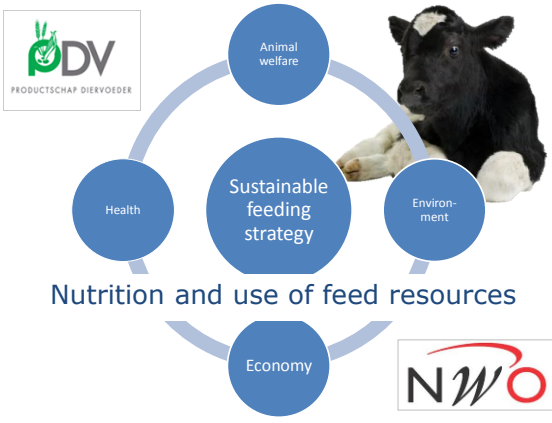
Nutrient utilization, dietary preferences, and gastrointestinal development in veal calves

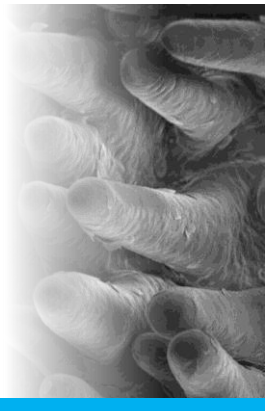
Interactions between solid feed and milk replacer

Harma Berends



Overview

- **Rumen development**
- N and E metabolism
- Dietary preferences
- Ruminal drinking
- Passage kinetics



Rumen development is crucial

- Rumen development
  - VFA stimulate growth papillae
  - Concentrates (highly fermentable)
  - Fibres stabilize rumen pH, fermentation and reduce plaque
  - Physical structure stimulates rumen development
- Early rumen development benefits abomasal health and utilization of solid feed *(Berends et al., 2012a)*

Chapter 2

Overview

- Rumen development
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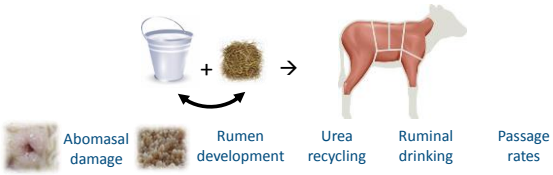
Interactions between MR and SF



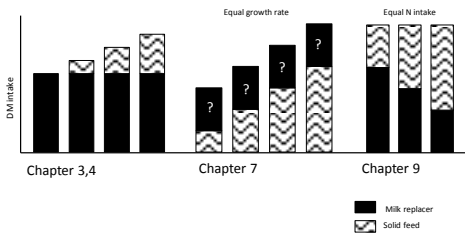
- Interactions partly age-dependent
- Interactions complicate accurate prediction of the feeding value of a ration consisting of MR and SF in veal calves
- How to predict feeding value?

Chapter 1

Research questions

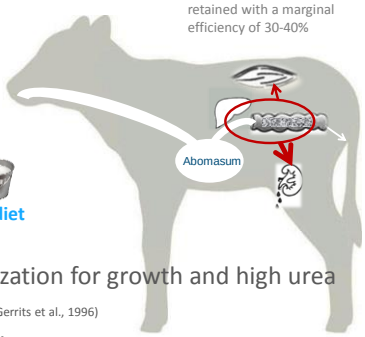
- What is the contribution of solid feed to:
  - Feed digestibility?
  - Growth performance?
  - Protein and energy deposition?
- What is the contribution of interactions between solid feed and milk replacer?

Experimental approaches



When providing only milk replacer, extra N is retained with a marginal efficiency of 30-40%

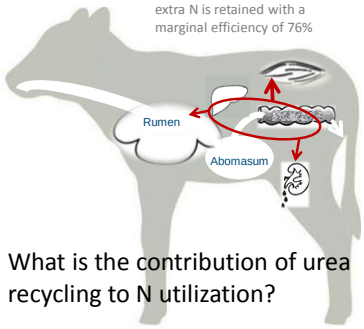
Traditional veal diet



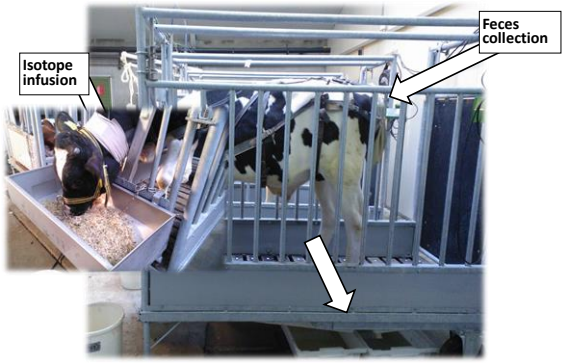
- Low N utilization for growth and high urea excretion (Gerrits et al., 1996)
- Urea recycling not important (Gerrits et al., 2001)

Milk replacer and solid feed

When providing solid feed on top of milk replacer, extra N is retained with a marginal efficiency of 76%



What is the contribution of urea recycling to N utilization?



