Effects of SiloSolve inoculants on silage quality, dairy performance, and production efficiency

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Chr Hansen

The challenge

Spoilage microorganisms that reduce the nutritional value with subsequent impact on economic returns

Ensiling problems

- Long period of wilting
- Unsuitable maturity stage of crop
- Dirty crops and silos
- Poor application of silage additive
- Too short compaction time
- Too long time to cover silo
- Air leakage into silo
- Opening of silo during warm weather
- Poor emptying technique
- Low emptying rate

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Challenges for good quality silage

Aerobic stability

Problem indicators:

- Growth of yeast and mold
- Heat formation (at feed out)
- Dry matter loss
- Very high pH values

Proper fermentation

Problem indicators:

- Slow decrease of pH
- Growth of clostridia
- Bad smell
- Loss of nutrients & dry matter
- Poor palatability

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Why aerobic deterioration?

- Destruction of the cover
- Slow progress when removing silage
- Poor compaction

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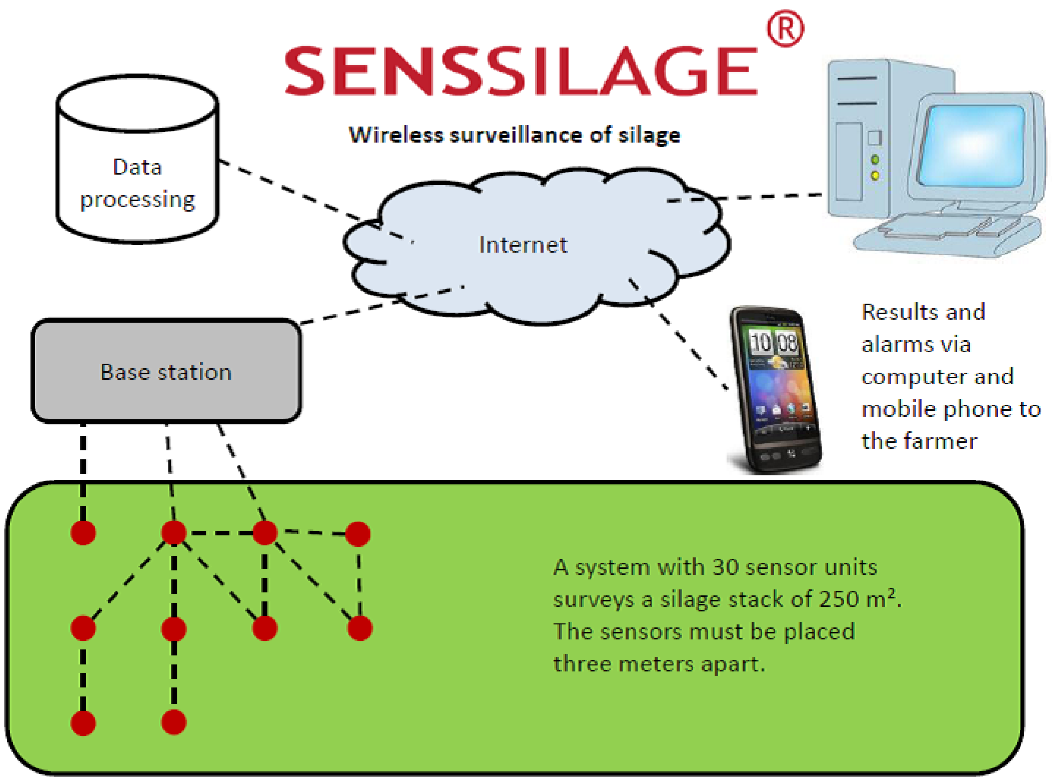
SensSilage

Mean temperature of all the sensors is found. If one sensor temp increases with 2 ° C (3.6 ° F) → alarm to the farmer!



