SmartCow

an integrated infrastructure for increased research capability and innovation in the European cattle sector

Ethics and Implementation of the 3Rs in cattle research

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Objective: To review developments and implementation of the 3Rs during SmartCow

- SmartCow will…
  - **promote synergy in research efforts implementing the 3Rs** (Replacement, Reduction, and Refinement) **in animal experimentation**,
  - …contribute to the development of cattle farming systems that are **more respectful of animal welfare and health**.
  - …have a **positive impact on the ethical acceptability** of animal experiments and husbandry by society.

Achievements: ethics of animal use

- Training courses

- Ethical appraisal of TransNational Access (TNA) proposals

- Open access chapters on ethics in cattle research
  - Veissier et al: **Ethics in experiments on live cattle: a pragmatic approach.**
  - Langbein et al: **Guidelines to apply for ethical approval of animal experiments**

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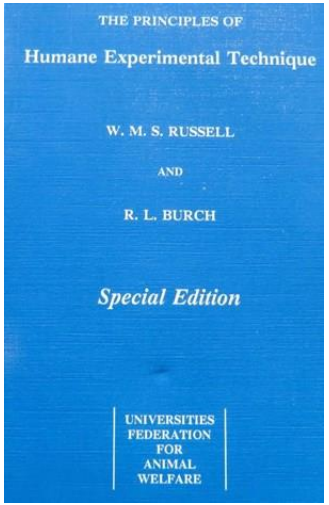
The 3Rs

- ***Replacement:*** *"the substitution for conscious living higher animals of insentient material"*
- ***Reduction:*** *"reduction in the numbers of animals used to obtain information of a given amount and precision".*
- ***Refinement:*** *"any decrease in the incidence or severity of inhumane procedures applied to those animals which still have to be used"*

Russell and Burch (1959)

https://norecopa.no/



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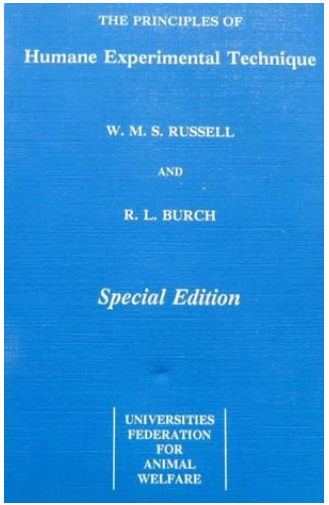
The 3Rs

- Why be interested in the 3Rs?
  - Ethical responsibility for sentient animals
  - Legal obligations
  - To increase societal acceptance of research
  - To improve the quality of research

https://norecopa.no/



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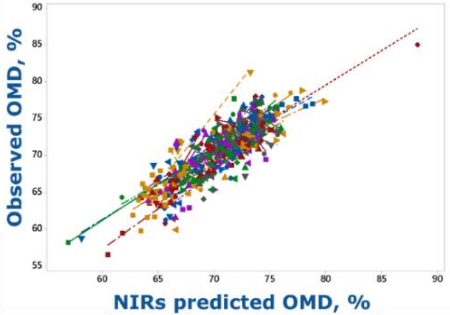
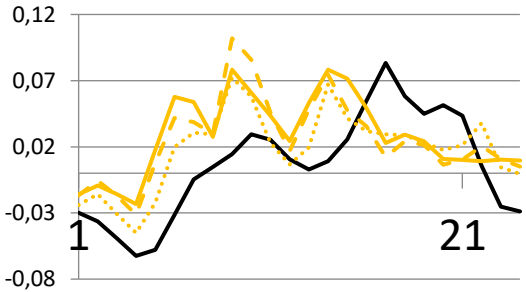
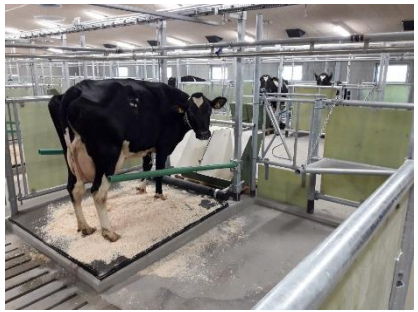
Achievements: implementing the 3Rs

- Improved housing facilities
- Improved procedures
- Welfare assessment
- Use of fistulated cows







Improved housing: INRAE

- stalls are open (side-by-side or face-to-face) to avoid animal isolation
- stalls can be adjusted to the size of the animal (300-900 kg), with more space available outwith sampling periods
- stall walls that can be folded down to allow without risk of injury for the animal or the experimenter
- slot to allow human interventions (for care, monitoring or sampling)
- foam mat to reduce lameness
- trough on strain gauges associated with a computer to feed and monitor the ingestion without disturbing the animal

