Nutrition and Welfare of Dairy Cattle: Calves, Lameness, and Metabolic Aspects

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Introduction

- Overall, welfare of dairy cattle is relatively high
  - Elevated economic value
  - Positive relationship between welfare and production
- In many occasions, the design of facilities is limiting welfare (improper bedding, excessive stocking density, poor ventilation....)
- In others, the limiting factor is nutrition
  - Calves
  - Early phase of lactation
  - Rumen upsets with consequences on hoof health

Calves

- Mortality in dairy calves ranges between 1 and 10% (Bach et al., 2008)

- Morbidity of BRD is around 15% (Stanton et al., 2010; Bach et al., 2011)

- In the 90‘s the most common cause of death was diarrhea (Virtala et al., 1996), but the trend has changed, and now BRD is the most important cause (Svensson et al., 2006)

- Part of the problem is an insufficient supply of nutrients to allow an adequate immune response

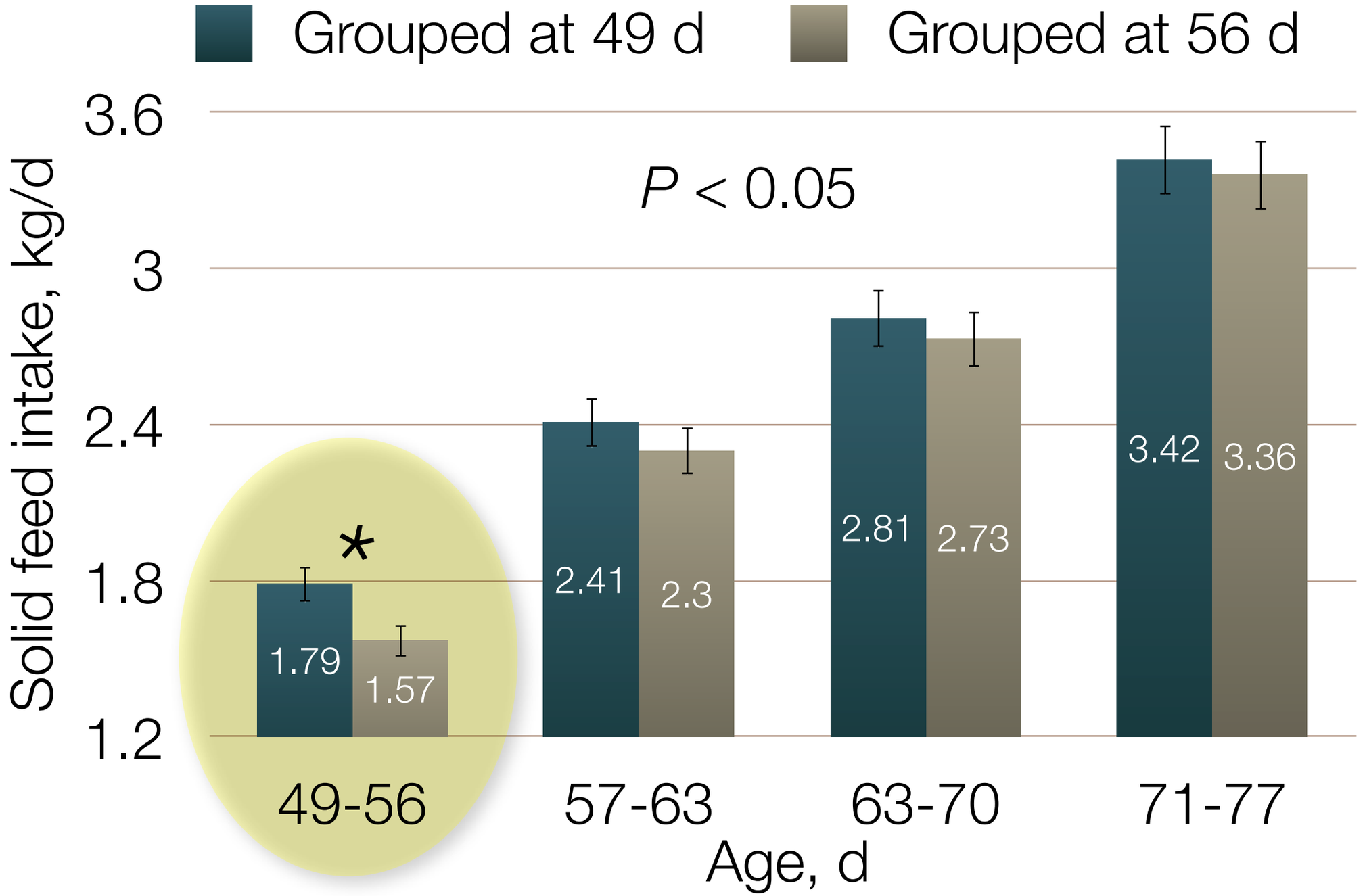
Calves

- The most common feeding practice for calves is 4 l/d of milk or MR twice daily
- However, calves can consume (and grow) much greater amounts (Jasper and Weary, 2002; Terré et al., 2007)
- Offering calves 4 l/d results in hunger, illustrated as increased vocalization (Thomas et al., 2001) and standing times (De Paula Vieira et al., 2008)
- However, feeding large volumes of milk compromises solid feed intake, and this may hamper performance around weaning and expose calves to disease

Calves

- Calves can be weaned based on solid feed consumption (Roth et al., 2009)
  - Long, expensive, and difficult to implement
- Progressive (step down) weaning (Khan et al., 2007)
  - Needs automatic milkers (expensive, unattended)
- Grouping before pre-weaning

