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Effects of Medium Chain Fatty Acids on Rumen Fermentation

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Our Company

- Producer of **premixes, concentrates and special feed ingredients** for the:
  - Animal feed industry
  - Large integrators
  - Home-mixers

- Represented in over 50 countries
- Member of Cehave Landbouwbelang Group (turnover 2008 1,2 billion euro)
- **Innovation driven attitude** ➡ creation of products with a *high added value* for our customers.

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Product development Aromabiotic

= Well defined mixtures of Medium Chain Fatty Acids (MCFA)

Pigs:

- *Growth enhancing effect, regulation of intestinal microflora*
- *E. coli control*
- *Salmonella control*

Poultry:

- *Growth enhancing effect*
- *Control of colibacillosis, Salmonellosis and necrotic enteritis*
- *Higher health status*

Possible Effects in **Cattle**? ➟ Field trials with calves and dairy cattle

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Aromabiotic Cattle: General Field Findings

CALVES:

- Reduced mortality
- Less problems with diarrhoea and lung disease
- Healthier animals

DAIRY CATTLE:

- Lowering somatic cell count
- Less clinical mastitis
- Better overall health status of the animals

What is the mode of action?

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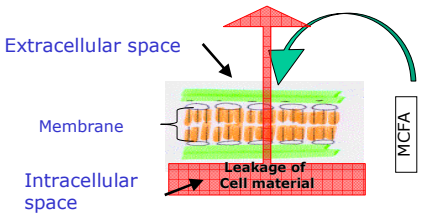
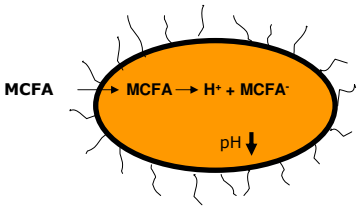
MCFA: Mode of action

I. Degradation of cellmembrane



II. Decrease of pH



III. Inhibition of lipolytic activity of bacteria

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MCFA: Mode of action - Ruminants

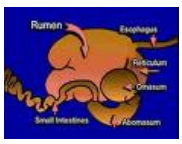
- Calves ~ monogastrics
- Cows = ruminants
  - ➥ Rumen = microbial ecosystem

⬇ *MCFA: antimicrobial activity*

MCFA influence rumen microflora

⬇

MCFA influence rumen fermentation



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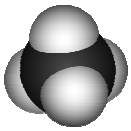
MCFA: Effects on Rumen Methanogenesis

Methane (CH_4): 12% gross energy loss to the animal

Decreased ruminal methanogenesis using MCFA:

- C12:0 and C14:0
  - Dohme *et al.*, 2001; Soliva *et al.*, 2004 *(in vitro)*
  - Blaxter and Czerkawski, 1966; Machmüller *et al*, 2000 *(in vivo)*
- C10:0
  - **Goel *et al.*, 2009** *(in vitro, in cooperation with Vitamex N.V.)*

➡ Reduced greenhouse gas emission
➡ Improved efficiency of digested energy utilisation



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MCFA: Effects on Rumen Fermentation - Trial

- **Purpose**: Effects of MCFA mixtures on ruminal parameters:
  - *Rumen pH*
  - *Cellulolytic activity*
  - *Ammonia content*

- **Materials and Methods**:
  - 3 lactating fistulated cows
  - 3 x 3 latin square
    - 3-week periods
    - Control (C) versus to mixtures of MCFA
  - Dosage: 10 g MCFA/cow/day
  - Ration:
    - Roughage: corn silage + grass silage
    - Protein corrector
    - Concentrate ~ milkproduction

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Medium Chain Fatty Acids: Effect on Ruminal pH

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MCFA: Effects on Ruminal pH

- **Materials and Methods**:
  - Measuring pH of rumen liquids
  - During last 3 days of each 3-weeks period
  - 6 samples/cow/day
    - Just before feeding (0h)
    - 1, 2 , 3, 5, 8 hours after feeding

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MCFA: Effects on Ruminal pH

- **Results**: *In vivo* effect of two MCFA mixtures on ruminal pH*

Hour	Control (C)	Mix A	Mix B	s.e.	P
0	6,43[a]	6,73[b]	6,74[b]	0,07	0,01
1	5,86[a]	6,07[b]	5,99[b]	0,04	0,00
2	6,14	6,08	6,07	0,07	0,77
3	6,13	6,27	6,38	0,10	0,20
5	6,15	6,23	6,29	0,08	0,47
8	6,29	6,35	6,40	0,08	0,63

* mean pH of three cows on three days; s.e. = standard error of mean

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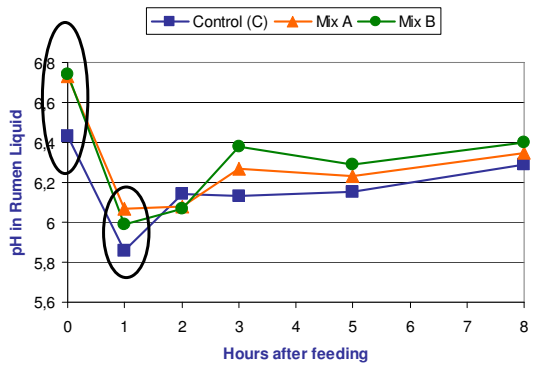
MCFA: Effects on Ruminal pH

Significant difference (P < 0,05)



pH continuously higher than control (except after 2h)

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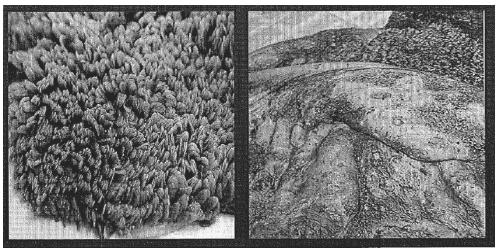
MCFA: Effects on Rumen pH

Rumen Acidosis



- Long flat rumen papillae
- Surface enlargement
- VFA-absorption ↑↑↑

- Damaged keratinezed papillae
- Surface reduction
- VFA-absorption ↓↓↓
- pH decreases further

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MCFA: Effects on Rumen pH

Rumen Acidosis

Fibre rich materials

Stimulation rumen motility

Optimal rumination
➥ Sufficient HCO3-production
➥ Higher ruminal pH

Structure layer

Extended time of large particles in the rumen

Today: High productive cows

➥ High levels of concentrate
➥ Less fibre
➥ High risk for acidosis!!