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Improved housing: Reading

- Adjustable side panels

- Waterbeds for cow comfort

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Improved housing: Aarhus

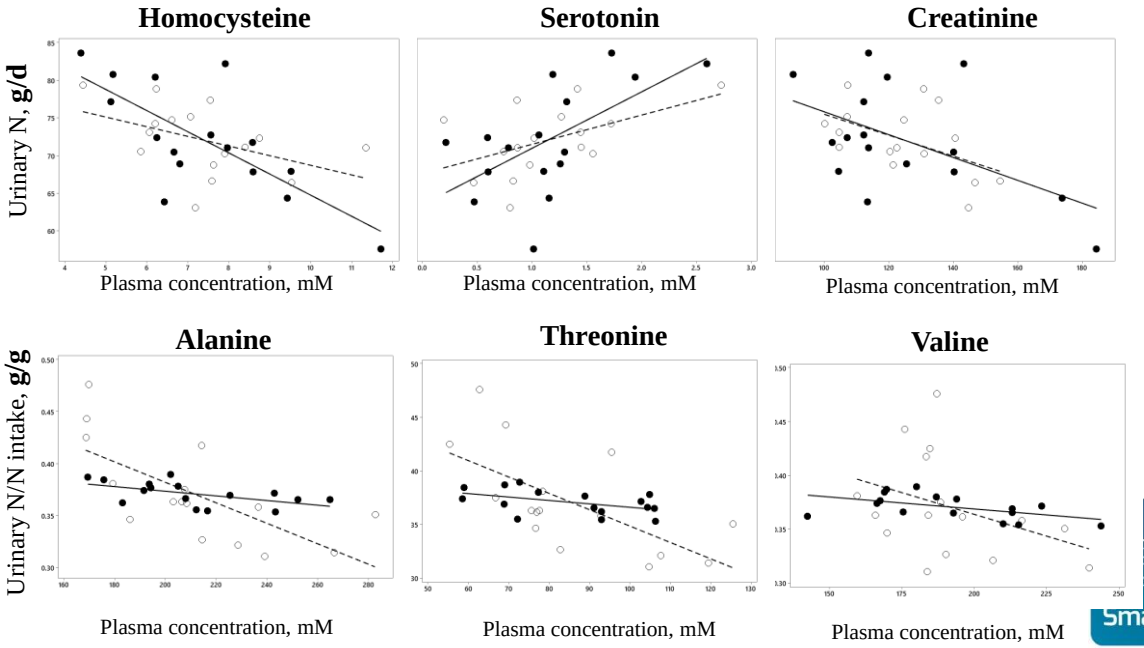
- **Loose housing for fistulated cows**
  - Larger
  - Replace tie-stalls
  - Social contact
  - Lying and other areas
- **New respiration chambers**
  - Large
  - Improved air quality
  - Better accessibility
  - Visual contact with other animals

Proxies to predict urinary N excretion?

PRELIMINARY RESULTS: A METABOLOMIC APPROACH REVELAED SEVERAL PLASMA METABOLITES RELATED TO URINARY N EXCRETION IN BEEF CATTLE

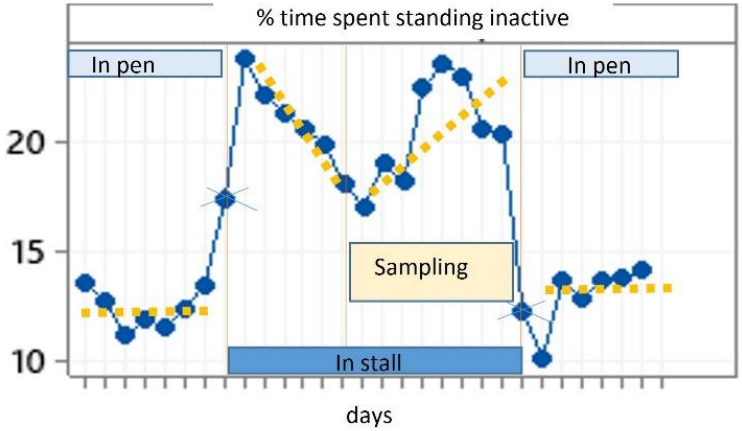
(Cantalapiedra-Hijar et al., Abstract 2022)

TO AVOID METABOLIC STALLS



Welfare assessment: housing duration

- Work at INRAE examined the impact of time in digestibility stalls on markers of welfare and stability of outcome data