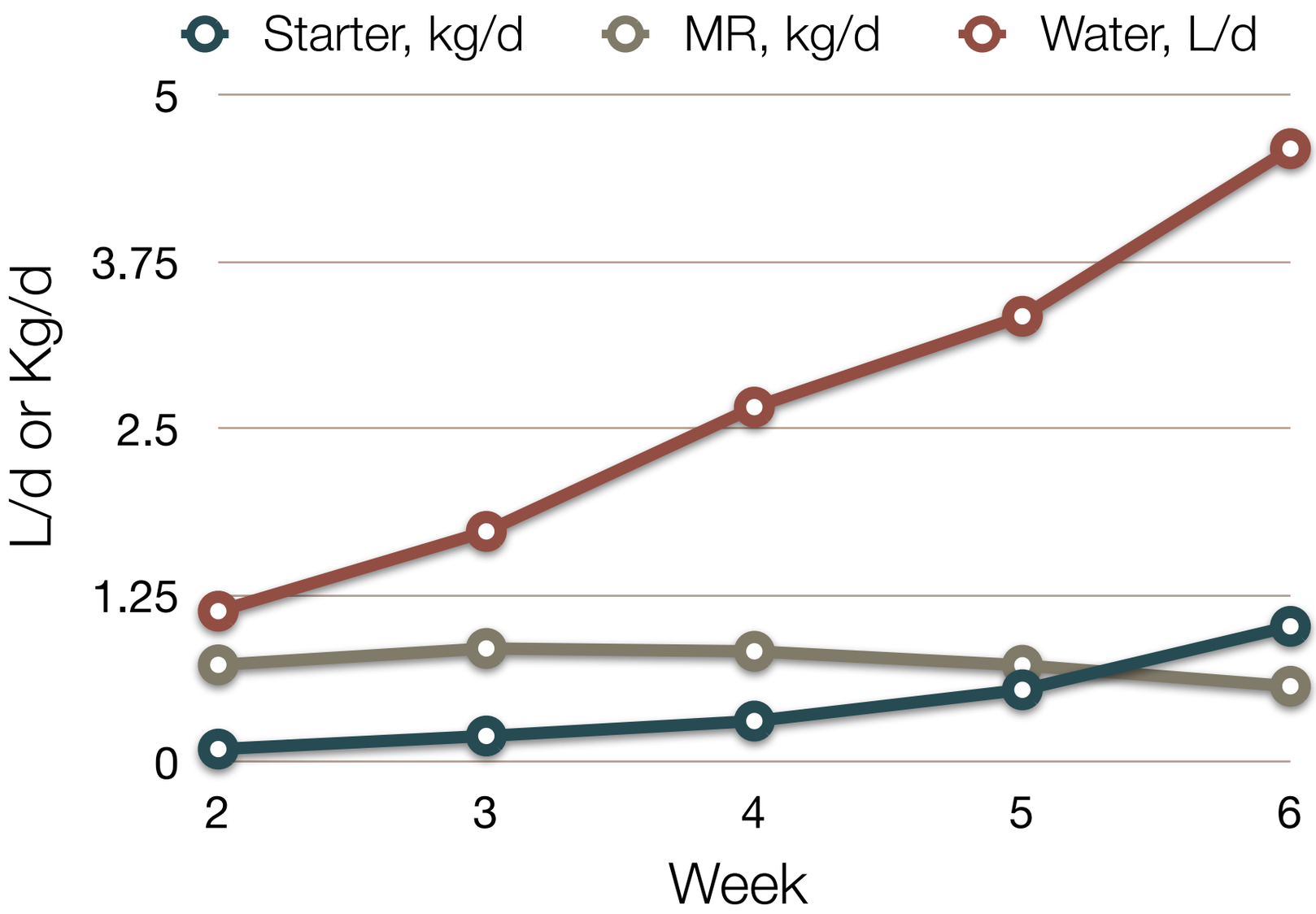
Calves



Bach et al., 2010

Calves

- Providing water to calves is often recommended
- However, little data exist on water intake by calves



Terré et al., 2006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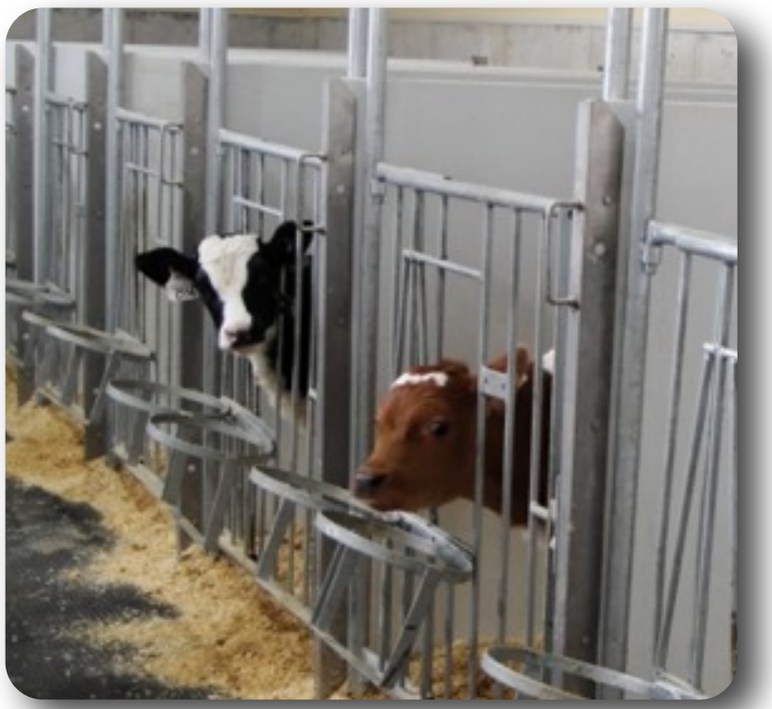


Calves

- It is commonly believed that texturized or coarse starters lead to better performance than finely ground starters (Warner et al., 1973; Warner, 1991) and that forage should not be offered to calves until 60 d of age

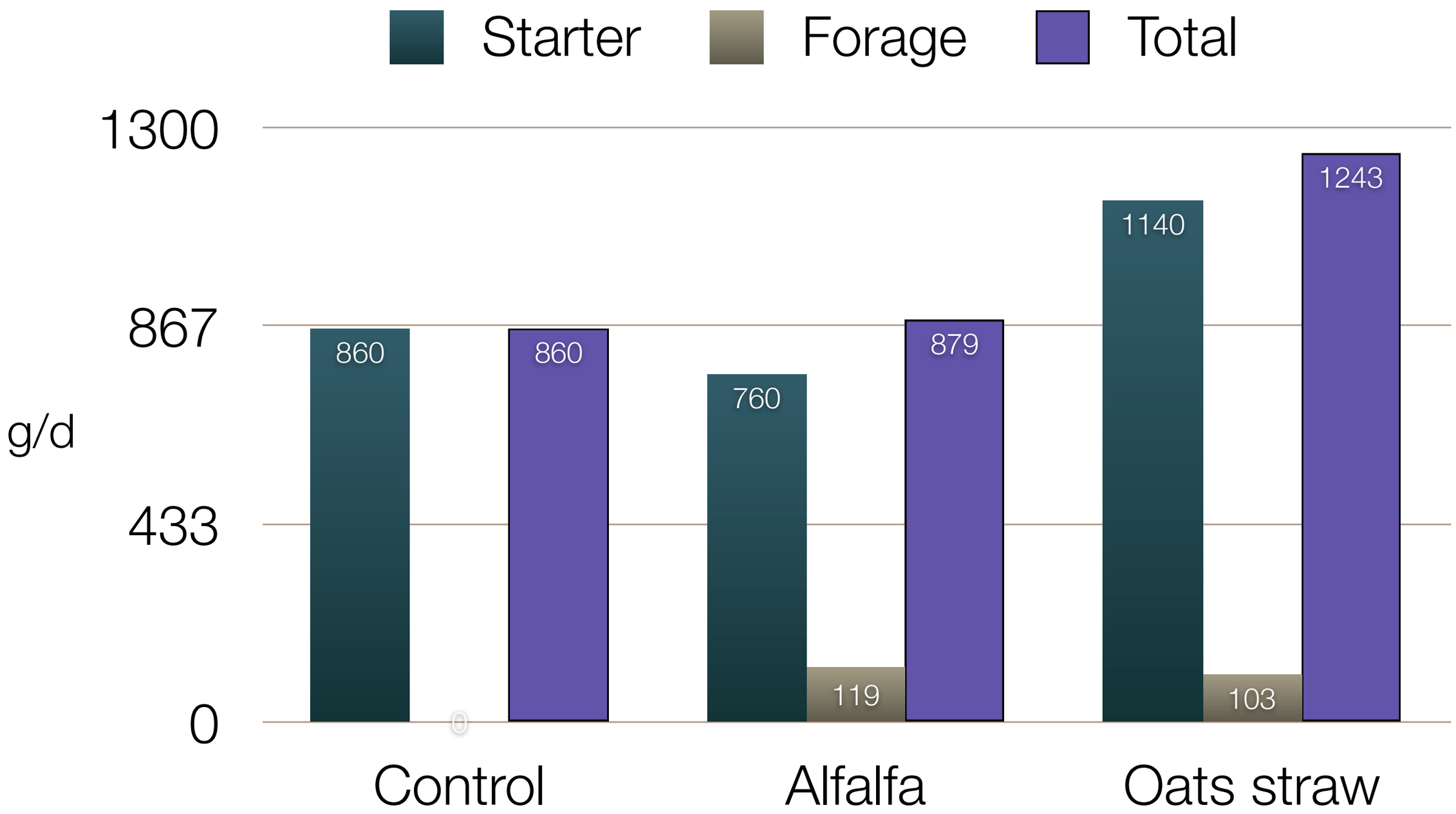
- There are many kinds of texturized starters

