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Determination of carry-over in automated milking, recording and sampling systems using fluorescent tracers

Peter Løvendahl, Martin Bjerring and Torben Larsen

Thanks to:

- BIOSENS Project:
  - Lattec (Foss + DeLaval)
  - Danish Cattle
  - Ministry of Food, Fisheries and Agriculture
- RYK – Livestock Registration and Milk Recording

- Test herd owners

The *Carry-Over* problem

- If a milk sample from **this cow** contains milk from the **cow milked just before** …
- Obvious source of error:
  - Cell count
  - Diagnostic indicators, PCR, mastitis, Johnes,,,,
- Special relevance to AMS
  - Complexity of AMS + sampler
  - ”Hidden reservoirs”

Determination of carry-over

- Approval testing of samplers
  - Milk fat percentage deviations (ICAR)

  ☹ Indirect measure, imprecise, non-complex
- Regression analysis, mixed model statistics

  ☺ Routine samples: *Løvendahl & Bjerring, 2006*

  ☺ **Direct measure**

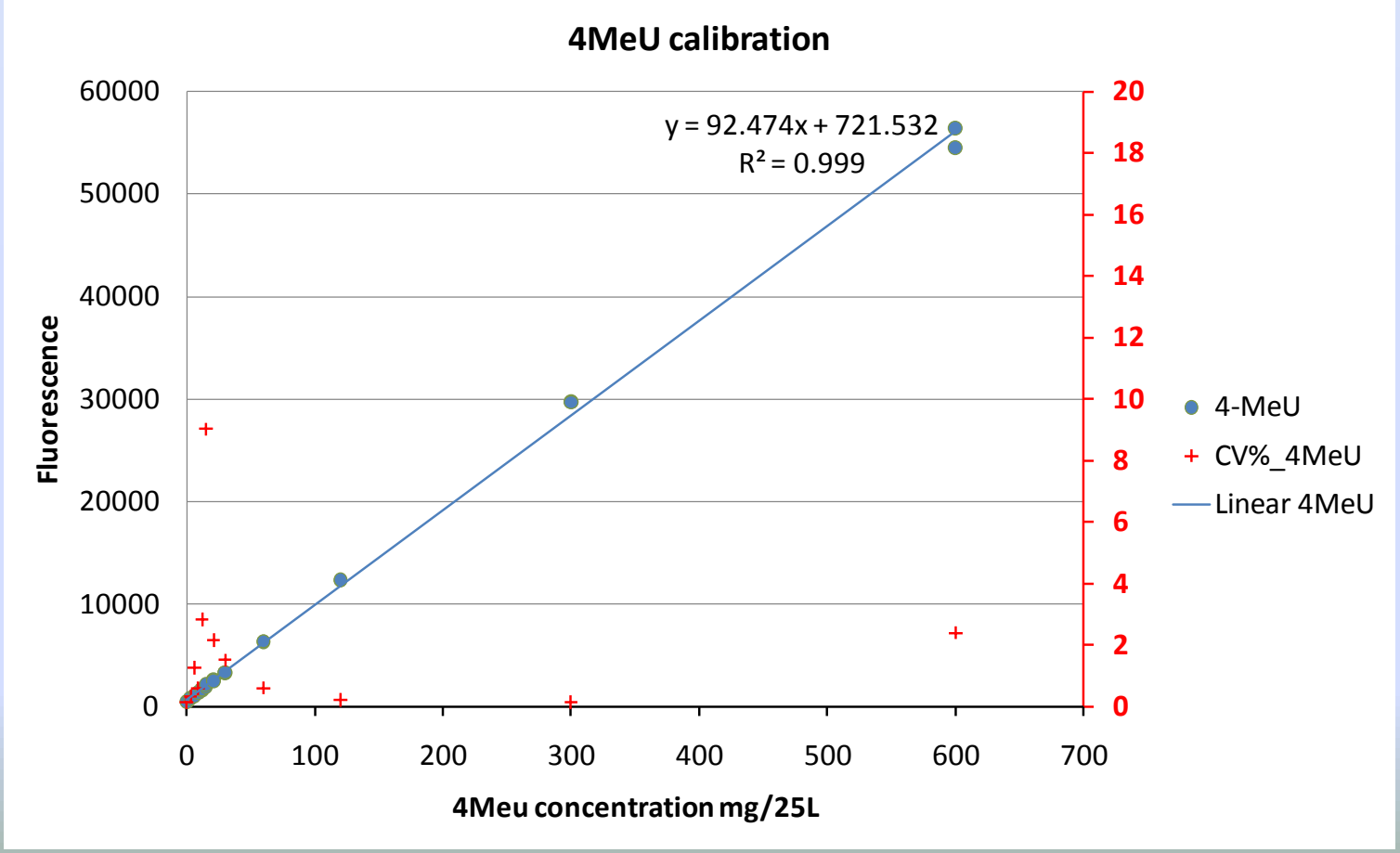
  ☹ Large data requirements
- Tracer method
  - This study: simple, reliable, affordable !

