Advances in enhancing the nutritional quality of milk

"Key Customer Day" – 20 April 2018

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Contents

- Fats
- Vitamin D
- Opportunities

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Enhancing nutritional status

To induce/maintain positive population (government) or personal health outcomes.

How?

- 1. Supplementation
- 2. Fortification
- 3. Bio-fortification
- 4. Bio-addition

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Fats

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Nutritional quality of dairy products

Animal products are high in saturated fatty acids & can have a poor health image.

However

- they are high in beneficial vitamins and minerals.
- impact of dairy products on health is under review - Milk is more healthy than was thought!
- AFBI research - optimise nutritional benefits:
  - **Increasing unsaturated fatty acids**
  - Enhancing cows' diet to give naturally spreadable butter with more "healthy" fatty acids.
  - Milk and cheese with increased omega-3 fatty acids.

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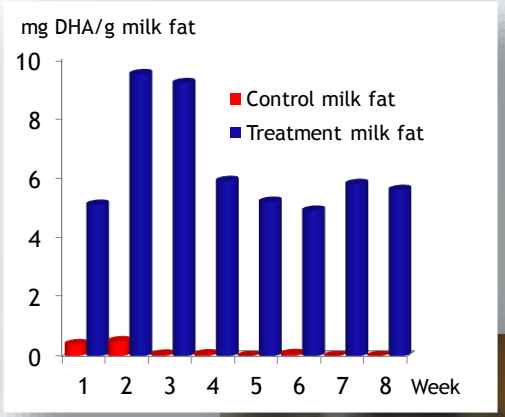
Production of omega-3 enriched milk on-farm

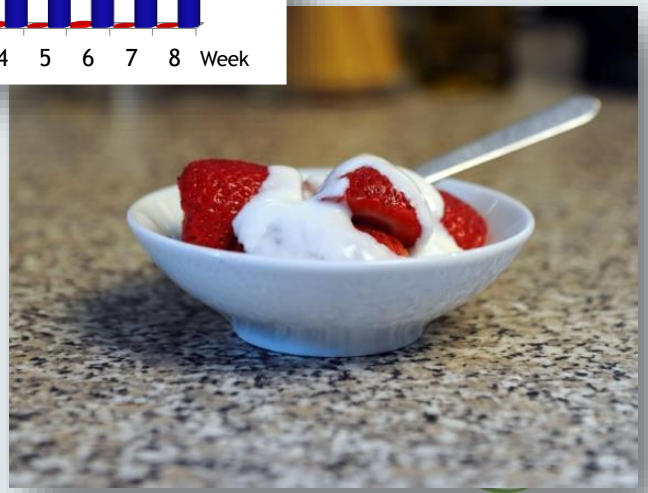
Goal

Production of omega-3 enriched milk on-farm for the manufacture of novel dairy products

Results

- Microalgae dietary supplement enhances omega-3 fatty acids in cow's milk
  - At least 5x increase in milk fat DHA content
- Animal feed intake affected above 150g/supplement/cow/day
  - Lower supplement no impact on feed intake
- Yoghurt manufacture with Loughry (CAFRE)





Funded by DAERA

Reduced fat cheese fortified with omega-3 fatty acids

Fortification of cheese milk with long chain omega-3 fatty acid DHA during manufacture

Optimised through choice of

1) supplement

- 2 algal products
- microencapsulated fish oil

2) point of addition

- cheese milk
- cheese curd

Outcome

Production of an acceptable reduced fat cheese with enhanced levels of omega-3”

Funded by DAERA, with industry advice and support

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Why Vitamin D?

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First EU-wide data offers "Firm evidence" of Vitamin D deficiency

40.4% of the EU population are vitamin D deficient

Deficiency = <50nmol/l

(ODIN Project)

So what's the problem……?