- Forages may stimulate the muscular layer of the rumen (Tamate et al., 1962) and promote rumination (Hodgson, 1971; Phillips, 2004)

- It may be “safer” to offer forage on the side

Calves

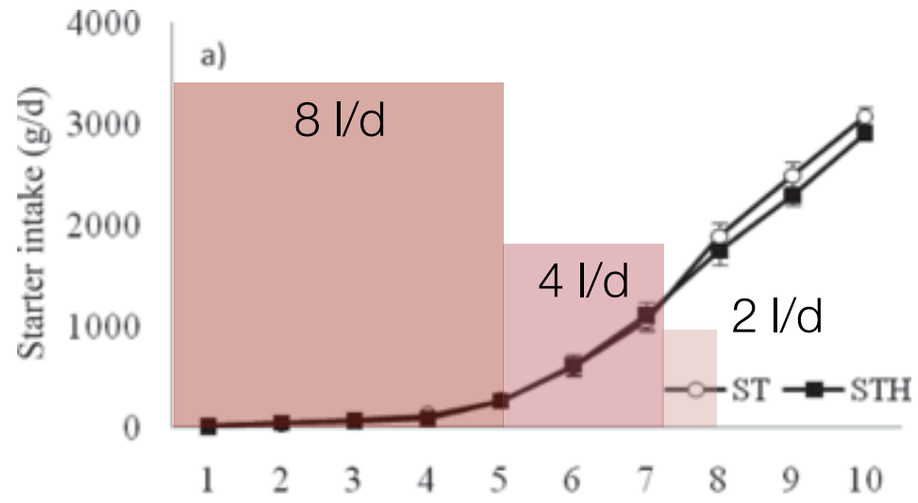
- Recent evidence (Castells et al., 2011) indicate that offering chopped forages (2 cm) increases total intake

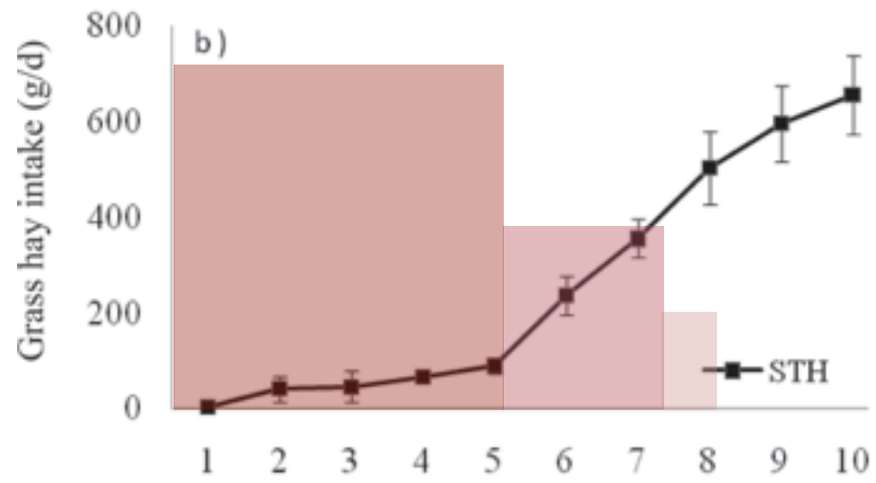


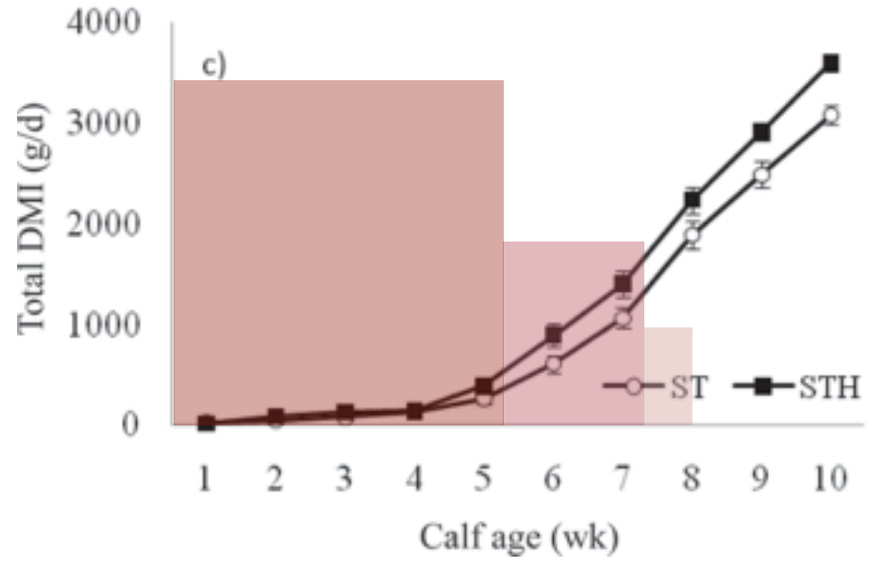
Calves

Khan et al. (2011)

- Access to starter (ST)
- Access to grass hay
  + starter (ST+STH)





