Levabon® Rumen E

a new generation autolyzed yeast

Euroopa Maaelu Arengu Põllumajandusfond: Euroopa investeeringud maapiirkondadesse

For improved
rumen function and productivity

Vesna Jenkins, PhD
Global Product Manager
Competence Center Gut Performance

Outline

- High energy diet – SARA challenge
- BIOMIN® Solution - Yeast as feed additive for dairy cows
- MoA of Levabon® Rumen E
- Proven in research and field
- Application
- Conclusion

The History of Yeast and Humans

- Goes back as far as civilization
- The basis of standard bread and many fermented drinks
- Beer is still produced with some very historic strains
- Recently beer and mead was brewed from a 5000 year-old Egyptian strain

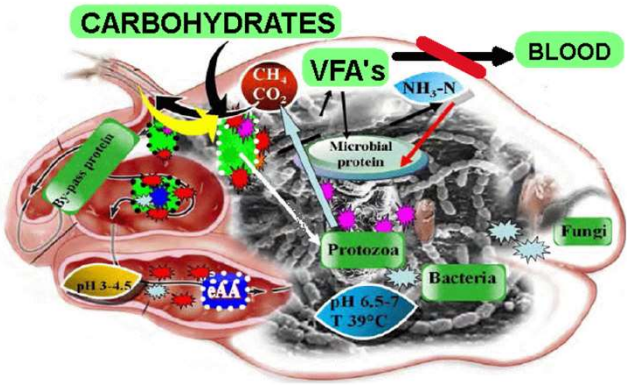
The History of Yeast Supplementation in Agriculture

- A more recent thing (decades rather than millenia)
- Now a common feature of modern dairy farming
  (used on majority of high-producing dairy farms)
- Benefits can be seen in rumen fermentation and production

Saccharomyces cerevisiae

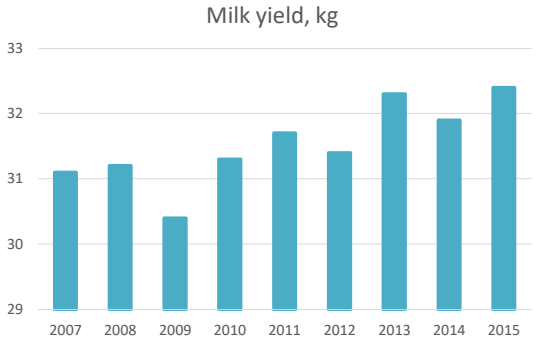
Healthy rumen healthy cow

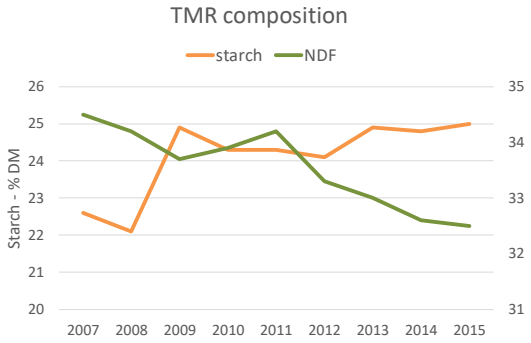
- Ruminants have a unique ability to digest forage
- This is due to rumen fermentation by microorganisms
- Rumen microorganisms produce volatile fatty acids (VFA's) – a primary source of energy for the ruminant
- Rumen microorganisms are also responsible for the majority of the protein supply for ruminants
- Yeast like Levabon® Rumen E stimulates rumen microbial activity



Shift in carbohydrates formulation of dairy diets

10,839,461 DHI records in northeastern US dairy herds



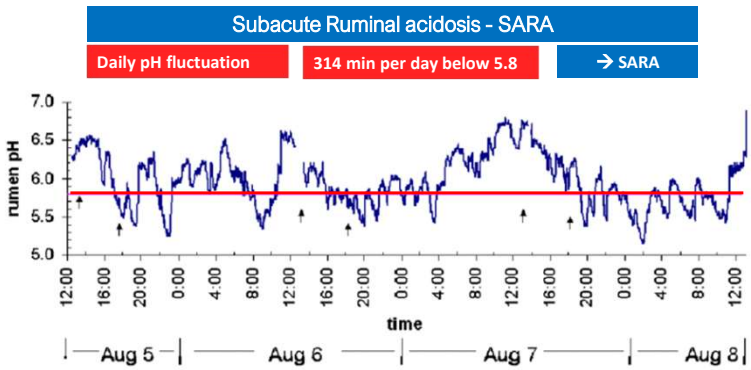


Hristov et al., 2018

Pressure for High Performance

SARA

- Modern farming involves high pressure to perform
- High starch diet can increase production but means a risk of acidosis
- Subacute rumen acidosis (SARA) and other health disorders depend on the degree of ruminal pH decrease (*Kleen and Cannizzo 2012*, *Minuti et al. 2014*).