- Not enough sunshine
- Skin cancer fear
- Not enough dietary sources
- Those that are available unpalatable and not widely consumed

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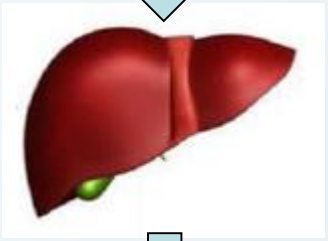
Vitamin D metabolism

Solar UVB radiation (290- 320nm)

7- Dehydrocholesterol

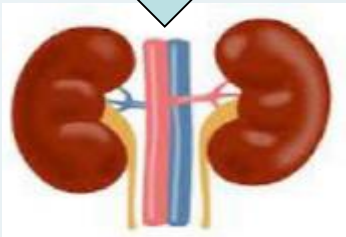
Cholecalciferol (Vitamin D-3)

Secondary source from food/ supplements. Vitamin D-3 (fish, meat),Vitamin D-2 (Mushrooms)



25- hydroxyvitamin D [25 (OH)D]

25- hydroxyvitamin D-1-ά-hydroxylase



Conversion of 25 (OH)D to 1, 25(OH)2D in the kidney is tightly regulated by PTH, calcium and phosphorus levels

1, 25 di-hydroxyvitamin D [1,25 $(OH)_2D$]

Increasing Vitamin D in milk

Agri-Food Quest project

Vitamin D enrichment of pork and cow's milk through UVB synthesis and dietary intervention.

Partners: AFBI, Devenish,Thompsons, Karro, UU,CAFRE

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Zero-grazing

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Towards zero-grazing

Rationale

- Reduced sward damage
- Better grass utilisation ~30%
- Increasing herd size
- More flexible grazing platform
- Reduced purchased feed costs

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Experimental

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Treatments

- Holstein Friesian dairy cows (114),
- **3 Treatments**,
  1. **Silage**: Housed & offered grass silage once daily
  2. **Zero-grazing**: Housed & offered fresh grass once daily
  3. **Grazing**: Full-time grazing. Rotational paddock grazing system, access to fresh herbage daily
- Concentrate feed levels were common across all treatments

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Sampling

- Milk Samples taken from all cows on two occasions (6 July and 20 September)
- Milk analysed for:
  - Vitamin D3,
  - Vitamin D2, 25-hydroxyvitamin D3 and
  - 25-hydroxyvitamin D2
- Other milk quality parameters measured

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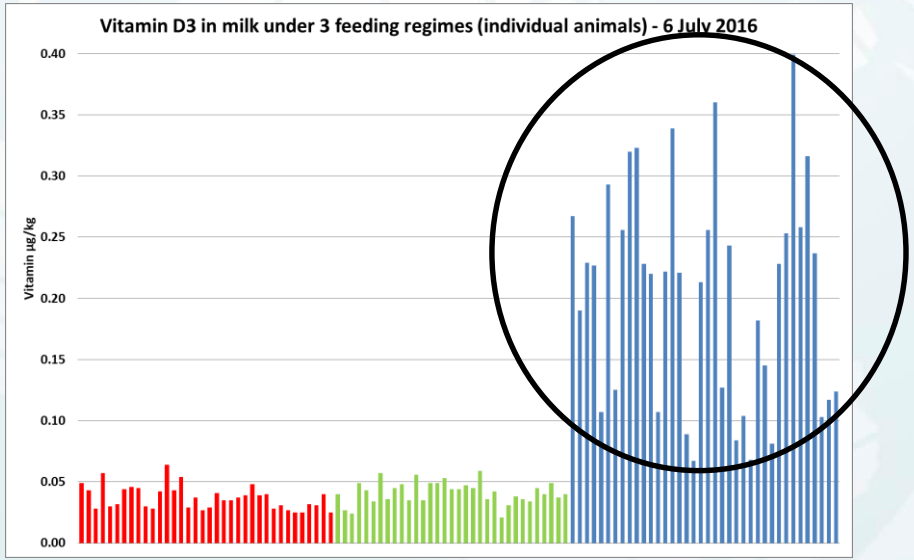
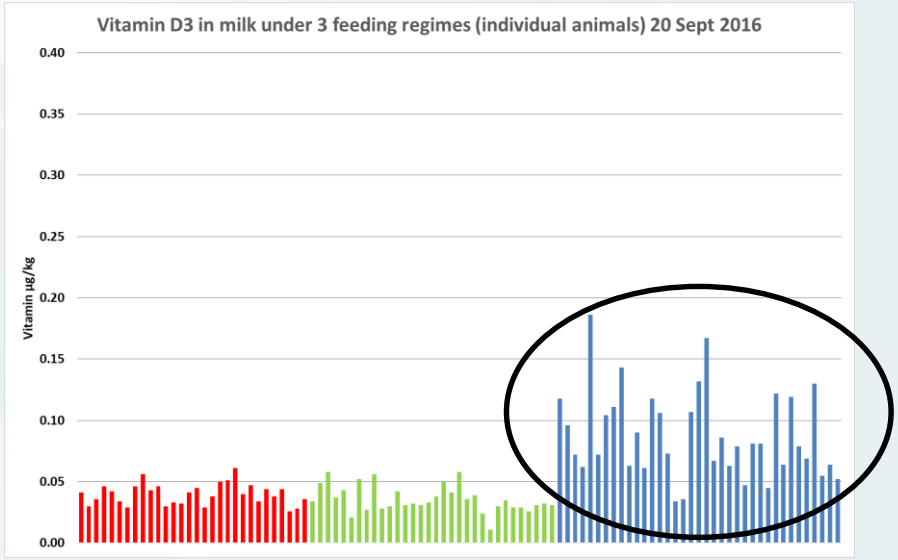
Results

