Iodine residues in milk

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Background

- Iodine is an essential trace element - humans and animals
- Deficiency affects reproductive capacity, brain development and growth
- Increased iodine content in food due to greater use in:
  - food processing, animal rations, antimicrobial agents
- Whole milk and dairy products contribute highest proportion of iodine to the human diet
- Human requirements:
  - US Food and Nutrition Board (2001) :
    - Adult - 150 μg/day; children - 110 - 130 μg/day
  - German nutritional reference point (DACH, 2000) :
    - Adult - 180-200 μg/day; children - 40 – 80 μg/day
- **Average: Adult : 170 μg/day; children : 90 μg/day**

Why is milk iodine a quality issue

- Ireland – major exporter of dairy products
- Milk quality is critical to maintaining and expanding this market
- Ireland is one of leading infant formula manufacturers worldwide
- Market has significant potential for growth
- Two mechanisms :
  - Milk powder as an ingredient can be sourced abroad
  - Milk powder can be produced and sourced at home
    - Preferable
    - Needs to have correct levels and balance of minerals including iodine
- Target for iodine in milk powder as an ingredient in IMF :
  - 100 μg iodine/ 100g powder
  - equates to <250 μg iodine/kg milk
- Difficult to source at times of year, e.g. - concentrations of >500 μg/kg recorded for December (O'Brien *et al*. 1999)

Iodine sources that can lead to high milk iodine

1. Concentrate feed

- Traditionally 1990's feeding up to ~60 mg of iodine /cow/day in early lactation
- Rogers (1999) - iodine status varied in feed and animals and nonclinical iodine deficiency was common
- Deficiency defects included :
  - 10-60% calf mortality; calf thyroid enlargement; retained placenta and infertility in >10% of cows and heifers in affected herds, and lower milk yield in cows
- Diagnosis based on:
  - local knowledge, clinical signs and post-mortem findings
- Diagnosis was confirmed by
  - finding thyroid enlargement, low levels of iodine in thyroid tissue, or by low iodine levels in blood and/or feed samples
- Definitive confirmation based on :
  - dramatic response to iodine supplementation of the affected animals

Iodine sources that can lead to high milk iodine

- Early 1990s – 139 µg iodine/kg milk; 97% of pasture samples – subnormal iodine levels
- Recommended adequate supplementation of iodine
- 12-60 mg of iodine /cow per day
  - ~12 mg of iodine /cow per day advised for routine continuous use
  - ~60 mg of iodine /cow per day advised for national use in a 5-month mineral programme for dairy cows

2. Teat disinfection

- Used as a routine practice on-farm post-milking, and potentially pre-milking
- Contribution of post- disinfection iodine to milk iodine may be due to absorption through skin
- In Irish scenario – same strength pre and post milking
- Pre-milking disinfection can pose a substantial risk of iodine transfer to milk
- Dependent on the degree of removal from the teats prior to cluster attachment

Effect of dietary iodine supplementation and teat disinfection on milk iodine levels

	Non-iodine teat dipping	Post milking teat dipping with iodine	Pre and post milking teat dipping with iodine	Average standard error
70 mg iodine /day	813	817	1115	39.4
30 mg iodine /day	692	982	1429	96.4
0 mg iodine /day	217	461	670	45.5

International recommendations on iodine requirements for cows

- British Agricultural Research Council - **0.5mg/kg DM** intake or approximately 10-12 mg/cow/day
- GfE: German Society of Nutrition & Physiology - **0.5mg/kg DM** intake or approximately 10-12 mg/cow/day (1999, 2001, 2004, 2006)
- US: National Research Council – 0.6mg/kg DM intake or approximately 12-14 mg/cow/day (1989); reduced to **0.5mg/kg DM** intake or approximately 10-12 mg/cow/day in 1994, 1998, 2001)

High iodine intake risks

- High milk iodine may be exacerbated by seasonal milk production
- Two situations particularly at risk:
  - Early lactation cows in a spring system
  - Winter milking cows
- Iodine routinely added to feed rations at 5-10 mg/kg
- Cows typically fed 6-7 kg/cow/day in early lactation – can deliver 60-70 mg/cow/day
- Level of iodine in feed set a/c to the volume fed
- Limitation: when feed levels greater than the planned feeding rate – then excessive iodine intakes

High iodine intake risks

- Excess iodine intake by cows excreted into milk &urine
- If deficient, iodine supplementation will have positive impact – if not deficient, no data to indicate advantage
- Many studies in Germany (Flachowsky et al.)
- Influenced EU Commission to decrease the iodine maximum level in cow feed from 10 mg/kg to 5 mg/kg
- Interpretation of this legislation is important

