



**Harper Adams**  
University

# Dietary inclusion of heterotrophic micro algae and its impact on milk composition and performance in dairy cows

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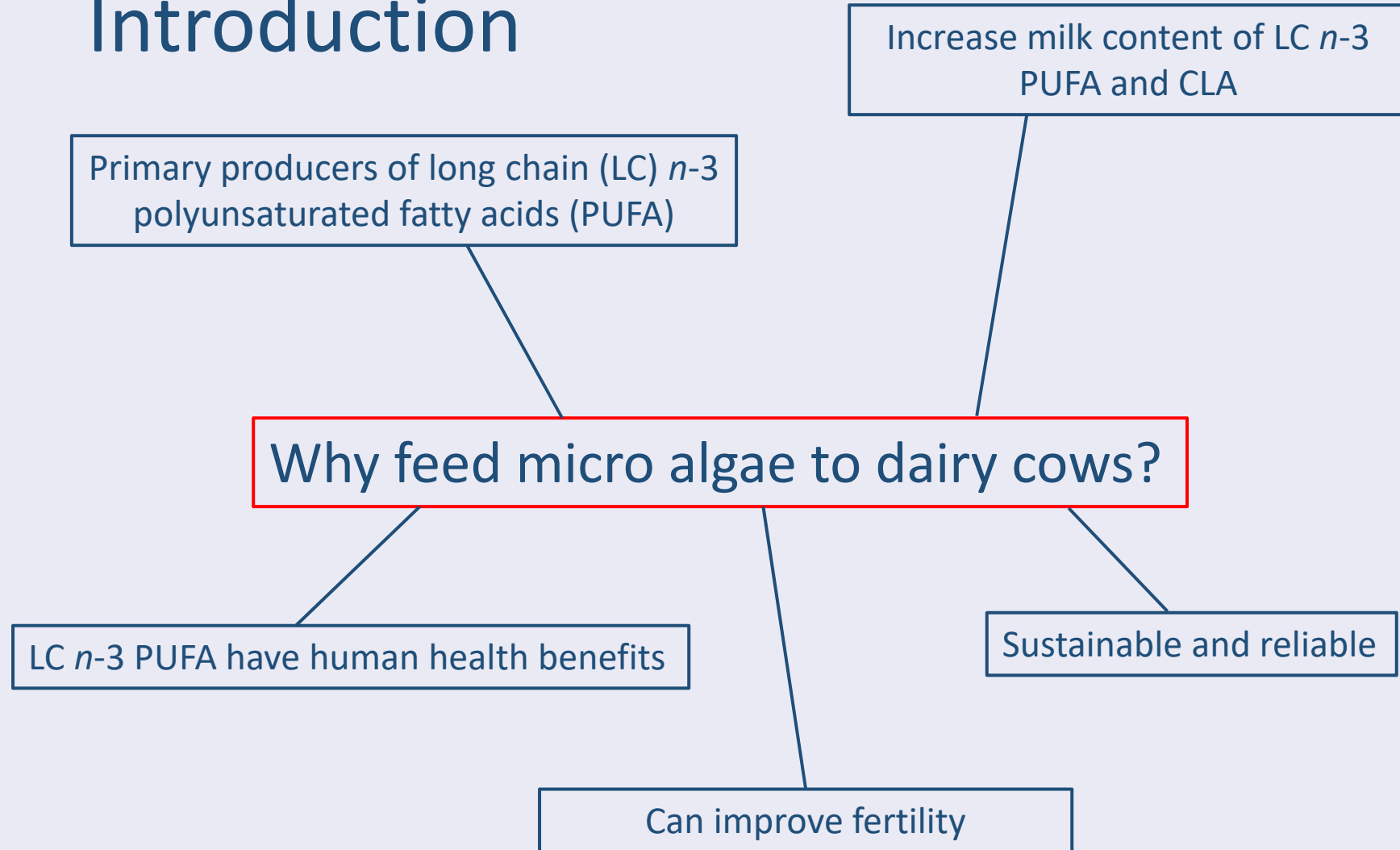
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# Introduction