Zero-grazing: Vitamin D3, individual animals

Milk analysed on 2 sampling dates 45 days apart



Zero-grazing **Silage** **Grazing**



Zero-grazing **Silage** **Grazing**

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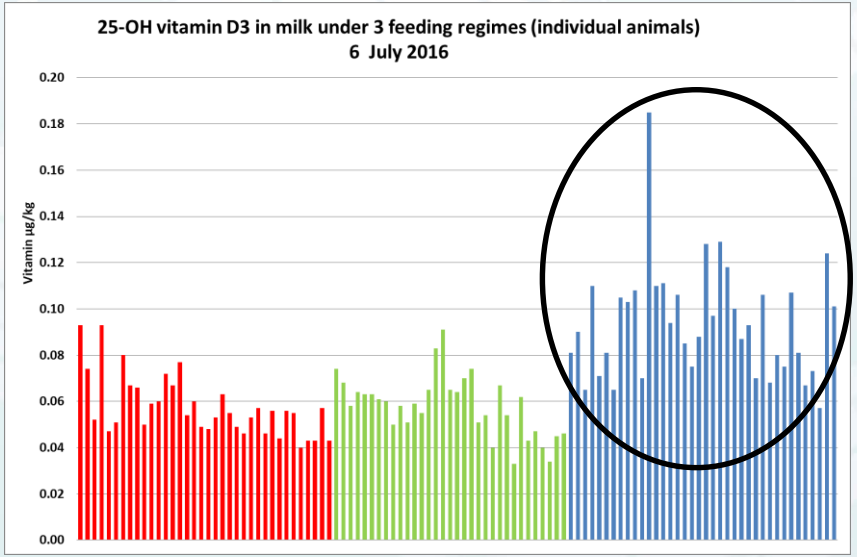
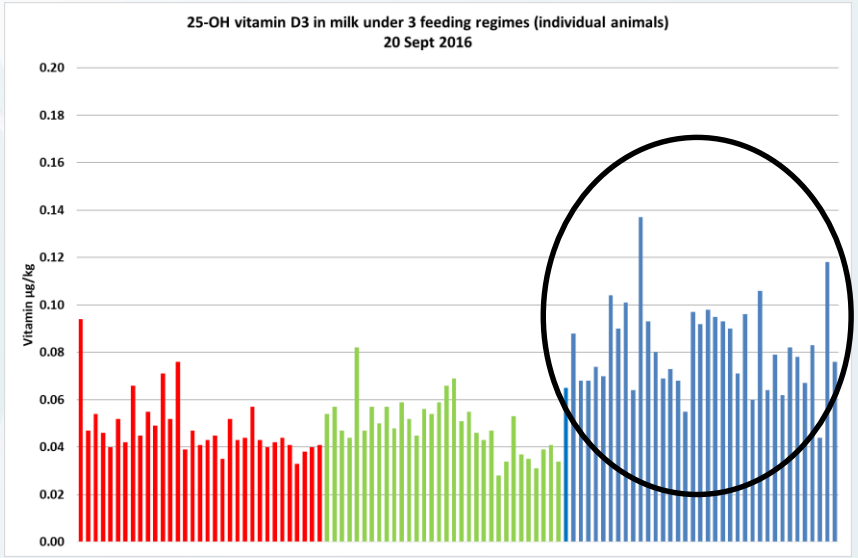
Zero grazing: 25-OH vitamin D3, individual animals