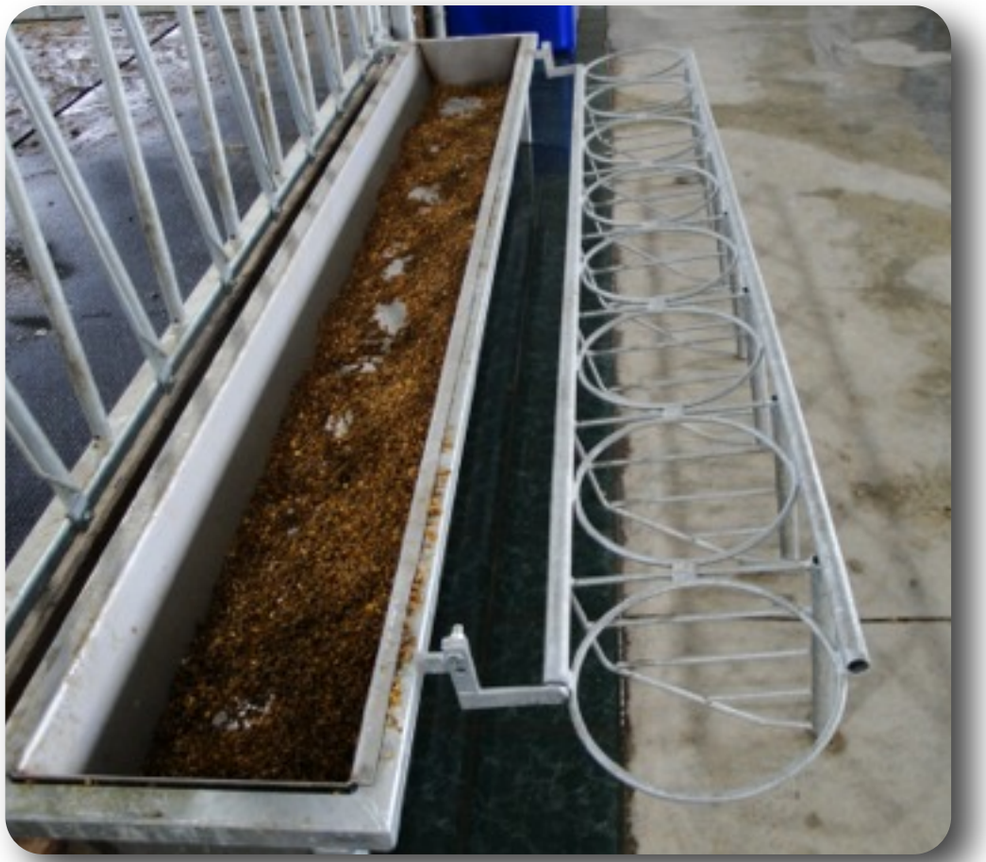


Calves

- The transition from liquid to solid feed is an area where more research is definitely needed

- Under most practical conditions, once calves are weaned, they continue to receive the same concentrate feed they were weaned on but at a restricted amount plus *ad libitum* access to dry roughage

- Weaned calves should be offered a dry total mixed ration that is adequately balanced for energy and protein (Bach and Ahedo, 2008)

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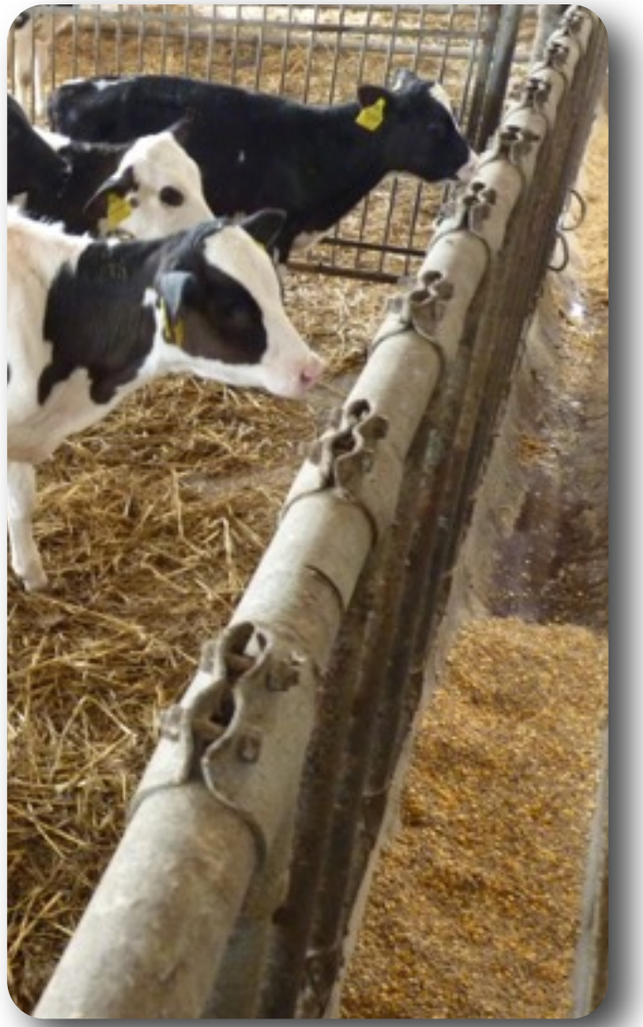
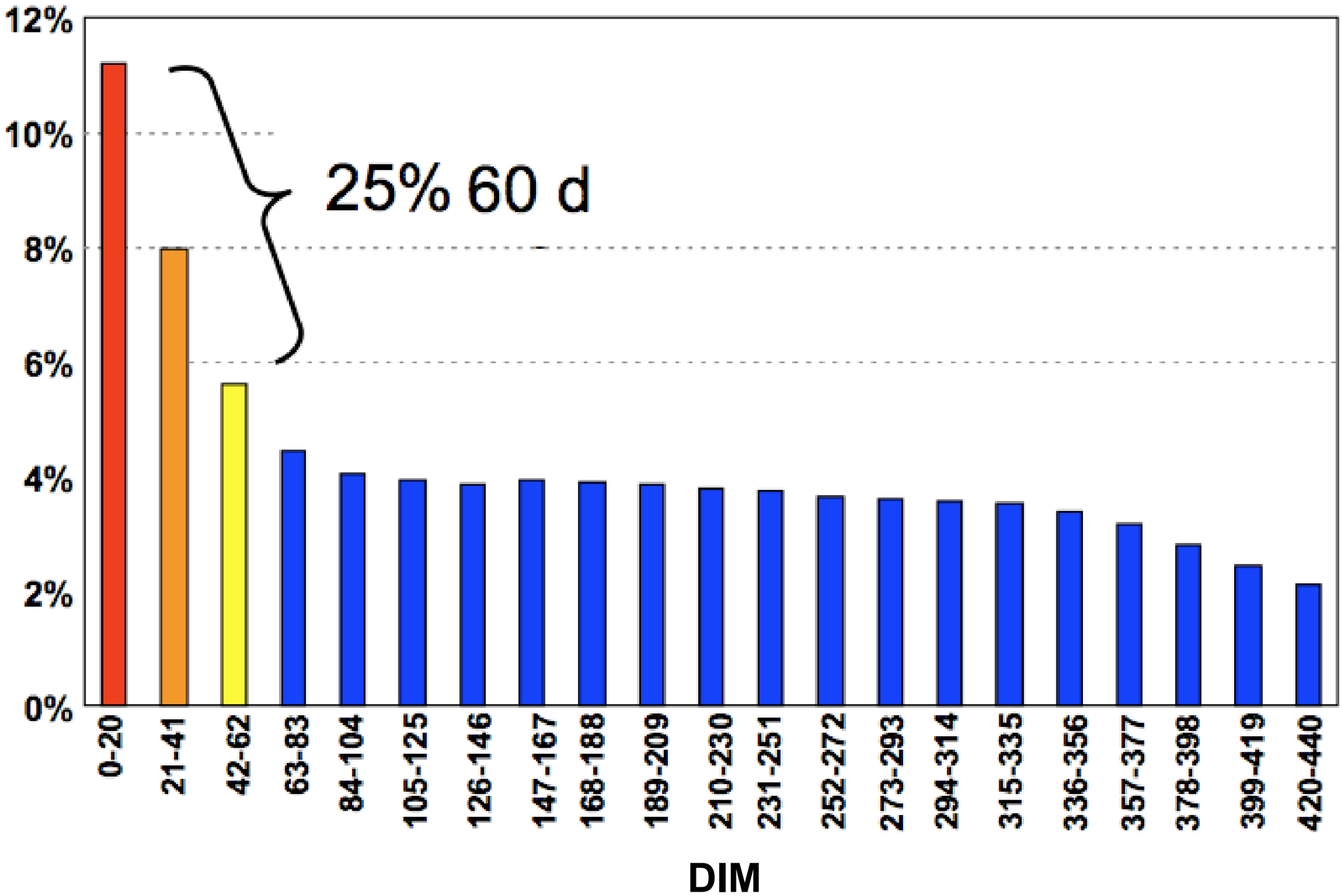