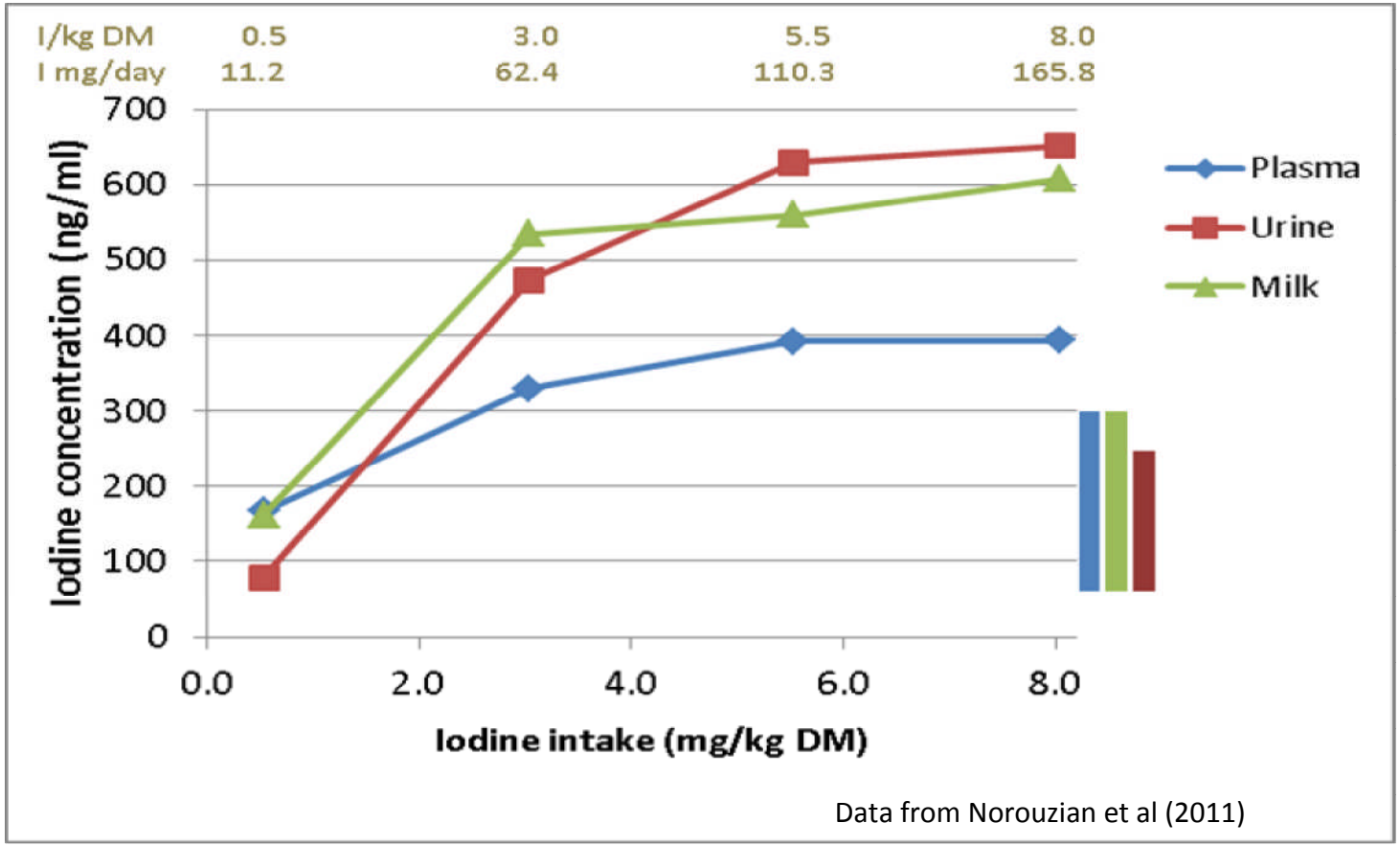
EU Commission legislation

Commission Regulation (EC) No 1459/2005 of 08/09/2005 on amending the conditions for authorization of a number of feed additives belonging to the group of trace elements

the maximum content of iodine in mg/kg of complete feeding stuff with a moisture content of 12% be 5 mg/kg

(This is a reduction from 10 mg/kg Commission Regulation pre 2005)

Iodine disposal



Data from Norouzian et al (2011)