Milk analysed on 2 sampling dates 45 days apart



Zero-grazing **Silage** **Grazing**



Zero-grazing **Silage** **Grazing**

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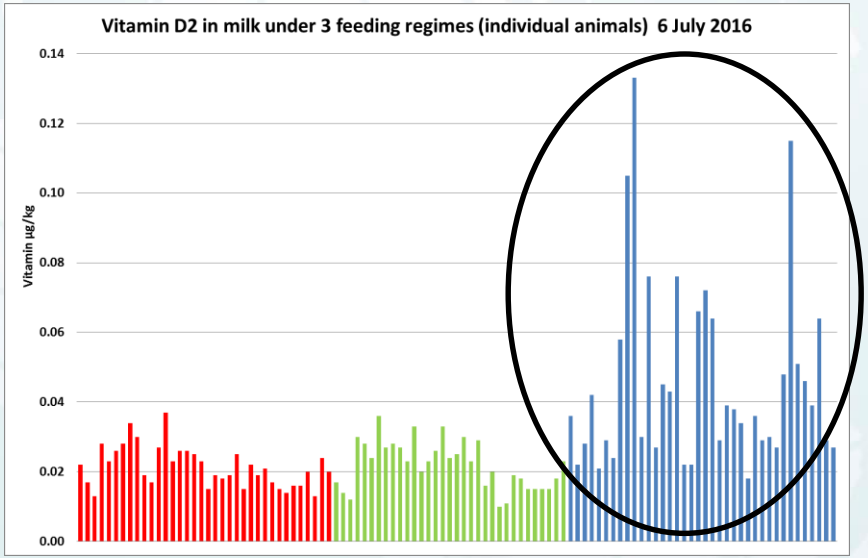
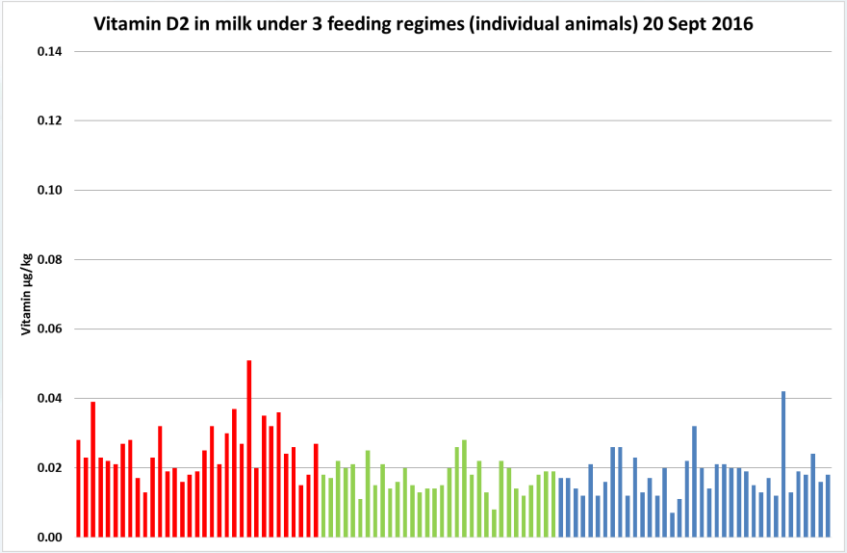
Zero-grazing: vitamin D2, individual animals

Milk analysed on 2 sampling dates 45 days apart



Zero-grazing **Silage** **Grazing**



Zero-grazing **Silage** **Grazing**

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Treatment effect on Vitamin D content of milk