# Human health benefit of PUFA

- Decrease the likelihood of developing coronary heart disease
- Modulate prostaglandin metabolism
- Lower cholesterol
- Enhance learning ability and cognitive function in children
- Lessen the severity of depression
- Important for:
  - Growth
  - Development
  - Immunity
  - Insulin activity

1. Intake is below what is recommended
2. Can enhance levels in ruminant products



# Important fatty acids

Conjugated linoleic acids (CLAs)

$C_{18}:2$  *cis*-9 *trans*-11

$C_{18}:2$  *trans*-10 *cis*-12

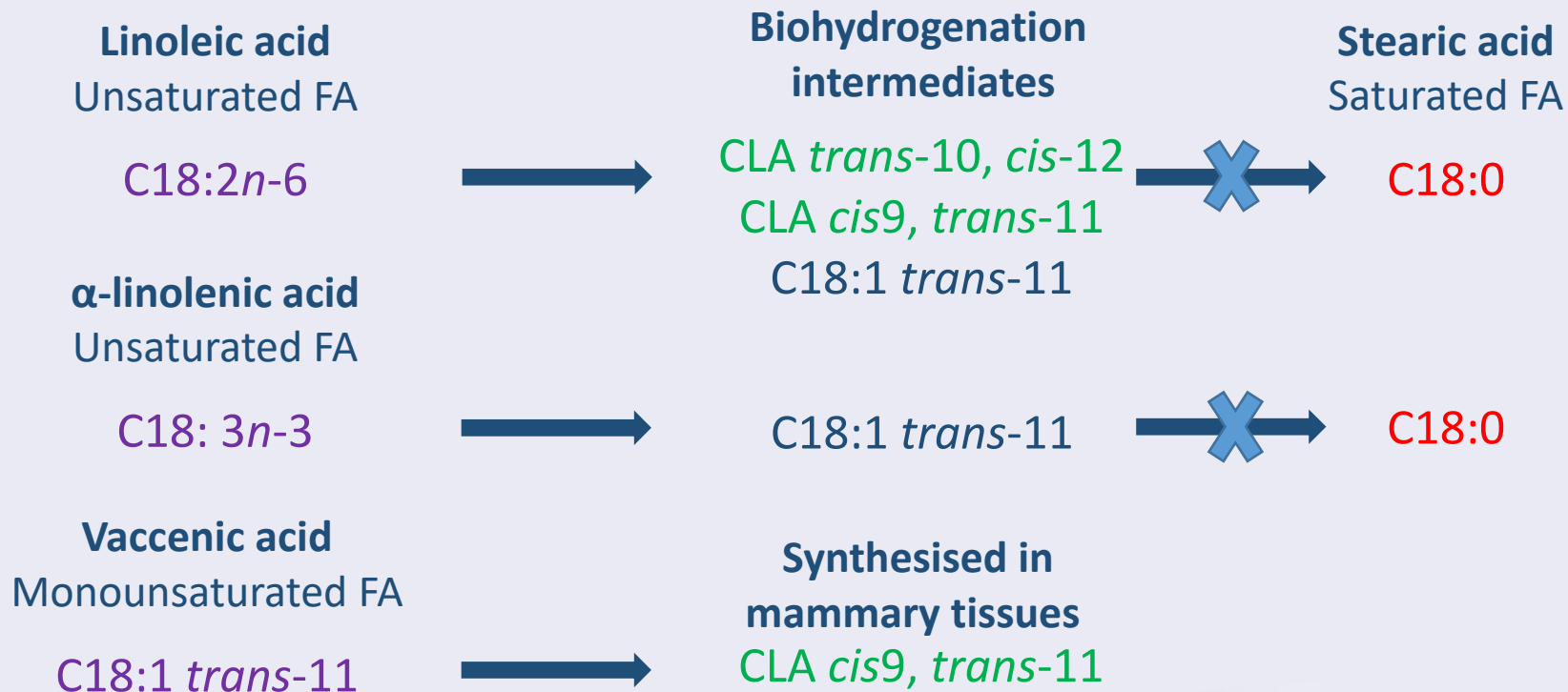
Docosapentaenoic acid (DHA)