SF provision benefits N economy

- The high marginal efficiency of N retention (76%) with SF intake is explained by
  - recycling of urea originating from milk protein (19%)
  - a more efficient post-absorptive N utilization
- Effect of age: benefit of SF was higher at 164 than at 108 kg BW
- The provision of SF rather than its level stimulates expression of mRNA of urea transporter-B in the rumen wall

Does N source affect N utilization?

- 30 HF male calves (23 wk of age, 180 kg BW)
- 3 iso-nitrogenous diets:

Solid feed level	CP content MR	CP content concentrates	% of total N delivered by SF
Low	21%	14%	12%
High	21%	14%	22%
High	15%	25%	36%

Chapter 9

N source affects N economy

- Increasing (low-protein) SF intake did not affect N retention efficiency
  - N from low-protein SF is used as efficient as N from MR
- Increasing the N content of SF decreased urea production (-20%) and increased N retention (+17%) and fibre digestion (+22%)
- A low N availability in the rumen limits microbial growth in calves
- Urea recycling cannot compensate for a protein deficit

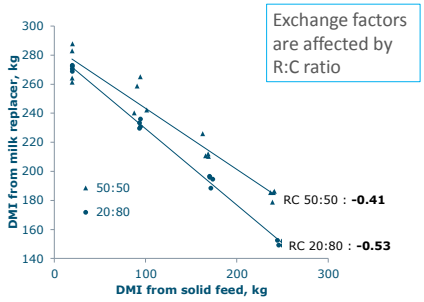
Chapter 9

Paired-gain experiment

- ? is the amount of MR needed to realize equal carcass gain
- For 2 forage:concentrate ratios
- MR intake adapted based on 2-wk BW
- Correction for gastrointestinal content and development

Chapter 7

Feeding value SF relative to MR



Chapter 7

Discussion

- Utilization of MR for gain decreased relative to that of SF during the fattening period:
  - Rumen development and fermentation
  - Interactions
- Performance:
  - Color and Hb increased with SF level, no effect of F:C ratio
  - Fat score was unaffected by SF level and F:C ratio

Chapter 7

Overview

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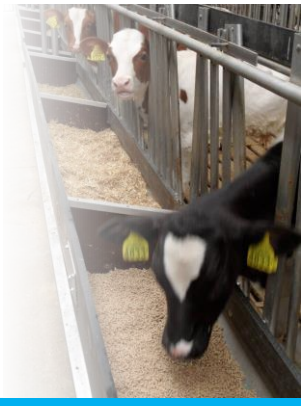
- **Dietary preferences**
- Ruminal drinking
- Passage kinetics



Research questions

- What is the dietary preference of calves until 6 months of age?
- Is their dietary preference consistent?
- Are they related to health aspects?

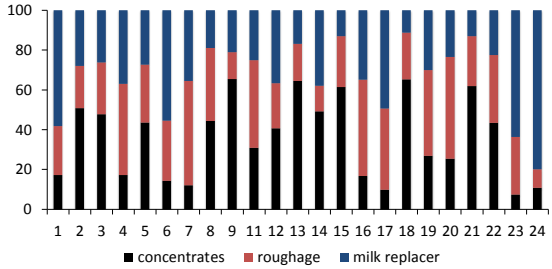
Experimental design

- 24 HF calves (2 wk of age, 46 ± 0.3 kg BW)
- Free and ad lib access to 6 diet components:

Chapter 5

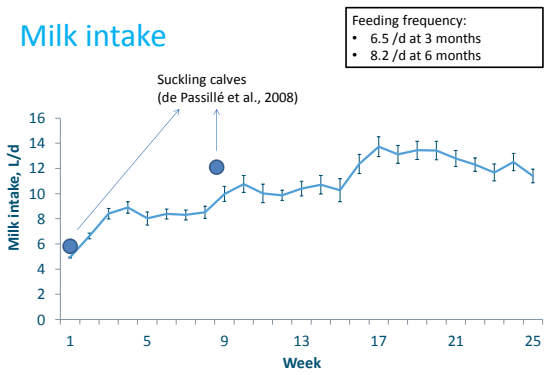
Measurement of individual feed intake

Large individual variation!