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Bacterial inoculants

Focusing on function

Improved aerobic stability

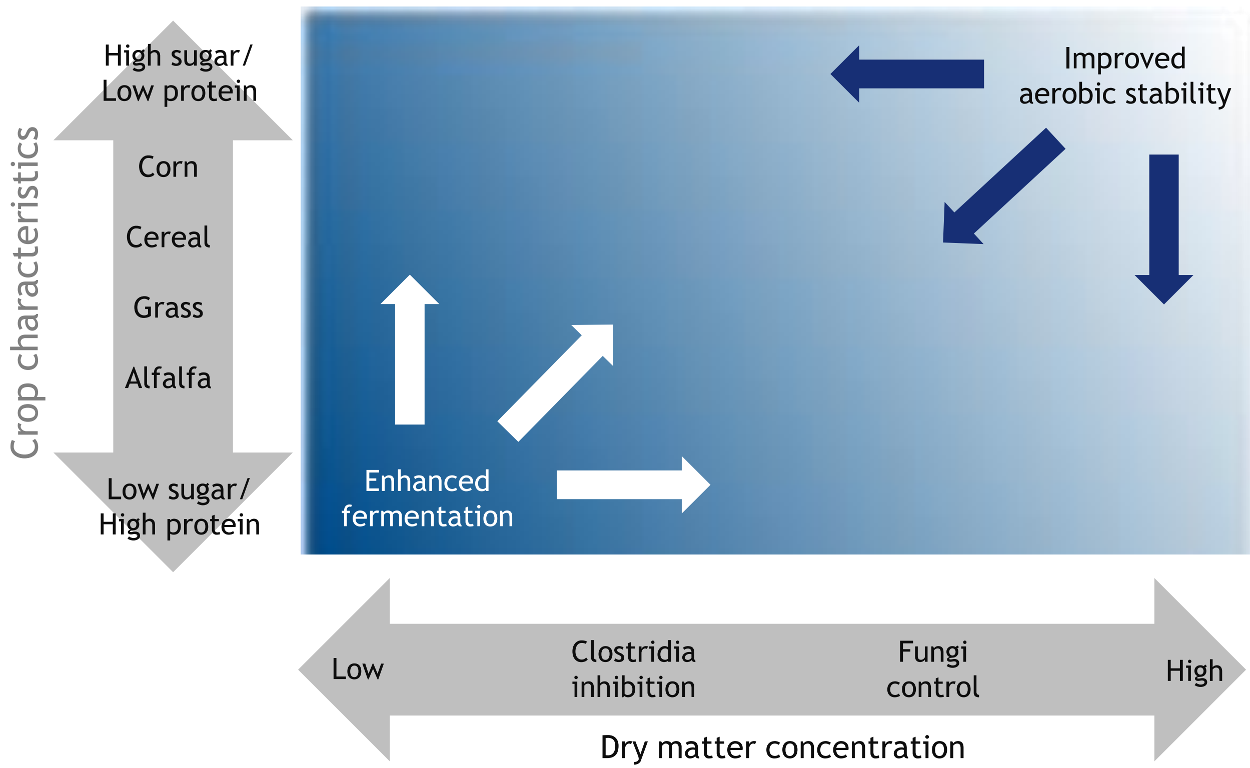
Improved fermentation and production

Reduction of *Clostridium*, yeast, and molds

Freeze dried culture

Type of Inoculant?

Crop and dry matter conditions determine the product selection



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Success factors for an effective ensiling with bacterial silage inoculants

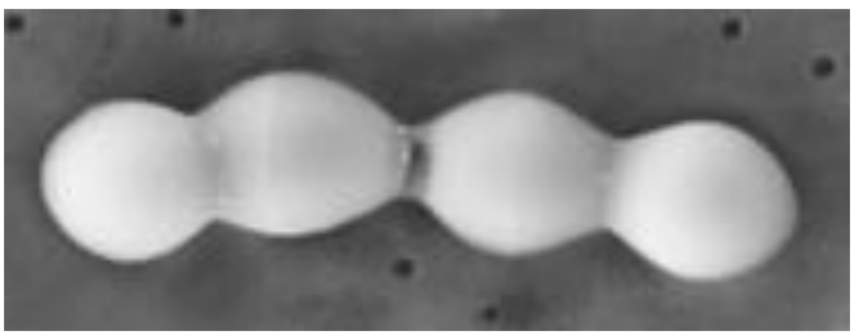
An effective strain	A strain that performs every time and outcompetes spoilage microorganisms	Relies on: Strong R&D; State of the art production facilities and quality control
A stable strain	A strain that delivers the same result every time	
The right formulation	A stable product that ensures the right concentration of silage inoculants during use	