Fluorescence based tracers

- Direct method –
- Based on dilution of colour intensity

Linear dilution & calibration curves

- Fluorescein (AY73) and 4MeU



Tested equipments

- 4 AMS and 1 conventional

Test no.	Type	Modifications
1	AMS	Standard
2	AMS	Standard unadjusted
3	AMS	Standard adjusted
4	AMS	Research modified
5	Manual Parlour	Standard electronic meter and sampler

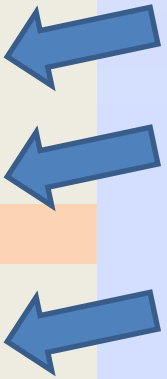
Protocol

- **Phantom cows**: Yellow and White
- 8 Kg "**yellow**" **milk**, samples before and after
- 8 Kg "**white**" **milk**, sample: how yellow is after ?
- Replicate 6 x

Replicate	*Run*	*Liquid*	*Volume (Kg)*	*Samples*
1	1_1	Yellow	5	A **B** C
	1_2	White	5	A **B** C
2	2_1	Yellow	5	A **B** C
	2_2	White	5	A **B** C
	2_3	White	5	A **B** C
3	3_1	Yellow	8	A **B** C
	3_2	White	8	A **B** C
4	4_1	Yellow	8	A **B** C
	Wash	No		
	4_2	White	8	A **B** C

Some result details

			Pre-sample, A		*Sampler, B*	
Run	**Type**	**Volume**	*AY73*	*4MeU*	*AY73*	*4MeU*
Carry-over in percent						
1_1	Yellow	5	100.0	100.0	95.1	93.3
1_2	White	5	0.4	0.3	18.5	18.0
2_1	Yellow	5	100.0	100.0	90.2	93.0
2_2	White	5	0.9	0.6	15.4	15.8
2_3	White	5	*0.5*	*0.4*	*2.8*	*2.8*
3_1	Yellow	8	100.0	100.0	96.4	98.0
3_2	White	8	0.7	0.5	20.0	19.7
4_1	Yellow	8	100.0	100.0	95.4	97.4
	WASH !					
4_2	White	8	1.0	0.7	1.7	1.4
First order carry-over without wash					***18.0***	***17.8***



Equipment results

Equipment	Volume (N)	CO%, AY73	CO%, 4MeU	Average
1.A AMS Standard	5 (1)	8.4	8.5	8.5
	8 (3)	3.3	2.8	3.1
1.B	8 (6)	6.7	7.2	7.0
2 AMS Unadjusted	5 (2)	17.0	16.9	17.0
	8 (1)	20.0	19.7	19.9
3 AMS Well adjusted	6 (1)	3.1	4.6	3.9
	8 (6)	2.1	2.5	2.3
4 AMS Modified	6 (2)	10.5	10.0	10.3
	8 (3)	11.2	11.8	11.5
5 Conventional	8 (6)	3.3	3.7	3.5

- Un-adjusted and modified: C-O up to 20% ☹
- Well adjusted: 2 – 5%, similar to conventional
- Conventional: 3.5%