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MCFA: Effects on Ruminal pH

- **Conlusion**:
  - Supplementation of Medium Chain Fatty Acids results in a **higher ruminal pH** compared to the control ration
  - Because of this increased pH there is a lower risk of **RUMEN ACIDOSIS**.

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Medium Chain Fatty Acids: Effects on Cellulolytic activity

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MCFA: Effects on cellulolytic activity

- **Materials and Methods**:
  - Incubation of 3 bags with grass silage in the rumen
  - In the last week of each period during 24 hours
  - Analysis: crude ash and NDF

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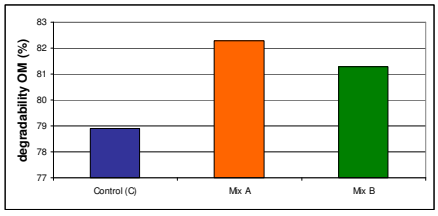
MCFA: Effects on cellulolytic activity

- **Results**: *In vivo* effect of two MCFA mixtures on degradation of OM and NDF*

	Control (C)	Mix A	Mix B	s.e.	P
OM	78,9	82,3	81,3	1,8	0,45
NDF	58,2	55,4	54,7	2,9	0,68

* mean of three cows ; s.e. = standard error of mean



- **Conclusion**:

Better digestibility of Organic matter

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Medium Chain Fatty Acids: Effect on rumen Ammonia content

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MCFA: Effects on Rumen Ammonia content

- **Materials and Methods**:
  - Measuring Ammonia content of rumen liquids (Voight and Steger, 1967)
  - During last 3 days of each 3-weeks period
  - 6 samples/cow/day
    - Just before feeding (0h)
    - 1, 2 , 3, 5, 8 hours after feeding

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MCFA: Effects on Rumen Ammonia content

- **Results**: *In vivo* effect of two MCFA mixtures on ruminal ammonia content*

Hour	Control (C)	Mix A	Mix B	s.e.	P
0	15,0	14,2	14,0	0,7	0,63
1	26,0	25,4	26,3	1,4	0,88
2	29,2	29,4	30,7	0,9	0,43
3	25,7	24,4	24,0	1,4	0,67
5	18,0	16,2	15,4	0,9	0,13
8	13,5[a]	10,7[b]	12,1[a]	0,6	0,02

* mean ammonia content of three cows on three days; s.e. = standard error of mean

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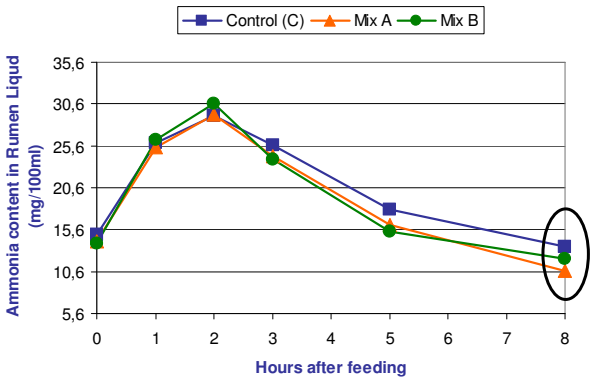
MCFA: Effects on Rumen Ammonia content



Significant difference ($P < 0,05$)

From 3 hours after feeding : a continuous lower level of ammonia in the rumen liquid compared to the control

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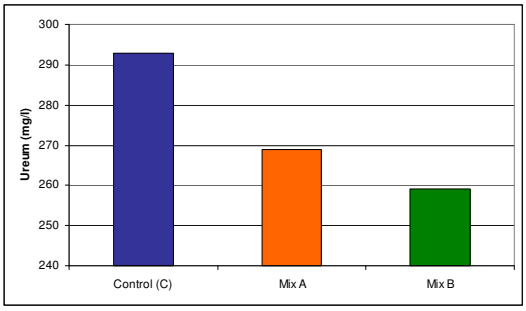
MCFA: Effects on Milk Ureum level



Remarkable decrease in Milk Ureum Level !!!

Reduced N-pollution of the environment!

↓ Milk Ureum ~ Blood Ureum ~ Urinary Ureum ↓

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MCFA: Effects on Rumen Ammonia content

- **Conlusion**:
  - Lower NH_3 level in the rumen
  - Decreased urea level in the milk
  - Better digestibility of organic matter

➡ a **more efficient protein metabolism ?!**

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Effects of MCFA on Rumen fermentation

General Conclusion

- Higher ruminal pH
  - ➡ Reduced risk for acidosis
- Lower rumen ammonia content
- Lower milk ureum level
- Higher digestibility of OM
  - ➡ Lower N-emission in the environment
  - ➡ More efficient Protein Metabolism

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Aromabiotic Cattle

- **Fundamental research**
- **Literature**
- **Field trials**

} **Aromabiotic Cattle**

- ➡ Lowering somatic cell count
- ➡ Less clinical mastitis
- ➡ Better overall health status of the animals

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Effects of MCFA on Rumen fermentation

Thank you for your attention !