- Studies across SmartCow partners suggest that shorter durations of behavioural restriction can be used whilst collecting repeatable and accurate data

- Pre-housing adaptation to trial diets can also minimise the necessary period of behavioural restriction

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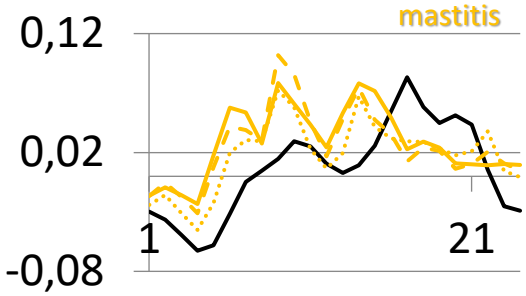
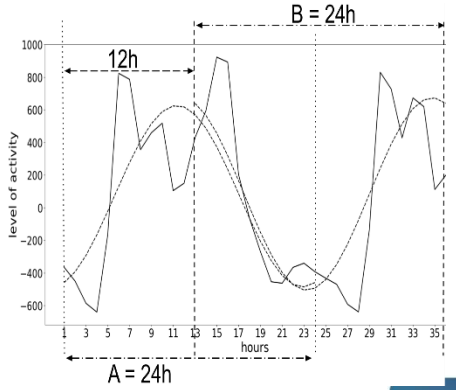
Welfare assessment: application of sensors

- SmartCow studies investigated the use of sensors for monitoring welfare
  - Sensors have substantial value in complementing human observations
  - Data volume means that knowing what to measure is key
  - INRAE work looked at circadian rhythm of behaviour as an early predictor of health/welfare issues





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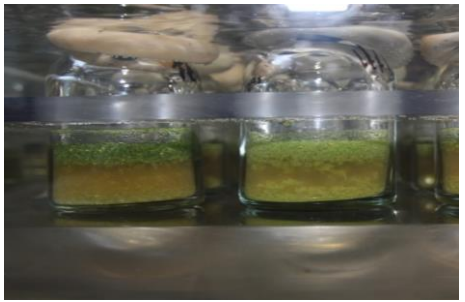
Fistulated cows

- **Replacing *in vivo* studies on ruminal digestion by *in vitro* fermentation**
  - *in vitro* screening before i*n situ / in vivo* validation allows reducing the number of experimental animals to a very minimum

- **Exploring other alternatives**
  - Laboratory based assessment of feed values
  - Tubing for fluid collection
  - Application of sensors



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Summary

- ***Replacement***
  - Replacement of animal use for research in this areas remains limited – but some progress is being made

- ***Reduction***
  - Increased use of *in vitro* techniques leads to lower animal numbers
  - Understanding and reducing measurement error will lead to lower required sample sizes in future studies

- ***Refinement***
  - Improved housing conditions increase welfare and data quality
  - Sampling for proxy measures can be less invasive
  - Better welfare assessment will improve study conduct

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Impact

- Research infrastructures
  - Enhanced sharing of information
- Funders
  - Researchers can meet the challenges of society's expectations regarding continuing improvements to the 3Rs
- Other academics
  - Clear demonstration that welfare can be enhanced at no cost to data quality, or with improvements to data quality
- Industry
  - Advances in welfare assessment translate from research to commercial practice

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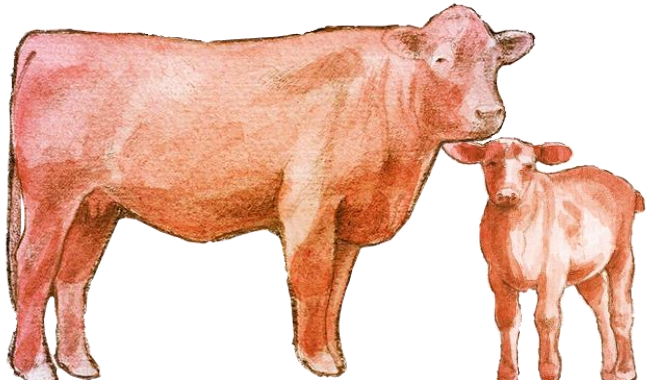
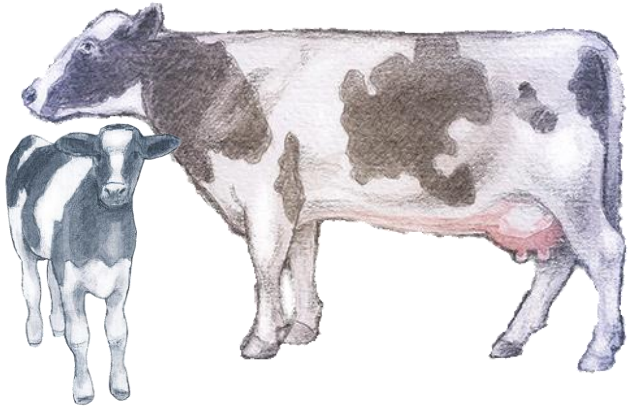
Impact – our study animals