Rumen changes during Subacute Rumen Acidosis (SARA)

SARA

Microbiota Shift

- Lower pH → Imbalance of the microbiota ↓
- Gram-negative bacteria → Endotoxin release ↑
- Fiber-fermenting bacteria ↓
- Lactate producer ↑

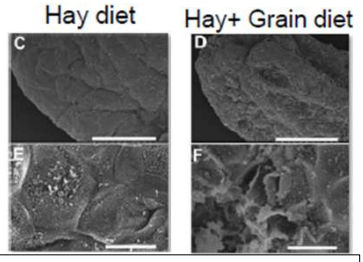
Neubauer *et. al.*, 2018

And Rumen Wall Affected

- Reduced papillae size and function ↓
- Reduced uptake of volatile fatty acids and nutrients ↓

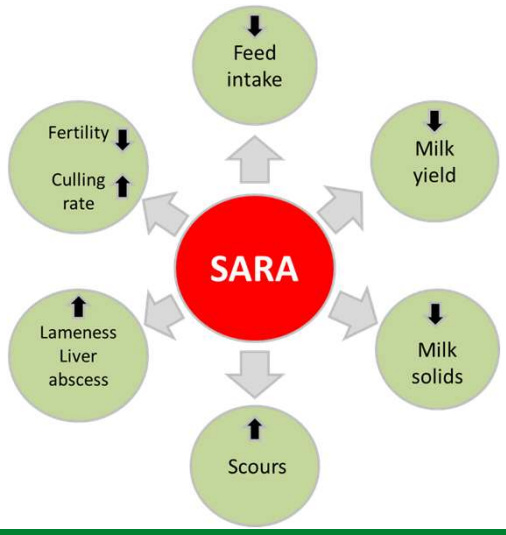
Acid load+low pH ↓

Profound cell damage
Lesions on rumen papillae
Tight junctions are disrupted



Steele *et. al.*, 2011, Liu *et.al.*, 2013, Meissner *et al.*, 2017)

Consequences of SARA



Prevalence 11% to 33% of cows (depending on DIM and diet)
(*O'Grady et al. 2008; Morgante et al. 2007*)

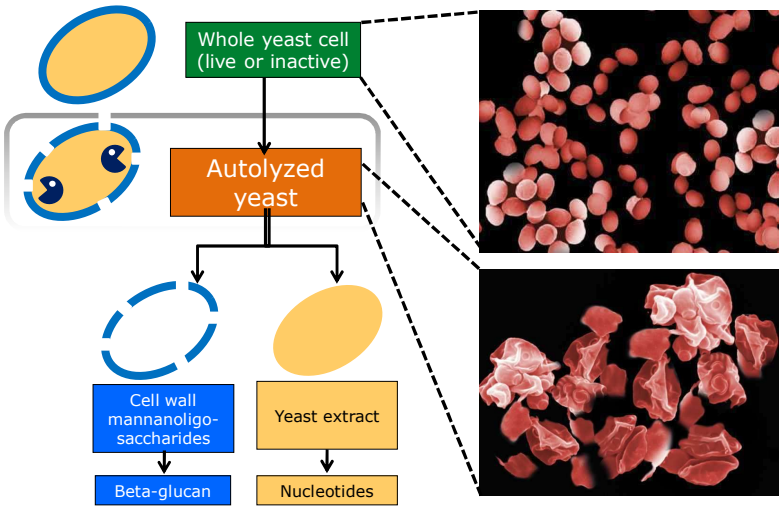
Costs 400€ /cow/year
(*Stone 1999, Plaizier et. Al., 2002*)

Management of Acidosis

- Avoid rapid diet transition
- Moderate starch content if possible
- Consider rumen buffers
- Use feed additives such as Levabon® autolyzed yeast

Levabon® Rumen E- Autolyzed yeast (*Saccharomyces cerevisiae*)

= Self-digestion, destruction of a cell by activation of its own enzymes



Whole dry yeast intact cells are not taken up by rumen microbes

Autolyzed yeast with broken cells Cell fragments are taken up by and more available to rumen microbes