$C_{22}:6n-3$



# Important fatty acids

- Milk FA originate from:
  - Circulation (carbon chain >16)
  - *De novo* synthesis in mammary gland (carbon chain <16)



# Hypothesis

- Feeding micro algae will increase milk DHA concentration but not affect performance

# Objective

- To determine the effect of rate of inclusion of micro algae on milk fatty acid composition and performance of Holstein-Friesian dairy cows



# Methodology

- 20 Holstein – Friesian dairy cows
- 4 levels of micro algae (37.5 % DHA) fed at:
  - 0 g/cow per day(Control)
  - 50 g/cow per day (Low)
  - 100 g/ cow per day (Medium)
  - 150 g/cow per day (High)
- 4 x 4 latin square design
- 21 d adaption period followed 7 d sampling
- Statistical analysis : Treatment split into linear, quadratic and cubic effects



# Sampling

- Daily milk yield
- Daily intake
- Milk
  - Fat, protein, lactose and fatty acids
- Body condition score
- Live weight





# Results: Feed analysis

	Control	Low algae	Medium algae	High algae	Algae
DM (g/kg)	372	374	369	371	-
Ash	60	73	66	70	31
Organic matter	939	942	939	939	-
Crude rotein	166	170	165	162	135
NDF	441	455	452	460	-
<b>Fatty acid (g/kg DM)</b>					
C16:0	10.9	9.11	12.2	10.1	146
C18:0	0.89	0.68	0.85	0.72	3.64
C18:1 $n$ -9	8.11	6.31	7.66	5.87	-
C18:2 $n$ -6	10.1	8.12	9.14	7.25	-
C18:3 $n$ -3	1.50	1.31	1.52	1.21	0.60
C22:6 $n$ -3	0.00	0.07	0.15	0.19	69.85



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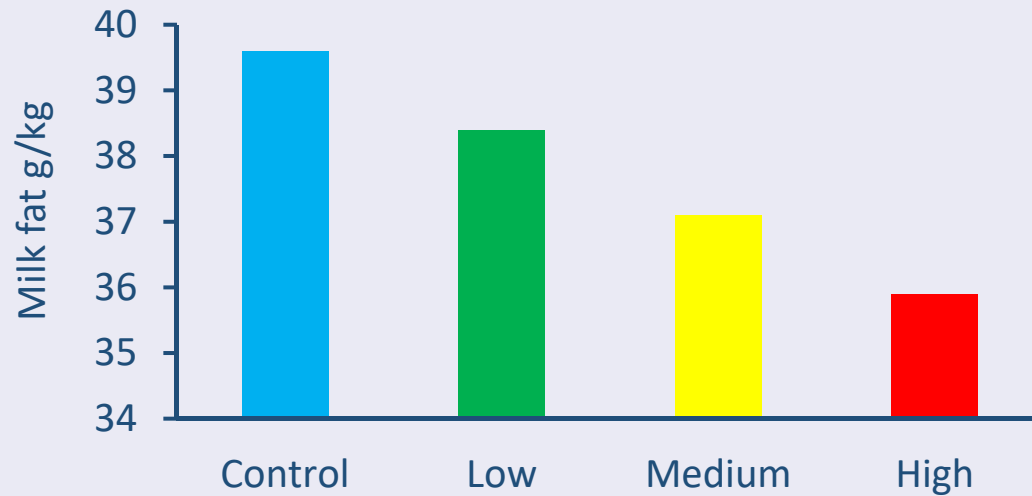


# Results: Performance

	Treatment					<i>P</i> -value
	Control	Low	Medium	High	s.e.d	Lin
DM intake, kg/d	23.7	23.3	23.1	23.3	0.323	0.162
Milk yield, kg/d	38.1	38.8	38.6	38.4	0.305	0.770
Live weight change (kg/d)	0.56	0.06	0.37	0.37	0.222	0.731
Body condition score	2.91	2.94	2.92	2.99	0.050	0.165