- Should be the primary beneficiaries of our efforts to apply **Reduction**, **Refinement** and **Replacement**

- Complex sentient creatures that support us to get important data





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Future prospects

- Whole animal work likely to be necessary for the foreseeable future
  - Alternatives are being developed, but many studies still require animal work
  - Many opportunities for further 3Rs advances exist

- Still many challenges to implementation
  - Researchers and institutions can struggle to get funding that directly targets welfare and the 3Rs
  - Some parts of the scientific community can be conservative and resistant to change
  - Attitudes to animals vary

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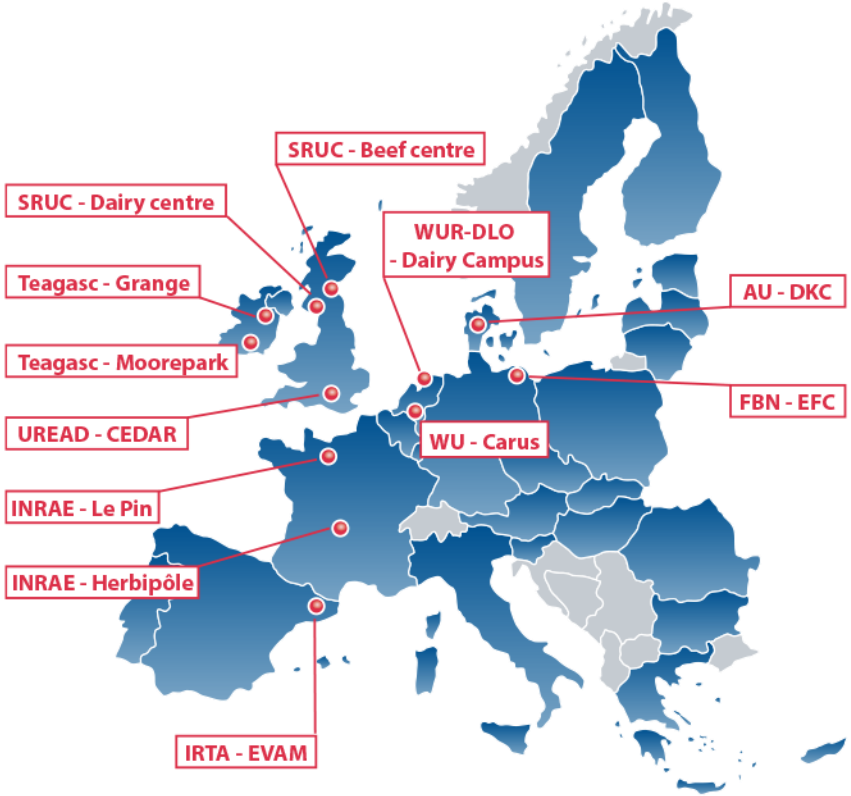
Conclusion

- Support for animal research is built on a social contract between the public and researchers:
  - based on the principles that we will only use animals when necessary
  - and that the harms we impose on study animals is the minimum necessary to achieve worthwhile benefits

- Cattle studies are likely to continue given pressing societal concerns relating to food production and environmental impact

- **SmartCow work shows that it is possible to conduct high quality science whilst also continuing to improve study animal welfare**

Thank you for your attention



First-class Cattle Research Infrastructures (RIs) across Europe:

- 11 major RIs distributed in 7 EU countries
- 12 locations, which include 18 installations
- 2500 dairy and 1000 beef cows

- **Networking of RIs** to inventorize resources, harmonize procedures, and share data
- **Joint research activities** to improve experimental methods and phenotyping capability
- **Interaction with stakeholders** to stay in line with industry needs and improve dissemination

http://www.smartcow.eu/stakeholders/

TRAINING PROGRAM

For Scientists, Technicians, Stakeholders, PhD students

- Face-to-face training courses
- Free web-conferences
- One-day study tours in 4 different countries

http://www.smartcow.eu/resources/training/

TRANSNATIONAL ACCESS CALLS

Offers external users (academic and industry) free access to SmartCow RIs

- 30 projects during the 4 years of SmartCow
- Access to around 10,000 cow-weeks

http://www.smartcow.eu/calls/

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