A good silage inoculant starts with bacteria selection

Bacterial strains are selected due to their unique functions

Chr. Hansen are experts in strain research, and we are using robot technology to screen strains

Production of bacterial silage inoculants



Inoculant bacteria differences

Homofermenter vs. Heterofermenter

- Homofermenter *-L. plantarum* → Most efficient

  1 6-C Sugar → 2 Lactic Acid

Less efficient ↓

- Heterofermenter *-L. buchneri*

  1 6-C Sugar → 1 Lactic Acid + 1 Acetic Acid + CO_2

  1 6-C Sugar → 1 Lactic Acid + 1 Ethanol + CO_2

  1 Lactic Acid → 1 Acetic Acid + CO_2 (*L. buchneri*, not all heteros)

End Product Comparison

- Lactic acid- strong acid, weak spoilage inhibitor, fermented in rumen to primarily propionate (very efficient)
- Acetic acid- weak acid, good spoilage inhibitor, not fermented in rumen
- Ethanol- neutral, good spoilage inhibitor, partially fermented in rumen
- Carbon dioxide- lost dry matter

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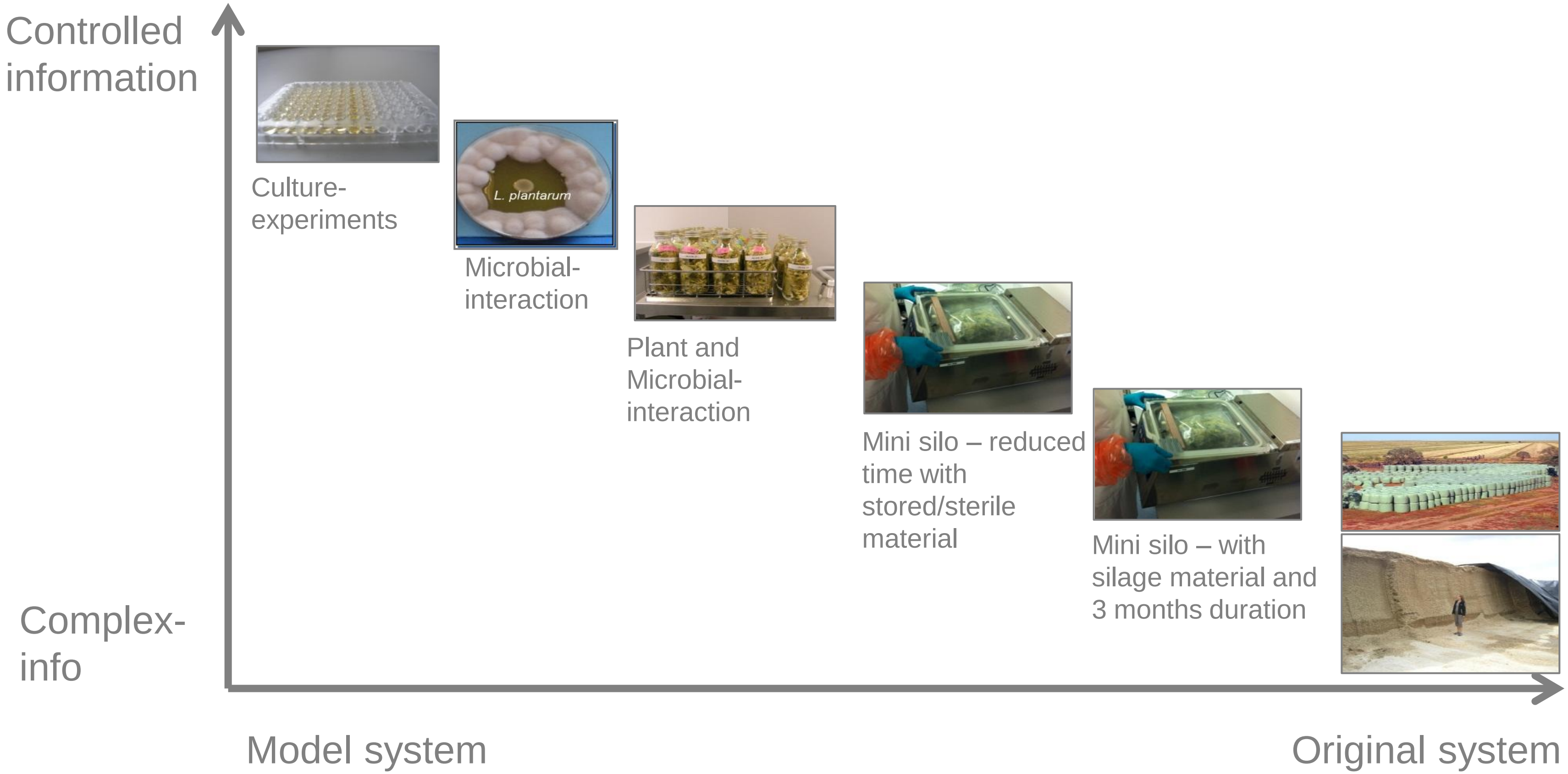
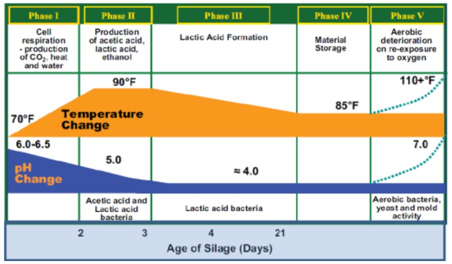
Silage competence platform