Metabolic problems



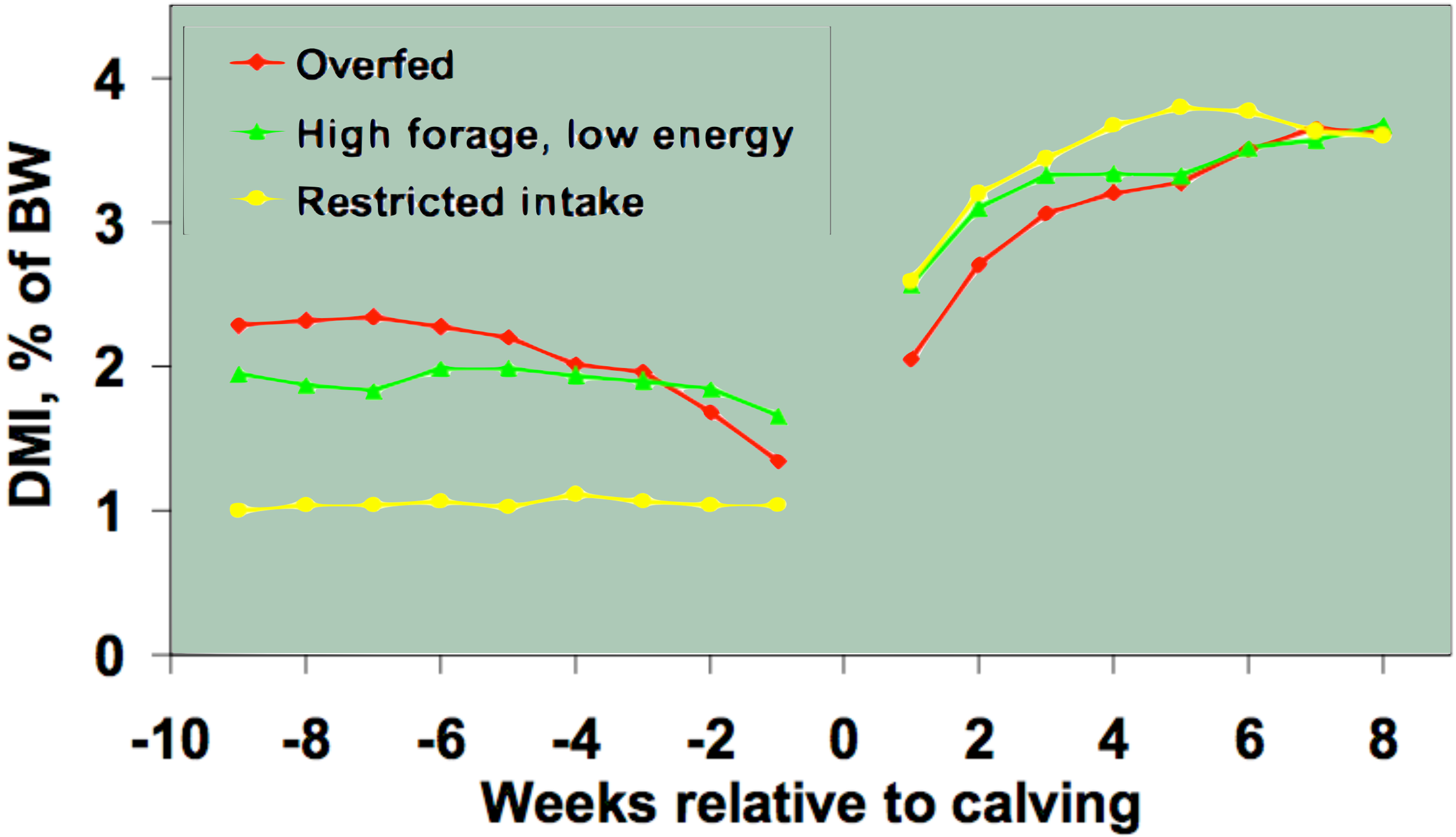
Metabolic problems

- Minor et al. (1998) compared pre-partum rations high in NFC with other high in fiber
  - Plasma glucose increased, and NEFA decreased when the rations were high in NFC
  - It was concluded (NRC, 2001) that the ideal ration would be:
    - < 35% NDF
    - > 38% NFC
    - ~1.65 Mcal/kg