	Date	Treatment			SEM	Significance		
		Zero grazing	Silage	Grazing		Management (M)	Date (D)	M x D
Vitamin D3 (µg/kg)	6 July	0.037^{a}	0.040^{a}	0.203^{c}	0.0094	<0.001	<0.001	<0.001
	20 Sep	0.041^{a}	0.036^{a}	0.088^{b}				
25-(OH) vitamin D3 (µg/kg)	6 July	0.058^{b}	0.058^{b}	0.094^{d}	0.0036	<0.001	<0.001	NS
	20 Sep	0.048^{a}	0.049^{a}	0.082^{c}				
Vitamin D2 (µg/kg)	6 July	0.021^{ab}	0.022^{ab}	0.046^{c}	0.0024	<0.001	<0.001	<0.001
	20 Sep	0.026^{b}	0.018^{a}	0.018^{a}				

Conclusions

Depending upon sampling date grazing animals produce

1. Between **2-5 times** more vitamin D3
2. up to **2 times** more 25-(OH)D3

than indoor housed animals

This study

1. highlights the natural seasonal variation milk production
2. suggests that strategies should be developed to ensure (as far as possible) maintenance of milk vitamin D levels year round
3. supports the use of UV-B as a strategy for production of milk with increased Vitamin D levels

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Effect of supplemental UV light and a dietary additive on Vitamin D levels in milk

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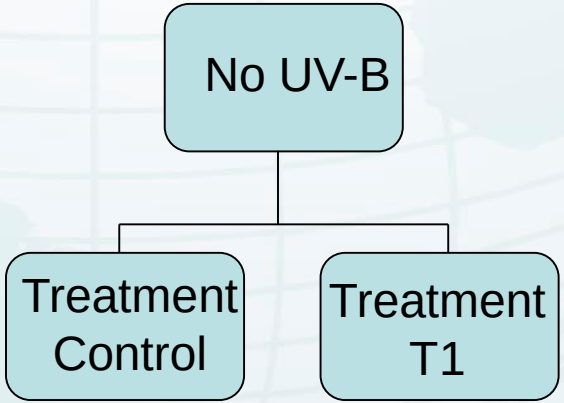
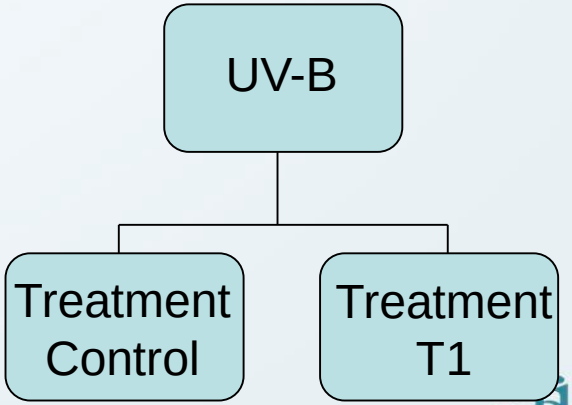
- 12 week study commenced 19-Sep completed 5-Dec
- 2x2 Factorial design (32 cows)
- 2 dietary treatments with and without UV-B exposure





Experimental: UV lighting

- Lights turned on for 20 minutes at maximum height
- Concentrate spread at feed barriers
- Cows locked in place
- Lights lowered
- UV-B exposure
- Cow at each position recorded

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Experimental: Sampling

- Vitamin D analyses
    - Milk sampled weekly
    - Blood samples bi-weekly
- Animal measurements
    - Milk yield
    - Milk composition- fat, protein, lactose etc.
    - Live weight condition score

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Results: Vitamin D3, milk

Week 8

- % Increase on UV ~35% for C and T
- % Increase on dietary treatment ~33%
- % Increase for UV + T 77%

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Preliminary Conclusions

Milk

- Vitamin D3 concentrations in milk can be enhanced by both UV and diet
- Potential for increased UV-B exposure

Plasma

Significant effect of UV

Opportunities

Production of Vitamin D Enhanced milk

produced though diet and bio-addition (use of UV-B)

For use in

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Thank you

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