Mini-silos - What do we measure



Each bag is sprayed with 8ml ~ 1.5E+05 CFU/g plant material

Un-treated corn from field

6 kg/ treatment

- Dry matter
- pH
- Cell count
  - Yeast & Mold
  - LAB

1000g/ bag

bag

Vacuum packed, stored @ 25° C for 3 months

- Dry matter
- Cell count
  - LAB
  - Yeast & Mold
  - Bacilli spores
- pH
- Small org acids
- Volatile org. acids
- Aerobic stability; 7 days @ room temp.
  - Temperature - continuous
  - Cell count
    - LAB
    - Yeast & Mold
    - Bacilli spores
  - pH
  - Dry matter

bag

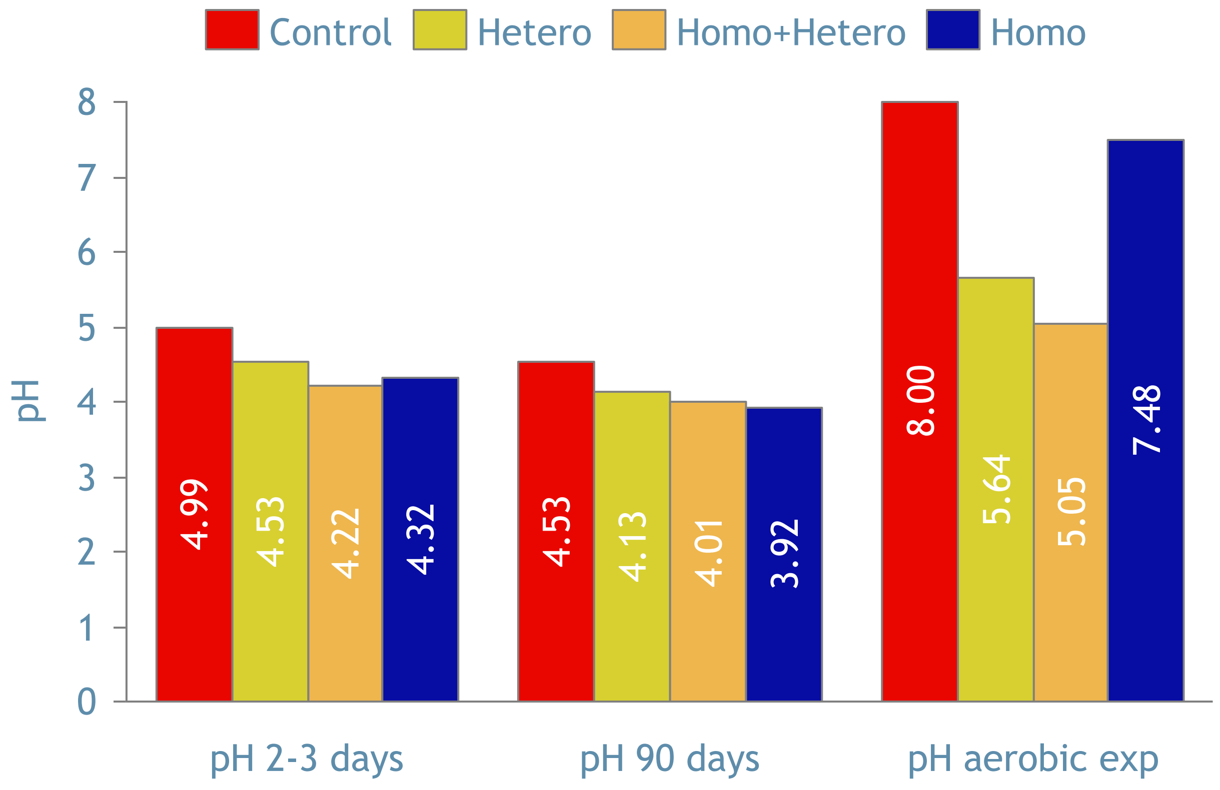
100g/ bottle

- Cell Count, LAB

Bottles @ room temp.

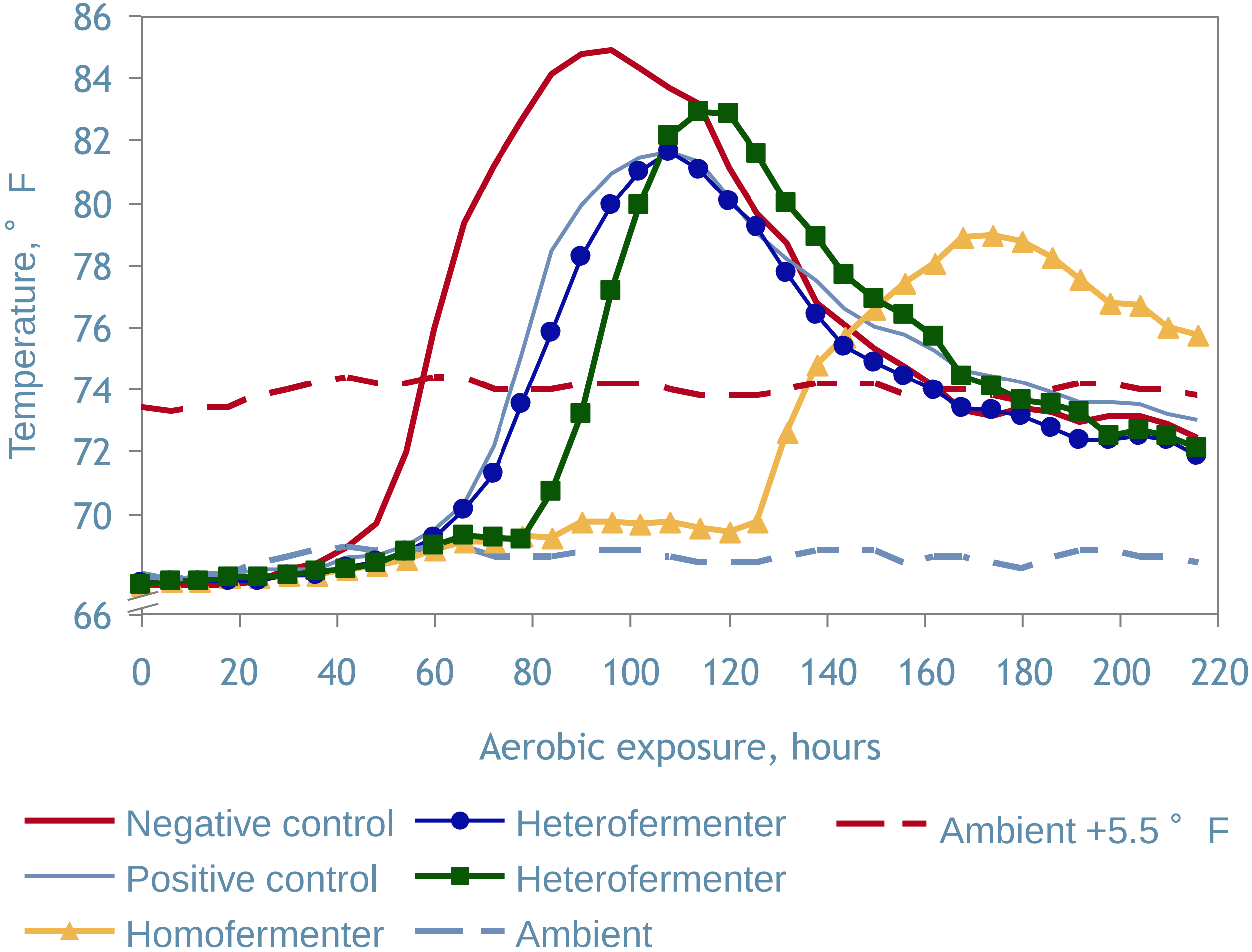
- Small organic acids; Day 7
- Gas samples; Day 0-3
- pH; day 0 & 7