# Results: Milk fat

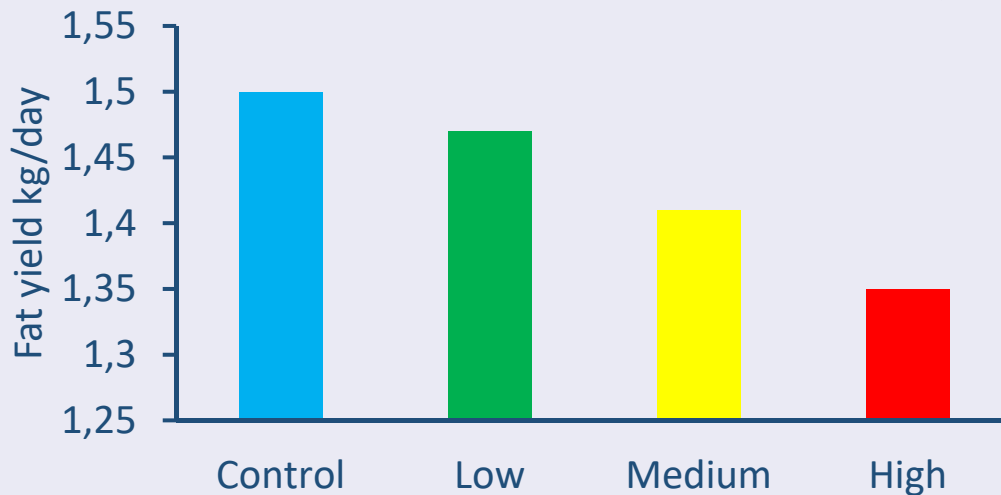


*P* value:

**Linear = <0.001**

Quadratic = 0.970

Cubic = 0.968



*P* value:

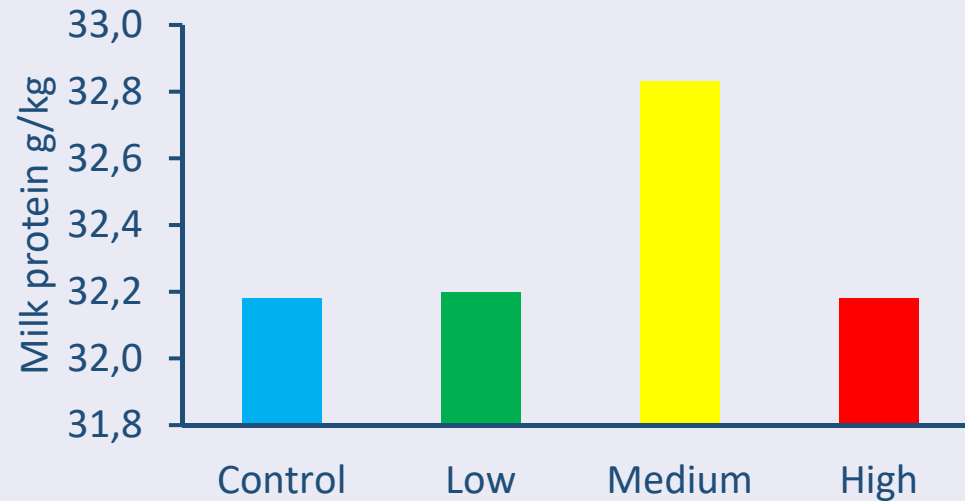
**Linear = 0.007**

Quadratic = 0.647

Cubic = 0.849



# Results: Milk protein

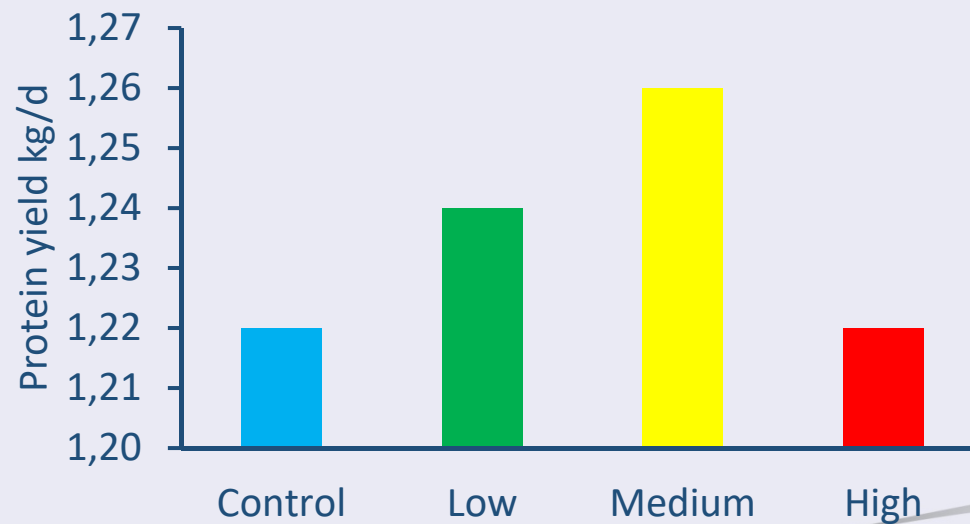


*P* values:

Linear = 0.623

Quadratic = 0.235

Cubic = 0.141



*P* values:

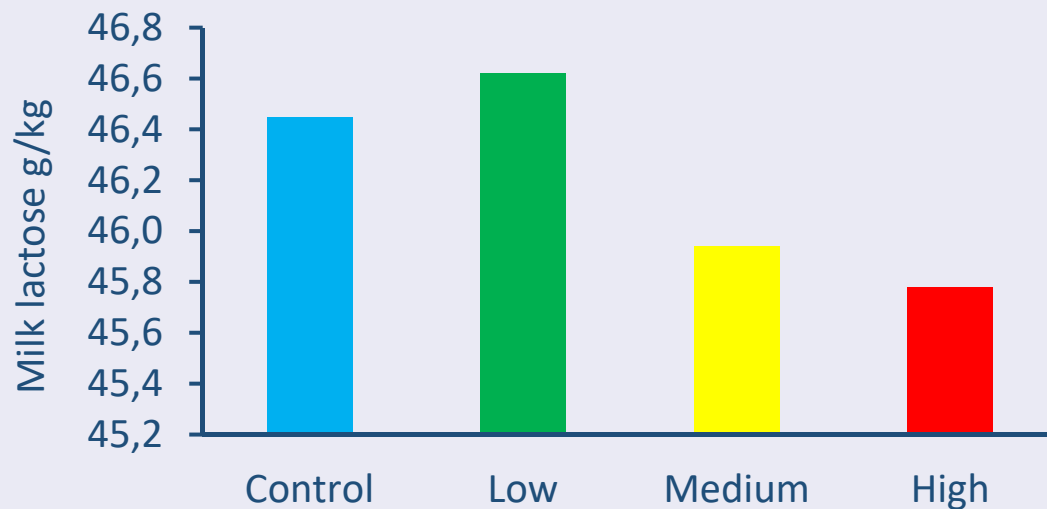
Linear = 0.972

Quadratic = 0.181

Cubic = 0.670



# Results: Milk lactose

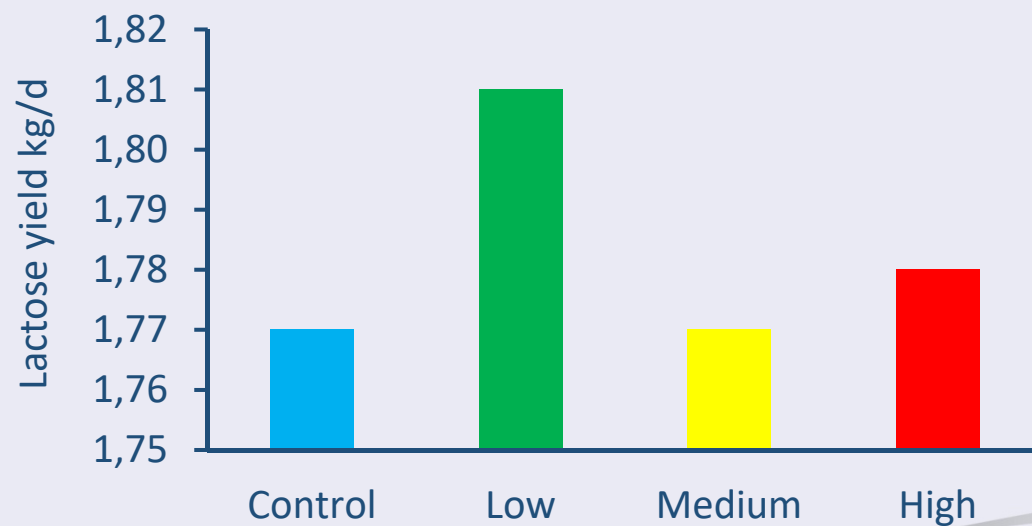


*P* values:

**Linear = 0.007**

Quadratic = 0.0442

Cubic = 0.160



*P* values:

Linear = 0.816

Quadratic = 0.552

Cubic = 0.279



# Results: Milk fatty acids

	Treatment					P value
	Control	Low	Medium	High	s.e.d	Lin
<b>C18:0</b>	9.70	9.60	8.58	8.73	0.239	<.001
<b>C18:1 <i>trans</i>-10</b>	0.61	0.78	0.82	0.87	0.090	0.01
<b>C18:1 <i>trans</i>-11</b>	1.15	1.28	1.63	1.84	0.173	<.001
<b><i>cis</i>9 <i>trans</i>11 CLA</b>	0.61	0.76	0.86	0.90	0.031	<.001
<b><i>trans</i>10 <i>cis</i>12 CLA</b>	0.03	0.03	0.04	0.05	0.005	<.001
<b>C20:5<i>n</i>-3</b>	0.07	0.07	0.06	0.07	0.006	0.24
<b>C22:6<i>n</i>-3</b>	0.08	0.15	0.25	0.37	0.017	<.001



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# Conclusions

- Feeding algae was associated with a decrease in milk fat content and yield
- Feeding algae was associated with a change in the milk fatty acid profile:
  - Decrease in C18:0
  - Increase in C18:1 *trans*, CLAs and DHA
- The effect of feeding algae was greater as the inclusion level in the diet increased



# Conclusions

- There was no effect on
  - DMI
  - Milk yield
  - Live weight
  - BCS
  - Milk protein content or yield
  - Milk lactose yield
  - Milk fatty acid: EPA
- Algae containing 37.5 % DHA may be fed at a rate of 100 g/cow/d without negatively impacting animal performance



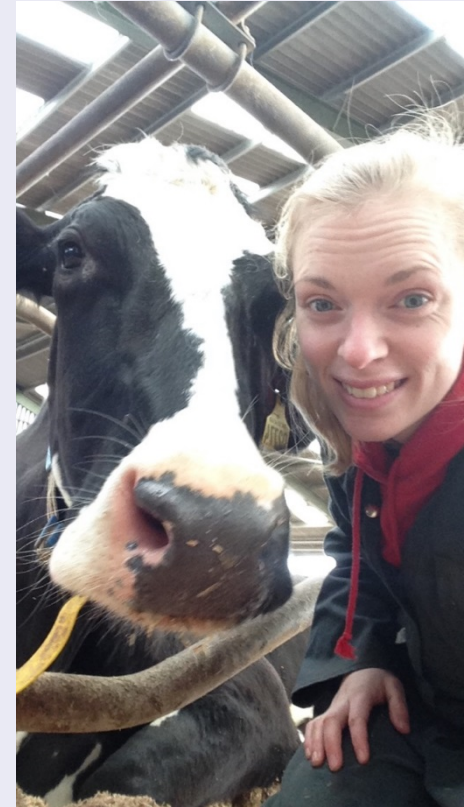
# Further analysis

- Cheese FA profile
- Cheese composition: Fat, protein, moisture and casein
- Blood metabolites: Glucose, urea, NEFA, 3-OHB, albumin, total protein
- Whole tract digestibility



# Acknowledgements

- My sponsors – Alltech
- Farm Technicians
  - Sarah Williams
- Farm Staff
- HRP students
  - Nicola
  - Hazel
  - George
  - Jess



Any Questions?