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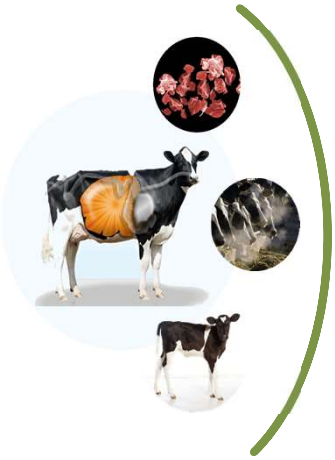
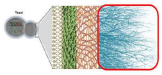
Levabon® Rumen E – Modes of Action



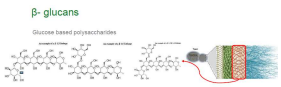
Multiple components for Multiple Modes of Action

Mannan-oligosaccharides (MOS)



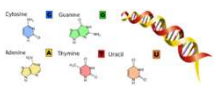
- Prebiotic – stimulates specific microbial population (e.g fibrolytic bacteria)
- Prevents pathogen adsorption
- Stimulates immune system

β -glucans



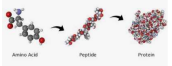
- Prebiotic
- Activates several immune cells : macrophages, neutrophils, monocytes, natural killer cells

Nucleotides



- Cell signalling
- Cofactors in enyzmatic reactions
- Energy (ATP)

Amino Acids and Peptides



- Nutrient uptake
- Cell stimulation

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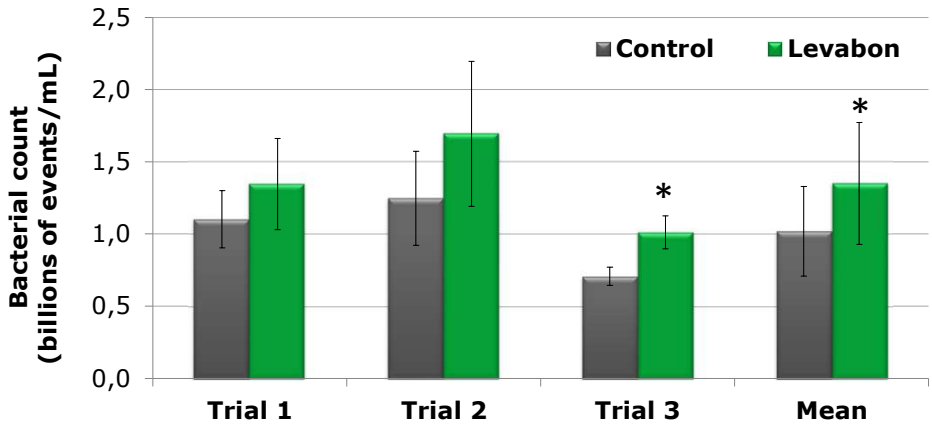
Levabon® Rumen E – Features

- Stimulation of beneficial microbiota
  - Improving rumen activity
  - Less pressure from pathogens

In Vitro Rumen bacterial count



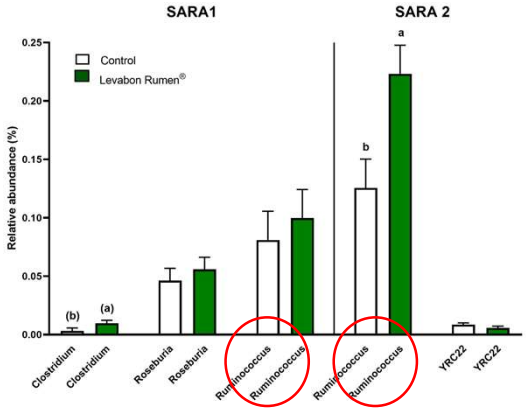
Bacterial abundances in rumen fluid *in vitro, n*=18, * = p<0.05

Effect of **Levabon®** (AY) on microbiota during the SARA challenge

vetmeduni vienna

Levabon®:

- ↑ Increase of fiber fermenters (e.g. *Ruminococcus*)
- ↑ Increase of gram-positive bacteria
- ↓ Reduction of gram-negative bacteria



J. Dairy Sci. 101:1–15
https://doi.org/10.3168/jds.2017-13565

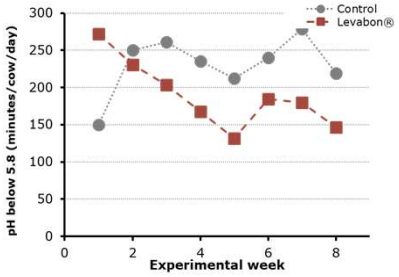
High-grain diets supplemented with phytogenic compounds or autolyzed yeast modulate ruminal bacterial community and fermentation in dry cows