Metabolic problems

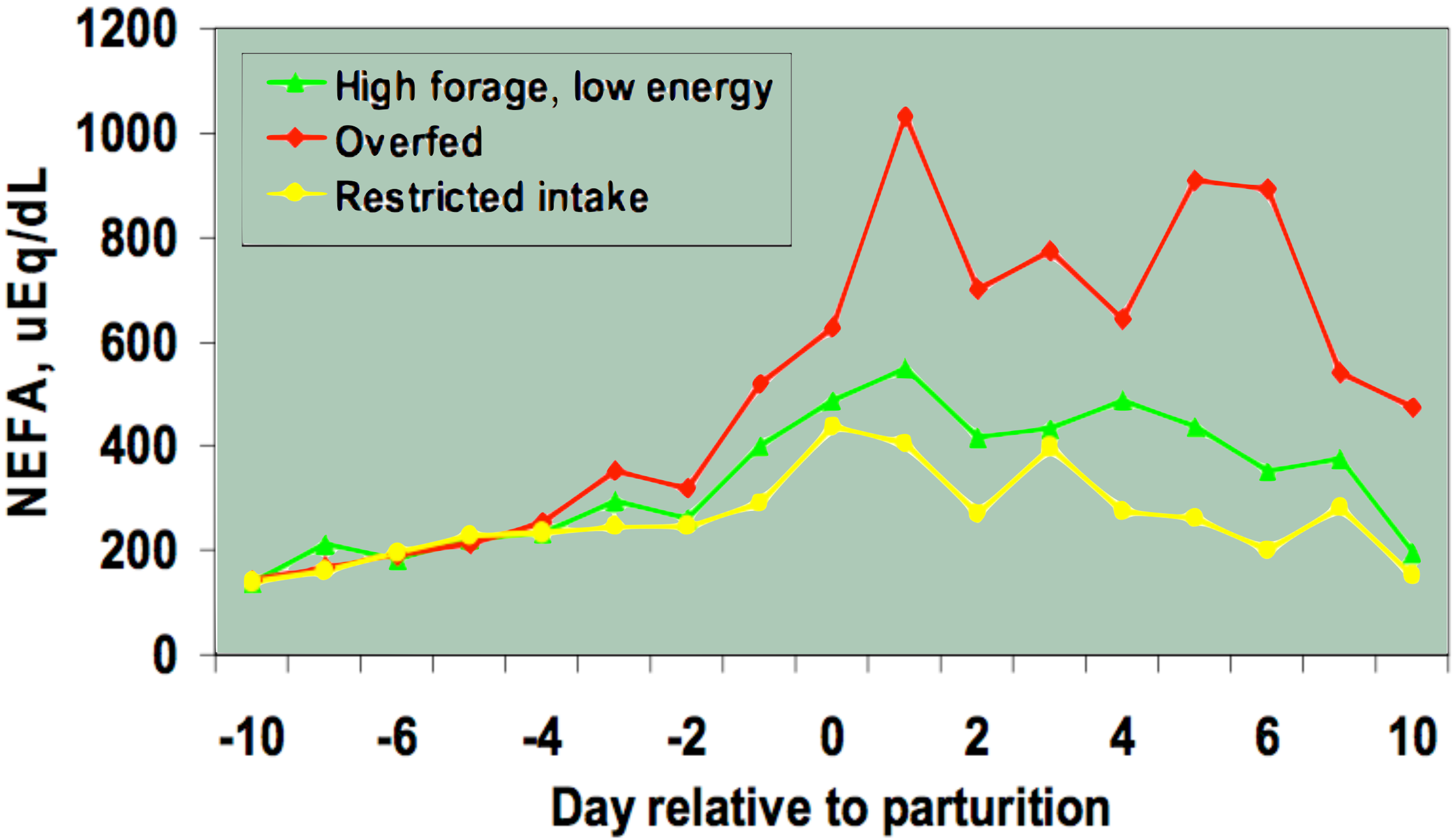
- After several years of implementing this type of rations, we have NOT diminished the incidence of ketosis post-partum
- Some studies (Rajala et al., 2004) suggested that pre-partum rations with more than 15 Mcal/d of NE resulted in a greater risk of DA

Metabolic problems



Janovick-Guretzky and Drackley, 2006

Metabolic problems



Janovick-Guretzky and Drackley, 2006

Metabolic problems

- An area to be further explored is the transition after calving

- It has been generally assumed that changing cows from a high-forage to a high-concentrate ration right after calving has no detrimental consequences for the cow (Hernandez-Urdaneta et al., 1976)

- A recent survey from Germany (Heuwieser et al., 2010) reports that only 21% of the herds had a dedicated fresh pen

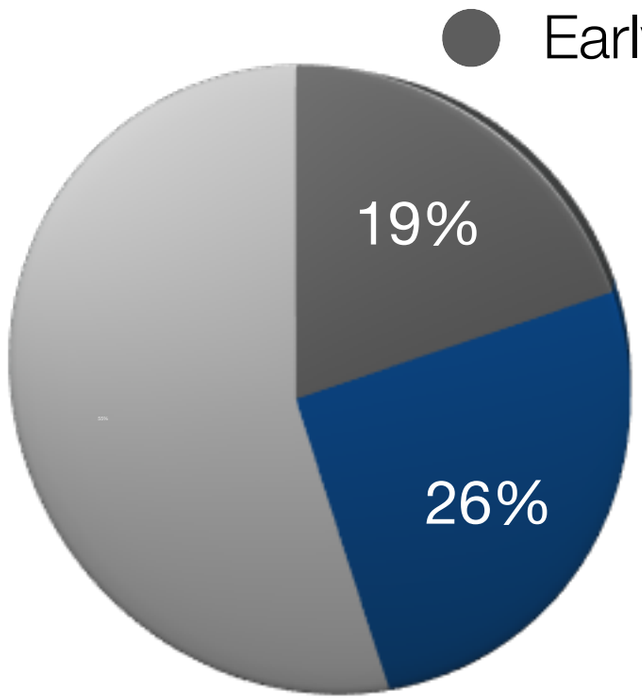
Metabolic problems

- Nevertheless, some producers will dilute the fresh ration with forage (Shaver and Hoffman, 2010).

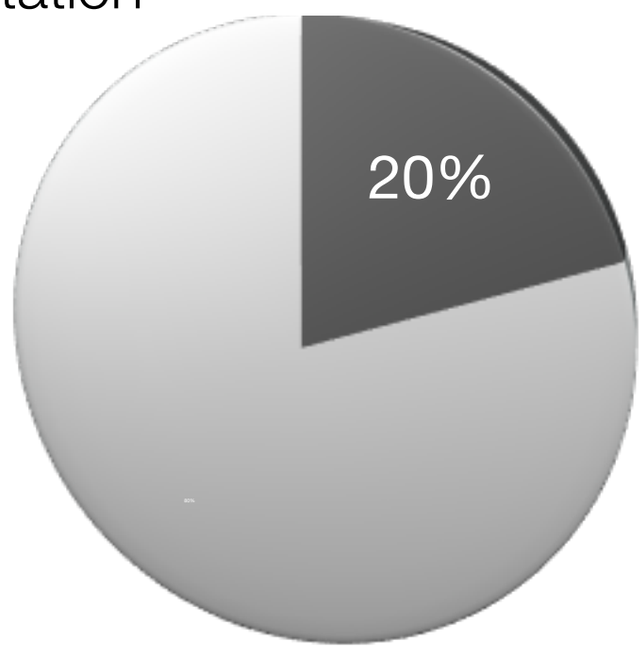
- There is no scientific evidence that this practice is effective, although it is likely that diluting the lactating ration with about 0.5 kg of chopped straw for about 15-21 d post-partum may actually help increasing intake and providing adequate structure to rumen contents.

Lameness

- Lameness is probably the most important animal welfare issue in today's dairy herds, and ruminal acidosis has been recognized as a major risk factor for laminitis (Nocek, 1997; NRC, 2001).
- Lameness, in conjunction with secondary reproductive failure and low milk production, is commonly the most important cause of premature and involuntary culling.