Moorepark Bolus Study - study of Dr. Stephen Butler

Study conducted in Sept

Grass only for previous 3 m

Sward low in iodine

- 0.26 mg/kg DM

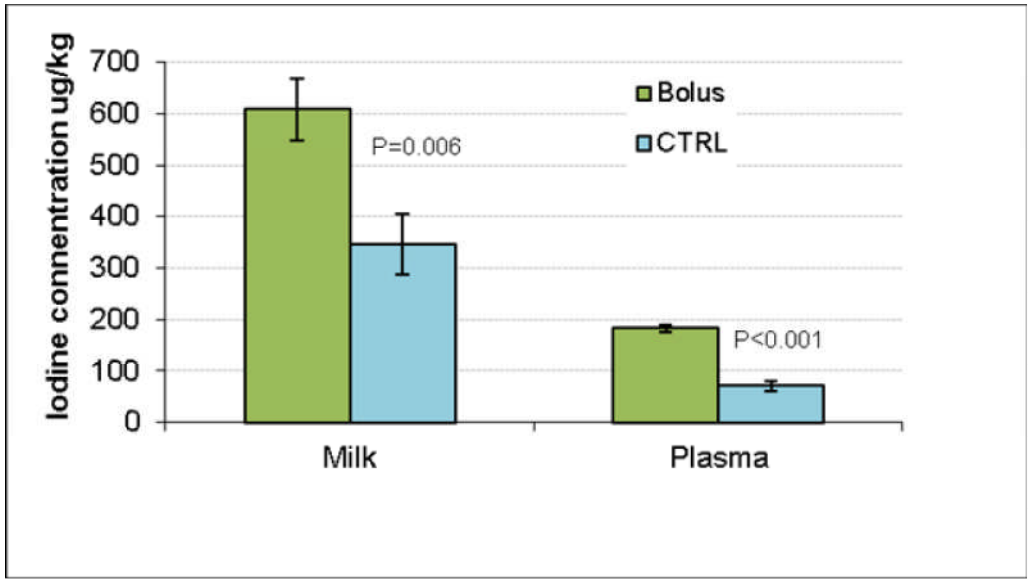
Iodophor teat dip used

Control treatment

- No bolus

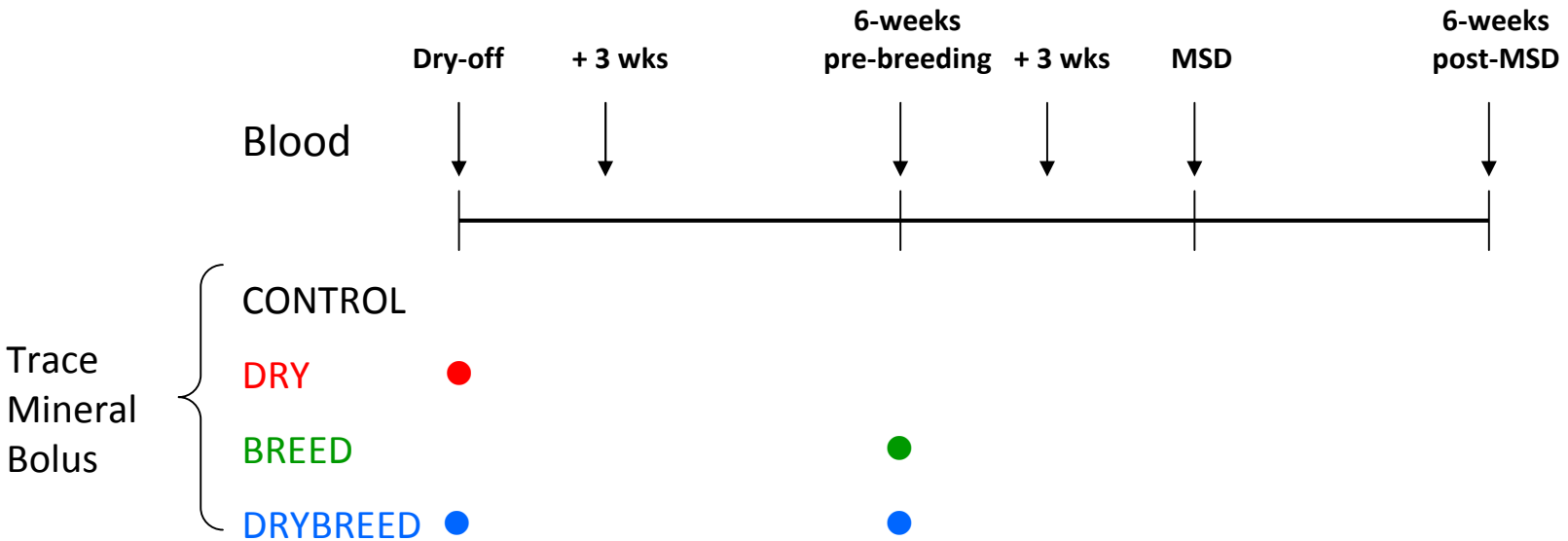
Bolus treatment

- 2 Animax Allsure boluses
- 6800 mg I



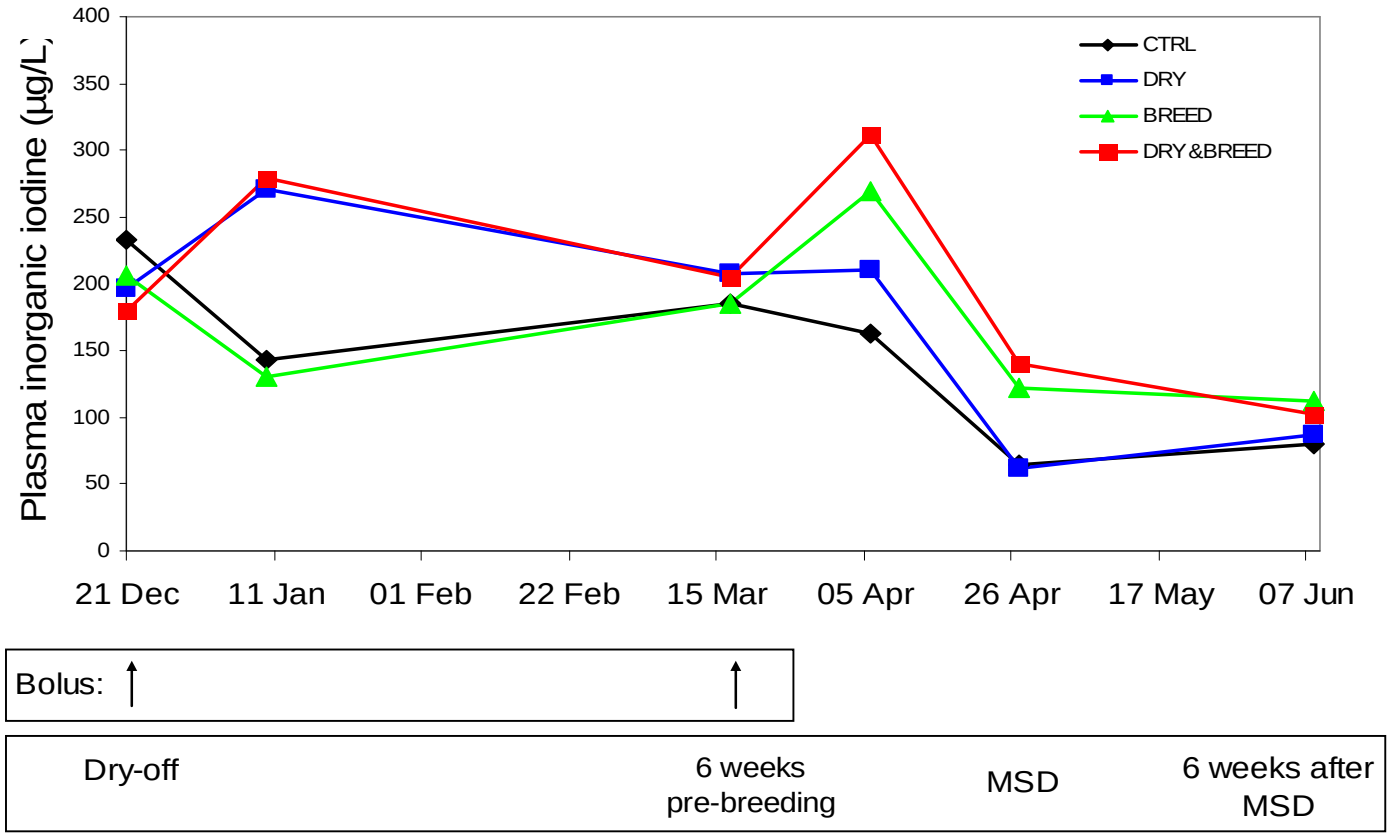
Moorepark commercial farm study

- **Dr. Stephen Butler**



- 5 farms, 4 treatments per farm
- 10 cows per treatment sampled on each farm
- Bloods analysed for plasma inorganic iodine

Plasma inorganic iodine



Conclusions

- Recommended supplementation level a/c to animal research documentation is 0.5 mg/kg DM/cow/day or ~10 – 12 mg/kg/cow/day
- Supplementation levels up to 60 mg/cow/day (up to 6 x)
- Still within EU recommendations – BUT causing a problem in milk
- Seasonal problem in Ireland; early lactation spring and winter milk production
- Milk iodine level is most important in areas where milk is destined for IMF
- At a limit of 250 µg/kg – little flexibility
- Methodology now set up at Moorepark – ICPMS
- Can monitor more closely – monthly milk sample collection – national perspective
- Ideally – establish iodine status of the herd – grass /and milk
- Supplement more precisely to meet requirement


Thank you