V. Neubauer,*† R. Petri,* E. Humer,* I. Kröger,* E. Mann,† N. Reisinger,‡ M. Wagner,† and Q. Zebeli*[1]

Levabon® Rumen E – Features

- Stimulation of beneficial microbiota
  - Improving rumen activity
  - Less pressure from pathogens
- Stabilizing rumen pH
  - Less time spent under SARA conditions,
  - Less occurrence of metabolic diseases

Lower risk of SARA proven with Levabon®



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For quality of life

Parameter	Control	Levabon®
Rumen pH	6.05[b]	6.16[a]
pH below 5.8 (min/cow/d)	254[a]	125[b]

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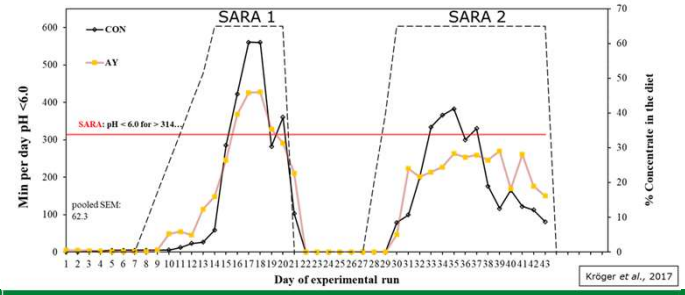


Conclusion

- Shorter time spent below the threshold for SARA (<pH 5.8)
- Maintaining higher pH in the Levabon® supplemented cows

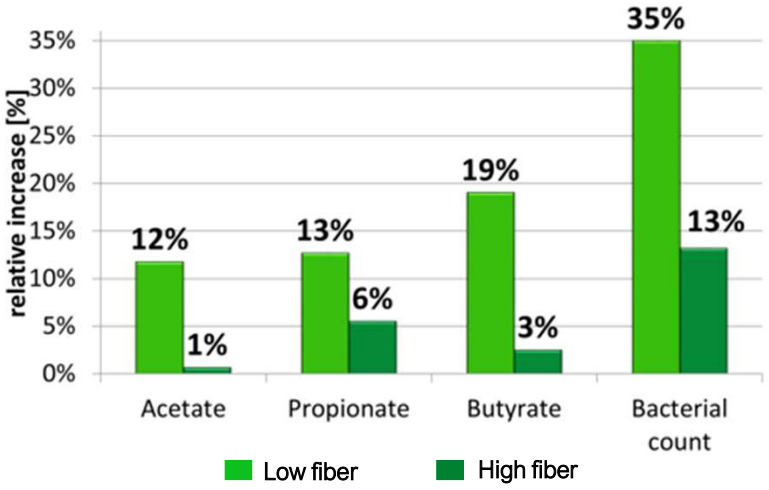
➡ Lower risk of SARA when Levabon® supplemented

Levabon® Rumen E – Features

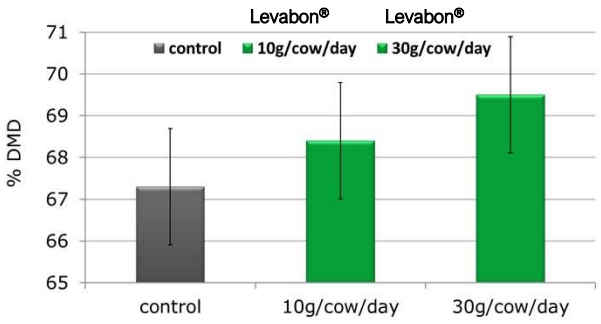
- Stimulation of beneficial microbiota
  - Improving rumen activity
  - Less pressure from pathogens
- Stabilizing rumen pH
  - Less time spent under SARA conditions,
  - Less occurrence of metabolic diseases
- Improved feed digestibility
  - More VFA's / nutrients for animal growth and productivity
  - Higher feed efficiency

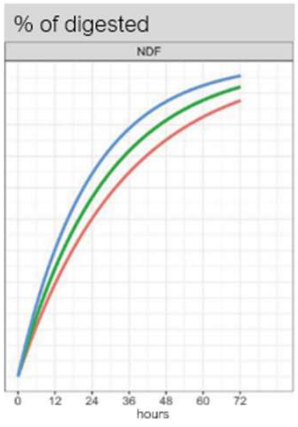
In vitro Rusitec trial with low and high fiber diet

Relative with Levabon® supplementation compared to Control



Total tract digestibility and *in situ* NDF degradation





Treatment
Control
Levabon 10 g
Levabon 30 g

- Levabon® boosts diet and fiber digestibility

Effects of Levabon® on dairy cows performance,
Blanca from the Pyrenees Trial, 2018