Garret et al., 1997



Oetzel et al., 1999

Lameness

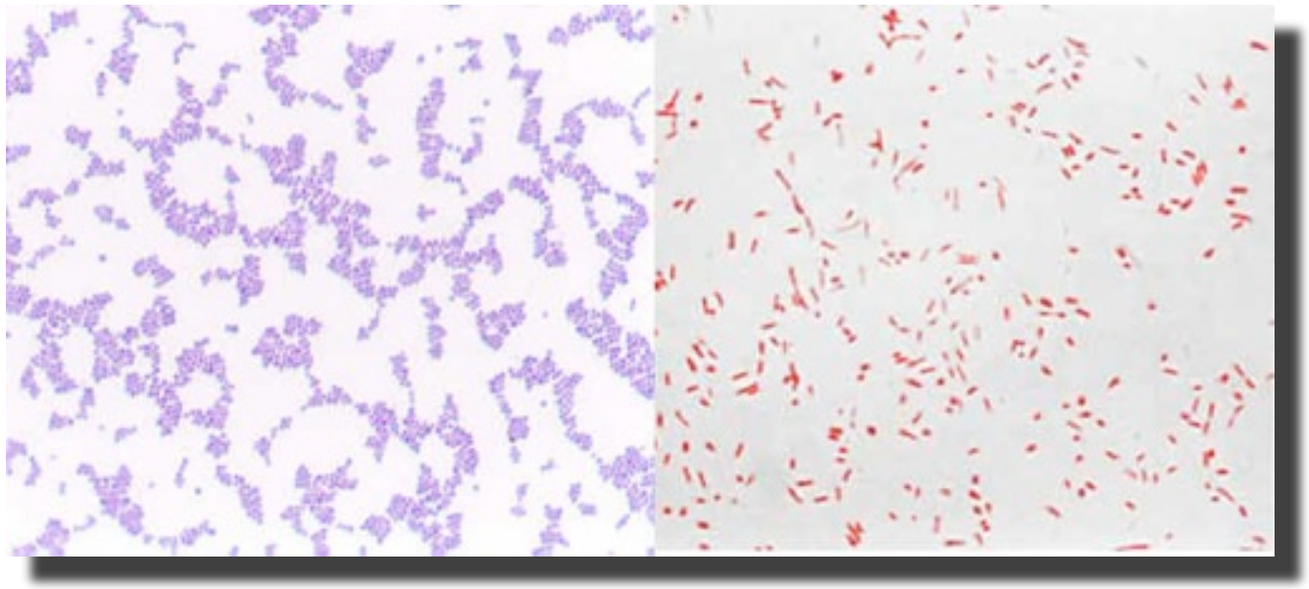
- In an attempt to provide sufficient energy to high-producing cows the proportion of nonfiber carbohydrates in the diet is increased at the expense of fiber or forage content

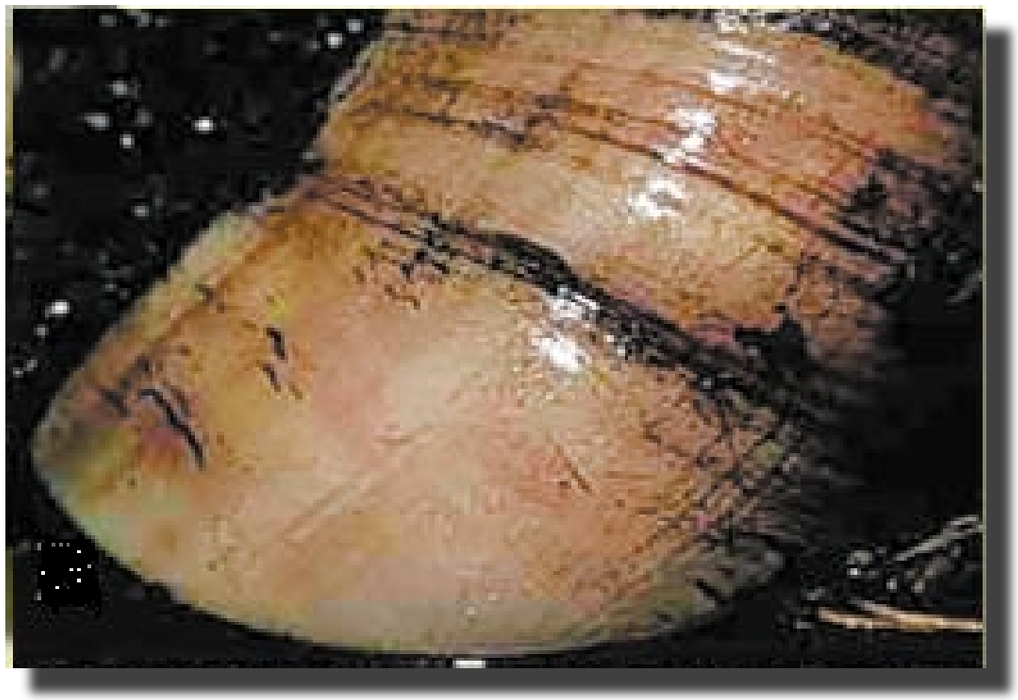
- Rations that ferment rapidly in the rumen and have low fiber or forage contents are considered to be potentially acidogenic

- Laminitis, not only causes pain to cows, but it also compromises milk production (Warnick et al., 2001; Green et al., 2002; Bach et al., 2007)

Lameness

- Lysis of Gram negative (Wells and Russell, 1996)
- Increased LPS (Andersen et al., 1994; Gozho et al., 2005)
- Inflammatory response cascade through an increase in acute phase proteins (Gozho et al., 2005, 2007)
- *Allisonella histaminoformans* (Gardner et al., 2004)





