- Crop science
- Plant pathology
- Agricultural zoology
- Horticulture

Main challenges
Environmental issues
- control of emissions
- quality of inhabited areas
- adaptation to global climate change

Welfare of animals and human beings
- sustainable animal production

Ecological efficiency of cultivation
- natural recourses, water, energy
- recycling of nutrients

Economical output

Utilisation of biotechnology

Animal Science (25)
- Animal breeding
- Animal nutrition

Agrotechnology (15)
- Agricultural engineering
- Environmental engineering

Biotechnology (<10)

From field to fork - analysis of the whole production chain
Animal Science Research Fields

- Feeds and feed preservation
- Regulation of animal product composition and quality
- Animal welfare, behaviour and health
- Genomic selection
Dairy cow research facilities:

- Viikki research farm of 353 ha in Helsinki
  - 157 ha of arable land
- Research herd of 60 dairy cows
  - 45 places in free-stall dairy barn
    - robotic milking
  - 12 individual places for intensive studies
    - conventional milking
Welcome to Viikki campus