Blanca From the Pyrenees

Experimental site and design:

- 63 Holsteins dairy cows; average DIM 127; average lactation number: 2.8; average milk yield at the beginning of the trial 33 kg
- Control Group- no Levabon® and Levabon® Group received 20 g/cow/day
- Diet: TMR *ad libitum*
  - 43% forage: ryegrass hay, fescue hay, wheat silage, ryegrass silage, alfalfa hay
  - 55% grain: barley, corn, soybean meal, soybean hulls, molasses, wheat middlings, beet pulp,
  - 1.7% minerals and vitamins: calcium carbonate, sodium chloride, magnesium oxide, mineral vitamix premix.
- Nutrients: CP 15.8%; NDF 30.6%; ADF 20.4%; NFC 43.0%; Starch 26.2%; NEL[1], Mcal/kg 1.62

([1] Calculated according to NRC (2001))

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Levabon® effect on Daily Milk Yield

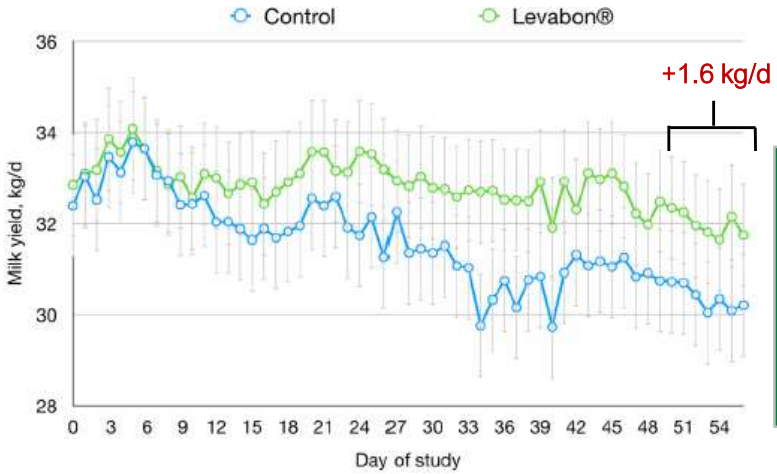

Figure 1. Milk production as affected by dietary treatments

- Levabon® significantly increased milk yield by 1.2 kg/d over time (P<0.05)
- At the end of trial milk yield difference 1.6 kg/d
- Similar fat % and protein %

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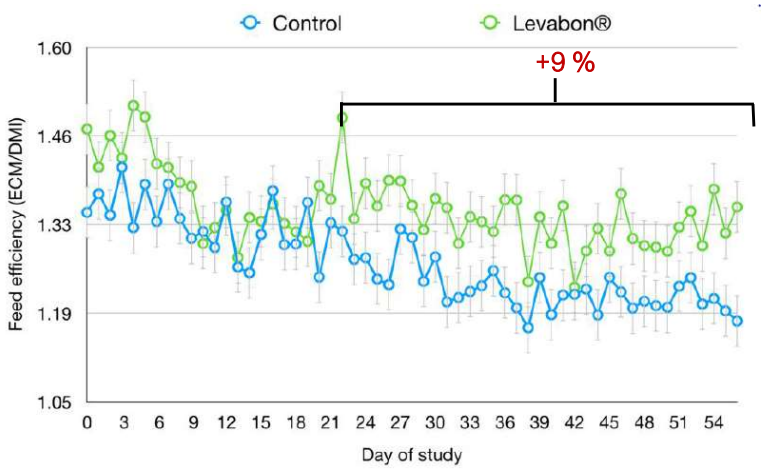
Feed Efficiency (ECM/kg DMI)



- Feed efficiency began similar, with a Levabon® benefit increasing over time (P< 0.01)
- Feed efficiency consistently higher with Levabon® from 21 days
- Levabon® group feed efficiency averaged 1.35 compared to 1.27 of Control

Figure 5. Efficiency of milk production (ECM/DMI) as affected by dietary treatments

Milk Yield (kg/day) effects over four farms

- Levabon® group received 15 g/cow/d
- Diet: TMR (hay, grass silage, maize silage, concentrate, starch varied from farm to farm from 16 to 22%)

	N	Control	Treatment	Treatment effect difference	SEM	P
Overall	178	34.8	35.7	0.87	0.296	**0.004**
Farm A	32	32.9	34.1	1.26	0.559	**0.034**
Farm B	64	34.9	35.5	0.60	0.502	0.233
Farm C	52	36.2	37.4	1.16	0.642	**0.078**
Farm D	30	35.1	35.5	0.41	0.433	0.356

Conclusion

- As a result of this successful study, around 100 000 dairy cows have been supplemented with Levabon® on a daily basis in Netherlands and Belgium.