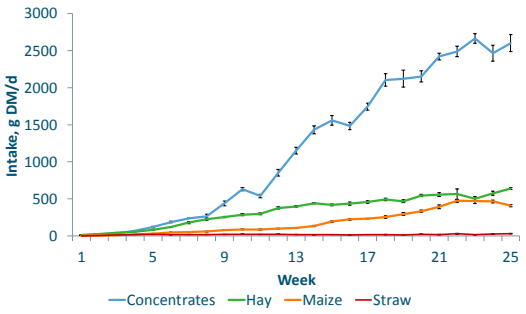
Chapter 5

Milk intake



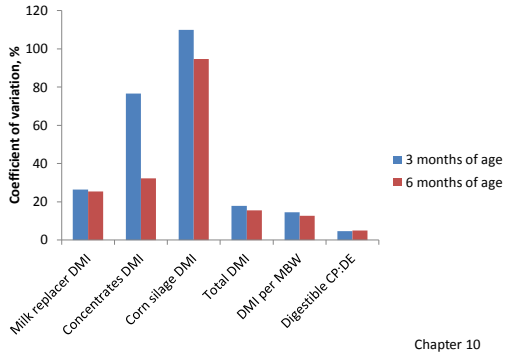
Chapter 5

Solid feed intake



Chapter 5

Calves choose a consistent CP:DE ratio



Chapter 10

Findings

- DMI and growth is high when given free choice
- Feed preference exhibited large individual variation and was not consistent between 3 and 6 mo of age
- Calves choose a consistent digestible CP:DE ratio
- **Associations between health and dietary choice**
  - Water - lesions
  - Corn silage at 3 mo - growth
  - Respiratory disorders – fiber intake at 3 mo

Chapter 5

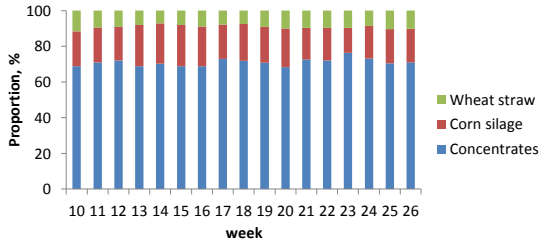
Eat more when given choice?

- 50 HF calves
- 10 – 27 wk of age

Chapter 10

Free selection does not affect intake

- No effect on growth (292 vs. 291 kg BW) or intake
- Consistent choice in time



Chapter 10

Overview

- Rumen development
- N and E metabolism
- Dietary preferences
- **Ruminal drinking**
- Passage kinetics

Ruminal drinking is an health issue

- Leakage of MR into the rumen, may result from failure of the esophageal groove reflex or backflow of MR from the abomasum
- In a clinical case: chronic maldigestion, ruminal acidosis, lack of appetite, recurrent bloat, and a reduced ADG
- In a subclinical case: effects on rumen fermentation and nutrient loss (a.o.)
- Quantitative data are scare
  - 0 – 25% in dairy calves (0-25%) *Abe et al., 1979, Guilhermet et al., 1975*

Chapter 6

Ruminal drinking has quantitative importance

- Ruminal drinking averages 17% (n > 300)
- Alternative techniques to measure ruminal drinking:
  - Ultrasonography
  - Dual tracer method
- Chapter 2: Concentrate inclusion (0 → 50%) increased ruminal drinking, but not from 50 to 80% (Chapter 8)
- Meta-analysis: ruminal drinking is not associated with ADG or any feed intake variable

Chapter 2, 6, 8, 10

Overview

- Rumen development
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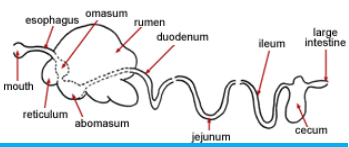
- **Passage kinetics**



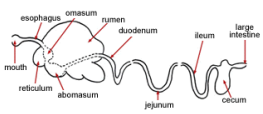
Studying passage of MR and SF

- Aim: study the effect of SF level and composition on passage rates of milk, concentrates, and fiber
- Experimental design:
  - 2 SF levels x 2 forage:concentrate ratios
  - 32 animals (27 wk of age, 248±4.0 kg BW)

	Roughage:concentrate ratio		
SF level	50:50	20:80	**n**
1170 g DM/d	8	8	16
3000 g DM/d	8	8	16
	16	16	32

Marker recovery

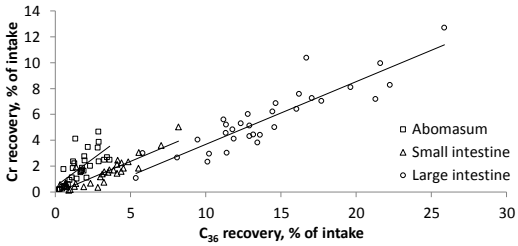
Diet component	Marker	Time to slaughter
Milk replacer	CoEDTA	4h
Concentrates	Alkanes (C36)	24h
Straw	CrNDF	48h



Findings

Passage rate, %/h	Low SF	High SF	SEM	*P*-value		
				SF	R:C	SF*R:C
Concentrates	3.30	4.93	0.621	***	NS	NS
Straw	1.30	1.67	0.235	**	NS	NS

- Increasing SF intake also increased fresh and dry rumen contents



- Strong relationship between Cr and C_{36} in small and large intestine suggests that digesta flow is determined by rumen and abomasal emptying
- Transit of concentrates and straw is similar in tubular parts of the gut

Acknowledgements

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