Developing and implementing technological wellbeing evaluation in dairy animals: COST DairyCare

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**Introduction**
Question: Is good husbandry more than absence of disease?
How important is the individual?

Do we care about individuals?

Do we always have that opportunity?
Dairy Animal Welfare

• EU dairying: the "bigger is better" problem

• How do we achieve good management in large units?
• How do we spot problems?
• Can the cow remain an individual?
Before you criticise big...

8000 cows in 80 units

8000 cows in one unit. A realistic target?

Worst welfare  Best welfare
What is DairyCare?

- A researcher network focused on dairy animal health and welfare
- Funded by COST: 141K € this year
- More than 650 members, 30+ countries
- Multidisciplinary
  - Biologists, ethologists, engineers, computer scientists, etc etc
- Organising and funding scientific conferences, researcher exchanges and other activities
DairyCare Key Objectives

• To improve the wellbeing of dairy animals through two mechanisms:
  - Accelerated development and application of relevant biotechnologies that will assist and promote good husbandry
  - Wider dissemination of best-practices

  - Note: COST does not fund actual research
DairyCare Core Scientific Focus: Knowing the Animal

- WG1 Biomarkers
- WG2 Activity
- WG3 Systems
DairyCare Deliverables (examples)

- Novel biotechnologies for:
  - Automated monitoring of dairy cow wellbeing
  - Automated detection of sub-clinical problems (eg SARA)
  - Automated monitoring of feeding behaviour
  - Automated detection of lameness

- Tailored "smart" husbandry support systems for automated herd management

- DairyCare "Blueprint for Action"

Knowledge translated into effective decision making
First DairyCare Conference

- Copenhagen, August 2014
- Health and Welfare of Dairy Animals
  - What data do we need?
  - What data can we get?
  - How can we use that data?
- WG sessions:
  - WG1 focus on ‘omics technologies
  - WG2 focus on automated activity measures state of the art
  - WG3 focus on data acquisition and management
What Data Can We Get?
The Potential for Omics in DairyCare

Professor David Eckersall
Veterinary Gene & Protein Group
Institute of Biodiversity, Animal Health & Comparative Medicine
University of Glasgow
State of the art of automated activity measuring technologies, and how to accelerate technology development

Matti Pastell
MTT Agrifood Research Finland
Precision Dairy Technologies: A Producer Assessment

Matthew R. Borchers and Jeffrey M. Bewley
University of Kentucky
Department of Animal and Food Sciences
Second DairyCare Conference

• Cordoba, March 2015
• Health, Welfare and the Lameness/Reproduction Interface
• Scientific Sessions
• Industry Platforms
• Funding Workshop
Third DairyCare Conference

- Zadar (Croatia), October 2015
- Feeding Behaviour as an Indicator of Health and Welfare
- Scientific Sessions
- Internationalisation Session
- Publishing Workshop
DairyCare Focused Workshops

• WG1 Meeting: HPA Axis, Cortisol and other Stress Biomarkers. Bern, September 2015

• WG3 Meeting: Sub-acute ruminal acidosis. Glasgow, April 2016

• WG2 Meeting: Activity measurement in Ruminant Research and Beyond. Leeuwarden, June 2016 (Joint with Precision Dairy Farming Conference)
Overview of Previous Topics

- Proteomics
- Lameness
- Non-bovine
- Metabolic issues
- TS ILVO
- Reproduction
- Social Behaviour Leeuwarden
- Stress Bern
- SARA Glasgow

BIOMARKERS

ACTIVITY
Fourth DairyCare Conference

• Scheduled for October 13th/14th 2016 in Lisbon
• Lifelong Health and Welfare Sensing
• Big Data and the Internet of Things
COST does NOT fund research!
FP7: EU PLF Project

Smart Farming for Europe
Value creation through Precision Livestock Farming

EU-PLF

You are here: Home » EU-PLF final conference

EU-PLF final conference
SFS-05-2017: Robotics Advances for Precision Farming

Specific Challenge: The specific challenge here is to help attain high levels of precision in modern farming through the smart use of robotics. The technological challenge is to develop and demonstrate new robotics technologies in real-world scenarios involving such as automated mobility around irregular farmland areas, accurate sensing of crop and livestock conditions, and dextrous manipulation of farmed produce. Farming is facing many economic

15 See definition of the 'multi-actor approach' in the introduction of this Work Programme part.

Part 9 - Page 22 of 182
Hello cow, how are you today? A simple question, but understanding the answer is not easy!