Levabon® trial, Maccarese, Italy

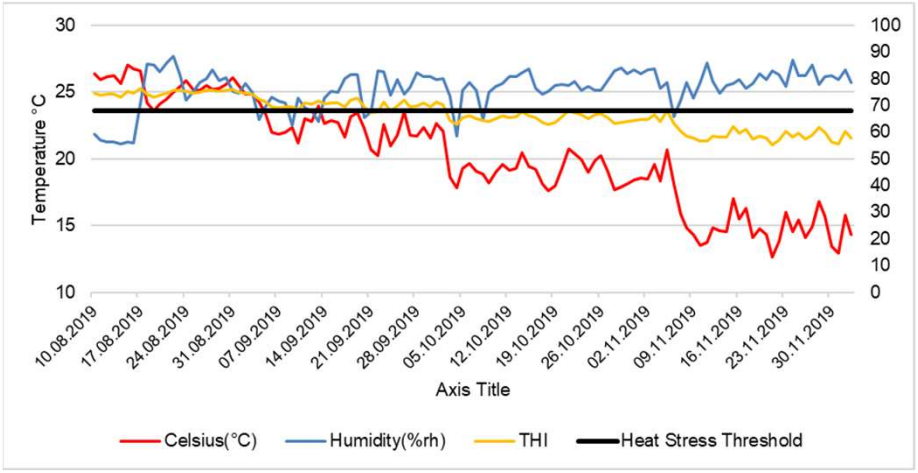
- The aim of this feeding trial was to evaluate the effect of supplementing autolyzed yeast (Levabon® Rumen E) on performance parameters of high yielding dairy cows at a large-scale commercial farm under a Mediterranean climate.

Effects of Levabon® on dairy cows performance in Mediterranean climate

Experimental site and design:

- 200 Holsteins dairy cows; average DIM 80; average lactation number: 2.6; average milk yield 42 kg
- Trial duration 12 weeks (from 05.09.2019 to 3.12.2019)
- Control group - no Levabon® and Levabon® group received 25 g/cow/day
- Diet: TMR ad libitum
  - 45.7% forage: corn silage, wheat silage, alfalfa hay, straw
  - 54.3% concentrate: soybean meal, CCM, corn, soybean hulls, cotton seeds, other concentrates
- Nutrients: crude protein (15.8 %), crude fat (3.7 %), NDF (35.0 %), ADF (21.7 %), starch (24.7 %)
- Parameters: milk yield and milk solids
- For statistical analysis 29 cows removed (dried off, culled) leaving Control group 92 cows; Levabon® group 79 cows

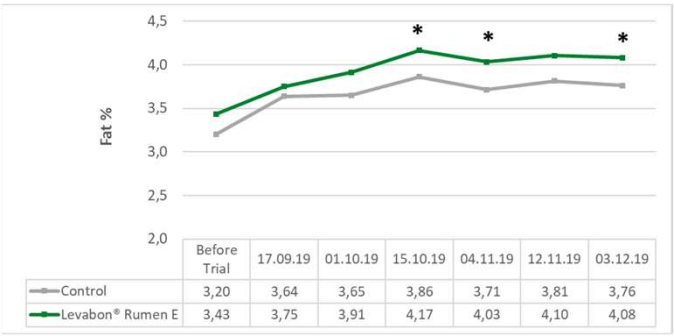
Environment conditions



For both treatment groups CTL and LRE, THI was above the threshold of 68 for a total of 26 days during the first month of the experimental period (05.09.- 02.10.2020).

Results Performance

Levabon® Rumen E increases milk fat % in high yielding cows



	Before Trial	17.09.19	01.10.19	15.10.19	04.11.19	12.11.19	03.12.19
Control	3,20	3,64	3,65	3,86	3,71	3,81	3,76
Levabon® Rumen E	3,43	3,75	3,91	4,17	4,03	4,10	4,08

Figure 1: Milk fat % as affected by dietary treatment over a trial period of 12 weeks.
* indicate significance at P<0.05.