Additives and pH value



Chr Hansen data from trials 80046, 80057, 80059, 80086, 80087, 80088, 80089

Aerobic stability of corn silage

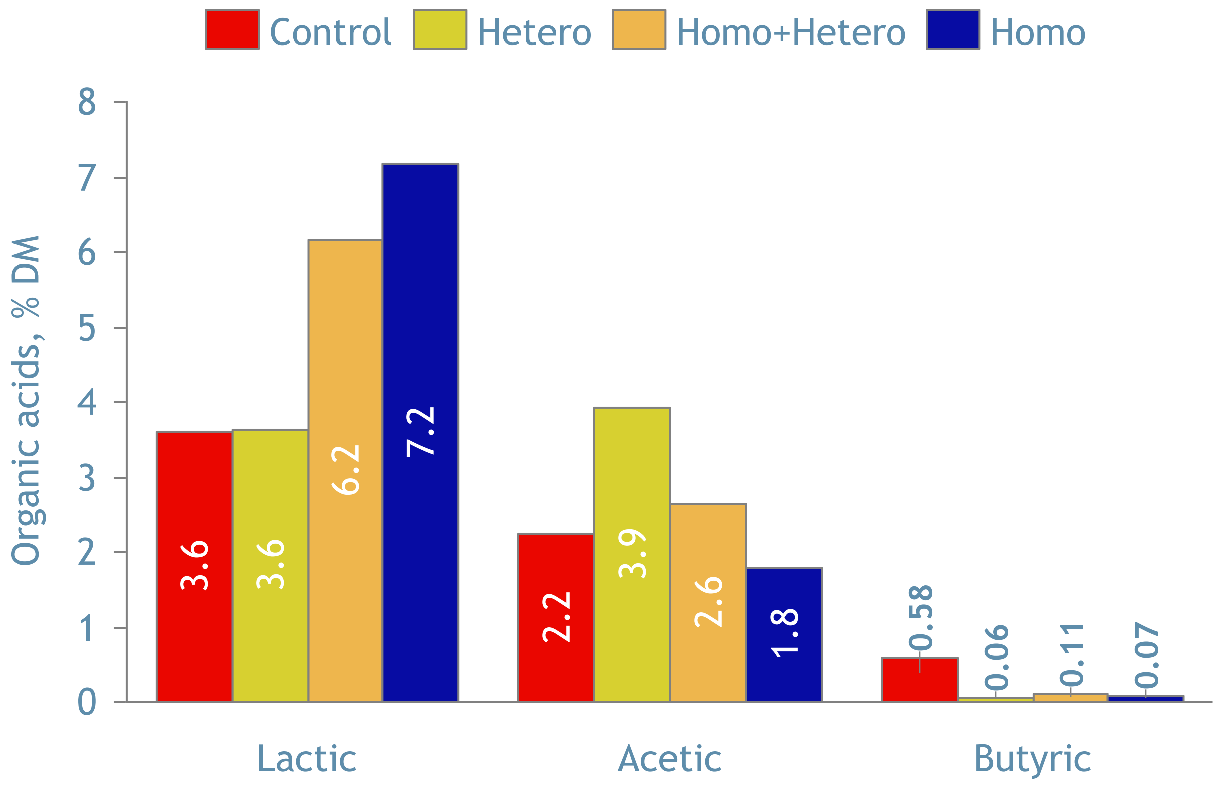


Temp increase above ambient, °F	Dry matter loss, %
2	3
3.5 - 11	10
> 11	15

(McDonald et al 1991)