Lameness

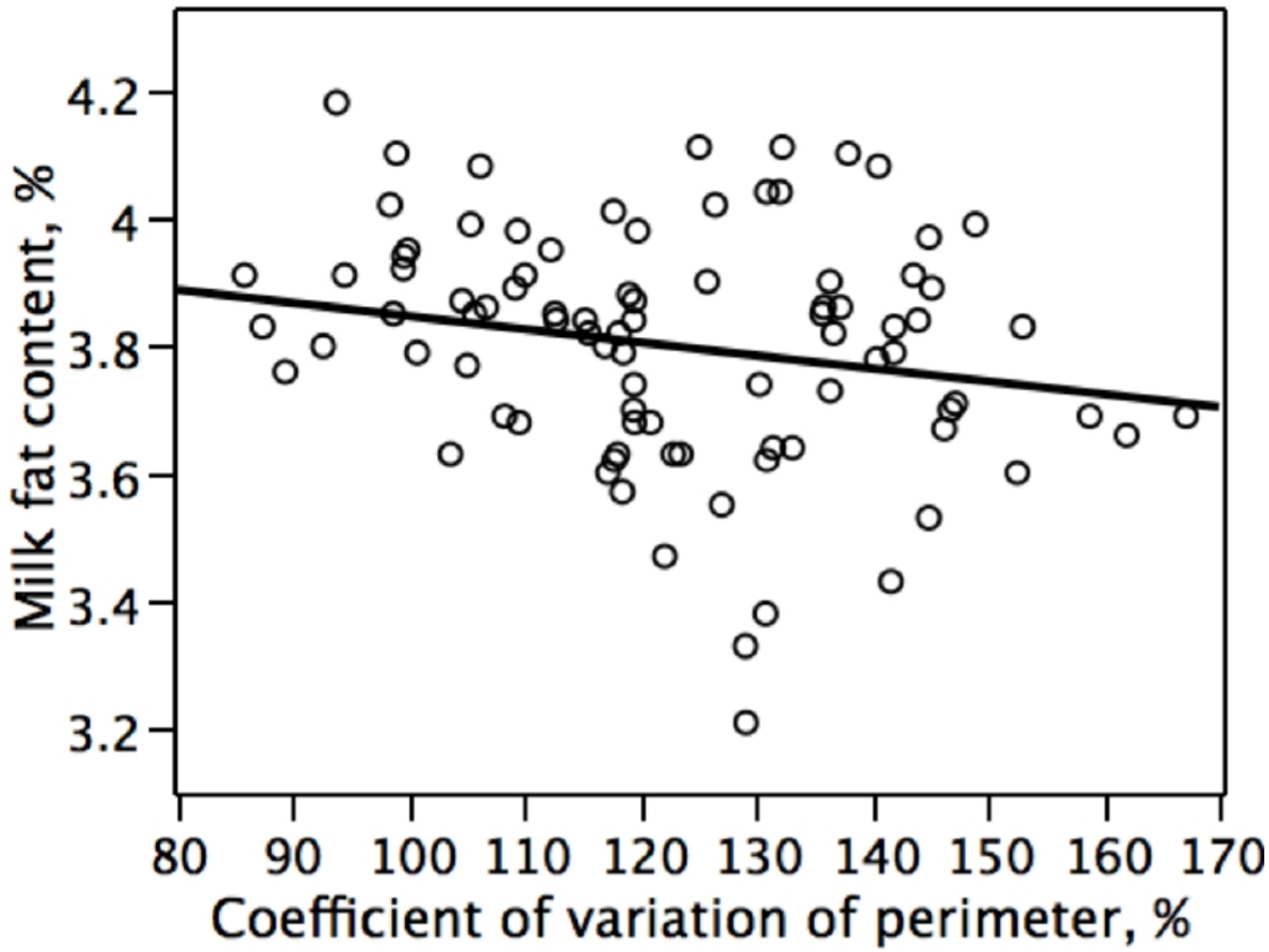
- To prevent ruminal acidosis, it is commonly suggested to provide a minimum of total fiber and physically effective fiber in the ration.

- Traditionally, feeding forages of small particle size has been correlated with decreased chewing activity (and saliva secretion), low rumen pH, and low milk fat percentages (Cassida and Stokes 1986)

- But traditional studies have been conducted in cows that are kept in tie-stalls

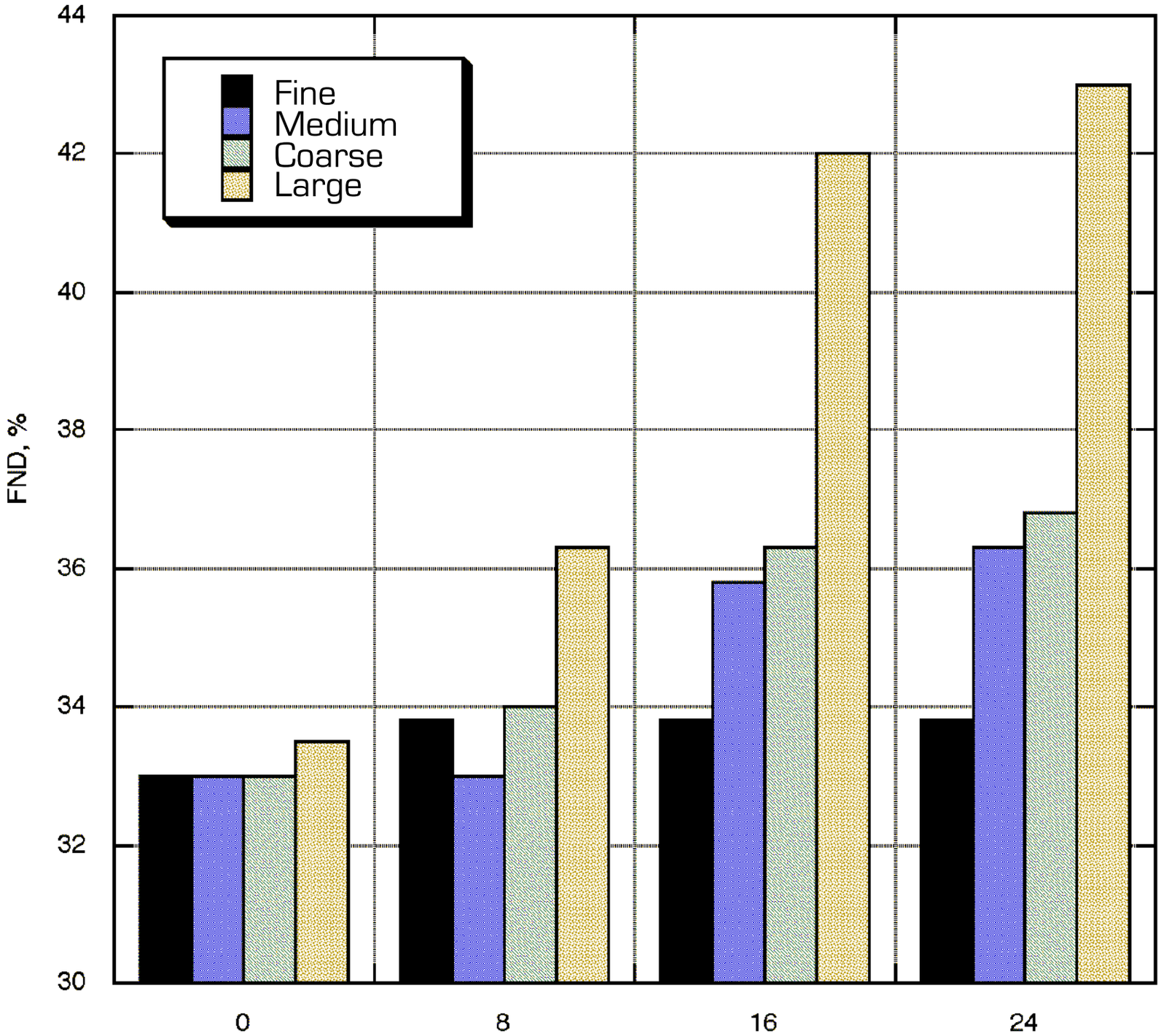
Lameness

- Nowadays, most dairy cows are kept in free-stalls or bedded packs, and Leonardi and Armentano (2007) reported that sorting activity was greater in cows fed as a group in free-stalls than cows fed individually in tie-stalls



Bach et al., 2003

Lameness



Knonoff et al., 2003

Lameness

- Improving the balance between fiber and nonfiber carbohydrates in the ration and avoiding selection against long particles in high-concentrate rations by using a homogenous particle size are pivotal in avoiding subacute rumen acidosis and the risk of laminitis and subsequent lameness

Concluding remarks

- Providing more nutrients and chopped forages (other than alfalfa) to young calves should minimize disease and improve performance

- Feeding low-energy rations before calving, and transitioning cows into a milking diet after calving should minimize metabolic upsets

- Properly balancing rumen fermentation and feeding diets with homogeneous particle lengths (to avoid sorting) should decrease the incidence of rumen acidosis and potential risks for lameness