	Control	Levabon®	SEM	Treatment P-value	Treatment x Time Interaction P-value
ECM* yield (kg)	38,6	38,8	0,81	0,281	0,649
Milk fat (%)	3,74	4,01	0,09	0,439	0,031
Milk fat (kg)	1,49	1,56	0,04	0,381	0,359
Milk protein (%)	3,22	3,27	0,03	0,410	0,257
Milk protein (kg)	1,29	1,26	0,03	0,383	0,638
Fat/Protein Ratio	1,17	1,27	0,03	0,974	0,373

*ECM was correct for 4,0% fat and 3,3%

ECM for 4 % and 3.3 % protein

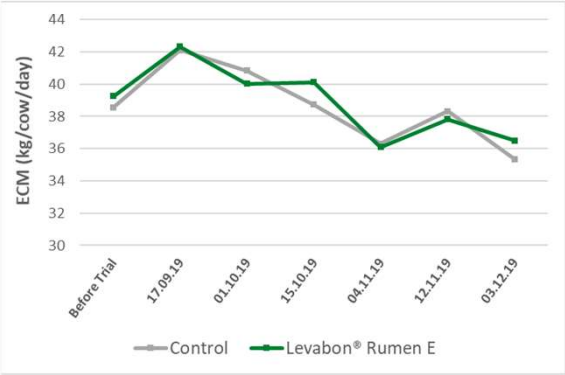


Figure 2: Energy Corrected Milk (ECM) yield as affected by dietary treatment over a trial period of 12 weeks.

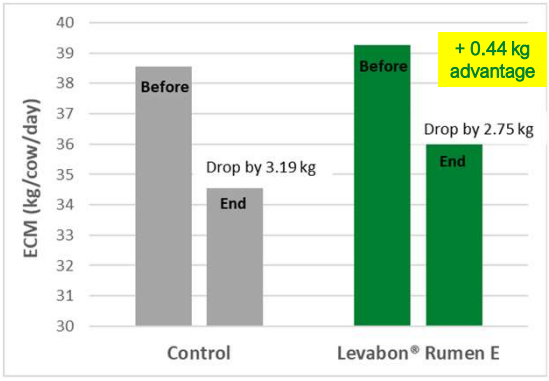


Figure 3: ECM drop as affected by dietary treatment over a trial period of 12 weeks

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Fat yield and casein %

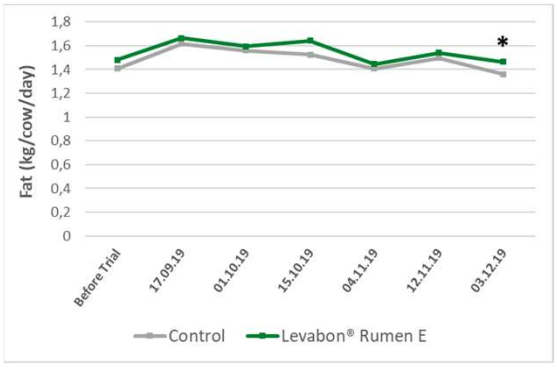

Figure 8: Fat yield as affected by dietary treatment over a trial period of 12 weeks. * indicate significance at P<0.05.

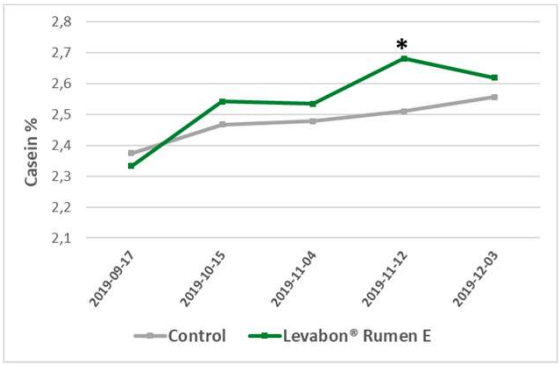

*Figure 9: C*asein % as affected by dietary treatment over a trial period of 12 weeks. * indicate significance at P<0.05.

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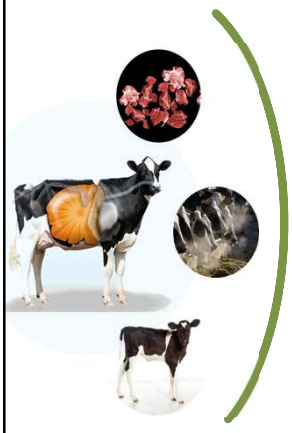
Conclusion