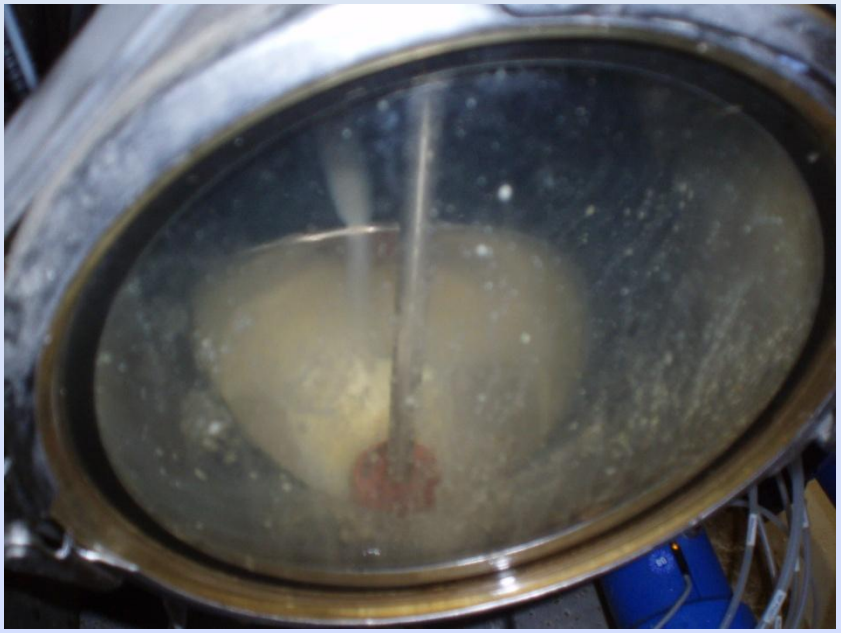
Reasons for carry-over

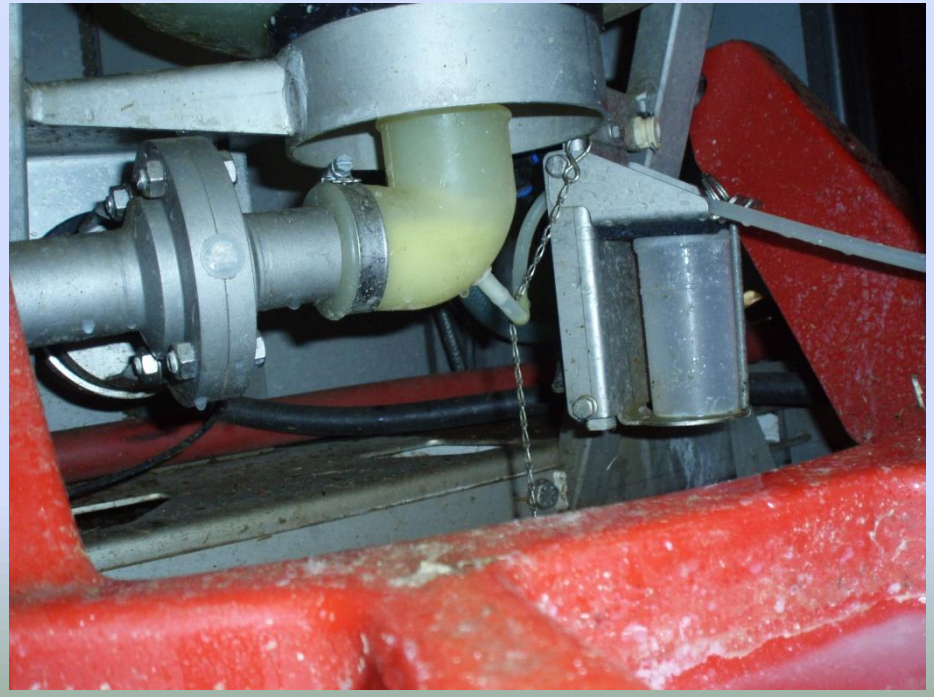
- Sampler
- Other parts of AMS / milking machine:
  - Mixing
  - Pump
  - Tubes

- Visible milk residues
- Hidden milk residues

- Adjustments and settings – sub-optimal

Visible residues – reduced with correct settings and adjustments





Method performance

- **C-0 from modified AMS/samplers**
  - agree with regression method *Løvendahl & Bjerring 2006*
- **C-O-tracer**,
  - DIY-phantom cows (2)
  - 3 h closing AMS, 6 replicates
  - 1.2 g tracer x 2
  - 200 L milk
  - 1 d lab-work – fast result

Summing up:

- Reliable, fast and direct determination of C-O as percentage
- Useful for development and improvement
- Testing the complete system
- Suited for ”bench-testing”