Iodine residues in milk

Bernadette O’Brien
D. Gleeson and K. Jordan

*Milk Quality Conference*
*4th December 2013*
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

<table>
<thead>
<tr>
<th></th>
<th>Non-iodine teat dipping</th>
<th>Post milking teat dipping with iodine</th>
<th>Pre and post milking teat dipping with iodine</th>
<th>Average standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 mg iodine /day</td>
<td>813</td>
<td>817</td>
<td>1115</td>
<td>39.4</td>
</tr>
<tr>
<td>30 mg iodine /day</td>
<td>692</td>
<td>982</td>
<td>1429</td>
<td>96.4</td>
</tr>
<tr>
<td>0 mg iodine /day</td>
<td><strong>217</strong></td>
<td>461</td>
<td>670</td>
<td>45.5</td>
</tr>
</tbody>
</table>
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
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)
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

Bolus: ↑

Dry-off 6 weeks
pre-breeding MSD 6 weeks after

CTRL  DRY  BREED  DRY&BREED
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