DairyICT is a consortium of researchers from 6 European countries whose goal is to find ways of answering the question, using modern and advanced technologies of data sensing, data computation and advice formulation.

The outcomes from our research will be better wellbeing for dairy cows and improved profitability for dairy farmers.
DairyICT: Building on Existing Technology

Herd Navigator:
- Progesterone
- LDH
- BHB

Add:
- SARA
- Lameness
- Feeding activity
- Estrus detection
Silent Herdsman;  
Automatic Classification of Eating and Ruminating in Cattle using a Collar Mounted Accelerometer

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University of Strathclyde,  
Glasgow, Scotland

\textsuperscript{2} Silent Herdsman Ltd  
Glasgow, Scotland
Activity data as proxy for feeding behaviours

Clustering Procedure
Novel (adjective):

Interestingly new or unusual

Existing biomarkers looked at in novel ways

• Focus on:
  • non-invasive sampling
  • automated (robotic) sampling
  • multiple application samples
  • minimal effective data
A novel approach to stress biomarkers

Pain related biomarkers

- Cortisol
- Inflammatory cytokines
- Blood
- Saliva
- Milk (and modified milk)
- Sweat
- Hair
Saliva: a non-invasive gold standard?

Results – Experiment 1
ACTH-Challenge

- Cortisol concentration (ng/ml)
- Time relative to ACTH injection (minutes)

$r = 0.75$, $P < 0.0001$

Data from Rupert Bruckmaier’s group
Hair cortisol: representative of chronic stress?

- Younger cattle had higher cortisol
- Pregnant cattle had lower cortisol than lactating cattle
- There were predictable effects of housing (not shown)
Interpretation: husbandry is not diagnostic

• How do we interpret different (cortisol) concentrations?

• If we find ”useful” changes within the individual cow, does it matter?

• The objective is to deliver TLC to whom it is needed, when it is needed
Focus on the cow, not the needle!
DairyCare: What could we do now?

- RFID
- Rumen pH
- SCC
- Milk metabolomics
- Accelerometry
- Remote analysis centre
DairyCare: We are not short of data

Sensors in:
- Ear
- Head collar
- Neck collar
- Rumen
- Leg collar
- Tail collar
- Tailhead
- Vulva
DairyCare: Getting more out of the data

Activity combined with lying/standing time may be predictive of lameness.
DairyCare: More, or less?

Drinking activity derived from rumen temperature

No milk increase, cow not healthy

Group change: back to close-up with TMR with less carbohydrates

Recovery: more milk unless lower NEL, increase of water intake
Multi-application sensor in rumen?

- Activity
- Temperature: water intake
- pH
- Balance
- Feed intake
- Rumen motility
What could we do in the future?

- RFID
- Rumen pH
- SCC
- Hair cortisol
- Transdermal cytokines
- Milk metabolomics
- Accelerometry
- GPS
- 3D imagery BCS
- Remote analysis centre

....and more, or better less?
DairyCare: "Third Sense"
Progressive Integration Model

1. Previously healthy cow
2. Possible wellbeing problem detected
3. Cow flagged for special sensing
4. Additional problems detected
5. Samples taken automatically
6. Cow moved to attention group

Third Eye
Drone based sensing

Third Ear
Rumen based sensing

Integrate
Know current fitness

Third Hand
Robot based sensing
Engineering to support wellbeing of dairy animals

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DairyCare:
Thank you for your attention!

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www.dairycareaction.org