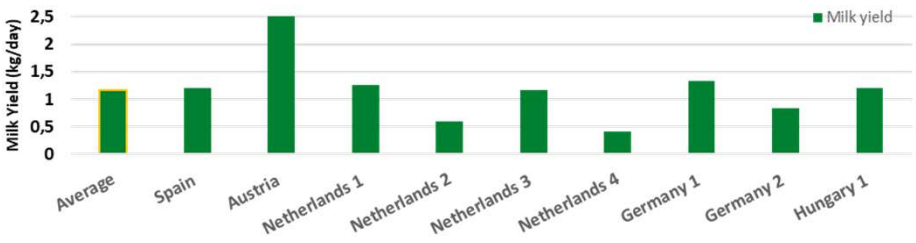
Levabon® Rumen E treated cows had:

- Milk fat % significantly higher during the trial, on average by 7%
- Casein % tended to be higher (significant at one point), important parameter for the cheese industry
- Trend of greater persistence of ECM milk production of 0.44 kg/cow (P=0.10) due to the relatively higher milk fat concentration (P<0.05).
- Ideal ratio of fat % and protein % (1.27), showing higher rumen efficiency, optimal fermentation ➡ less likelihood of metabolic diseases
- Economic benefits in average over trial period ROI 2.4

Increase of milk yield with Levabon® Rumen E

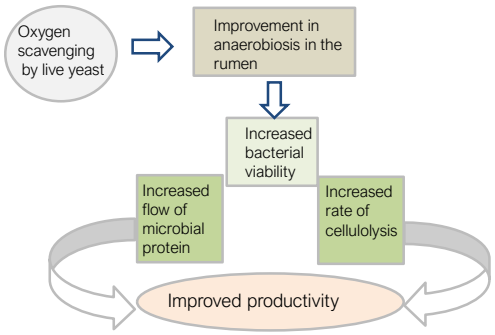


Consistent increase of milk yield in high-producing dairy herds



Levabon® Rumen E – Competitor Live Yeast

Competitor	Differentiation of Competitor	Elements of Counter-Argumentation
Live Yeast (e.g. Levucell SC)	probiotic MoA lower price/head/day	• different MoA - no quantifiable bioactive compounds • shorter shelf life • survival in final feed challenge, pelleting only at certain °C?



Adapted from Newbold, 2003

40% samples failed to meet guarantied cfu

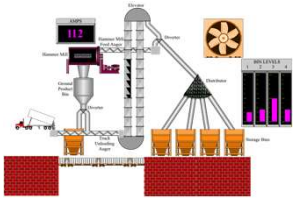
Table 2. Colony-forming units observed upon receipt in samples of commercial active dry yeast products (experiment 1)

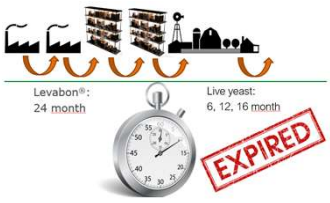
Product	Season acquired	Yeast viability, cfu/g	Mean ± SEM, $\log_{10}$ cfu/g	Geometric mean, cfu/g (% of guarantee)[1]
A	Spring	2.15×10^{10}	8.78 ± 0.78	6.04×10^{8} (242)
	Summer	6.83×10^{8}		
	Summer	1.50×10^{9}		
B[2]	Spring	4.70×10^{8}	8.87 ± 0.69	7.38×10^{8} (—)
	Summer	6.10×10^{7}		
	Summer	1.40×10^{10}		
C	Spring	3.62×10^{10}	9.60 ± 1.07	3.97×10^{9} (79)
	Summer	2.93×10^{9}		
	Summer	5.87×10^{10}		
D	Spring	3.04×10^{9}	7.63 ± 1.05	4.26×10^{7} (21)
	Summer	7.33×10^{8}		
	Summer	3.47×10^{9}		
E	Spring	1.11×10^{11}	12.08 ± 0.61	1.21×10^{12} (8,052)
	Summer	1.11×10^{12}		
	Summer	1.43×10^{13}		
F	Spring	1.46×10^{9}	9.43 ± 0.13	2.71×10^{9} (123)
	Summer	3.77×10^{9}		
	Summer	3.63×10^{9}		

Sullivan and Bradford, 2011, J. Dairy Sci. 94: 526-531

Levabon® application

1. Easy to mix in TMR
2. Applicable in pelleted feeds and mineral premixes
3. Heat stable and long shelf life





Dosage:
Dairy cows: 15 – 25 g/animal/day
Beef cattle: 10 – 15 g/animal/day
Calves: 5 – 10 g/animal/day
Goat/sheep/other ruminant: 1-5 g/animal/day

Levabon® Rumen E

Levabon® Rumen E is a new generation of yeast product with enhanced prebiotic effect **to optimize rumen function** leading to **improved feed efficiency, better animal welfare and higher productivity.**

Thank You!

Questions & Answers

Biomin®