Whole-crop maize ensiled at ca. 27% DM (73% moisture), Baisogala 2010. Jonas Jatkauskas. Trial 80088.

Additives and organic acid



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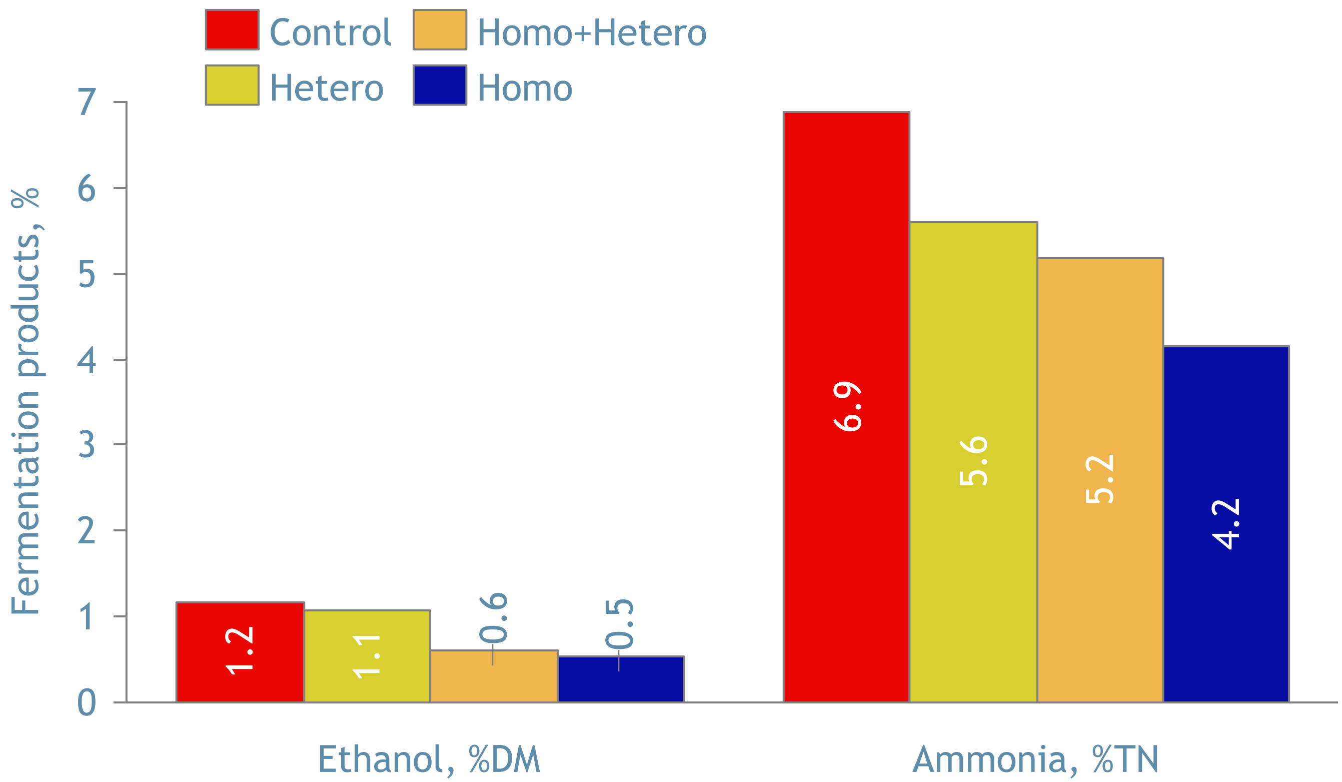
How does your silage smell?

Additives and ethanol and ammonia



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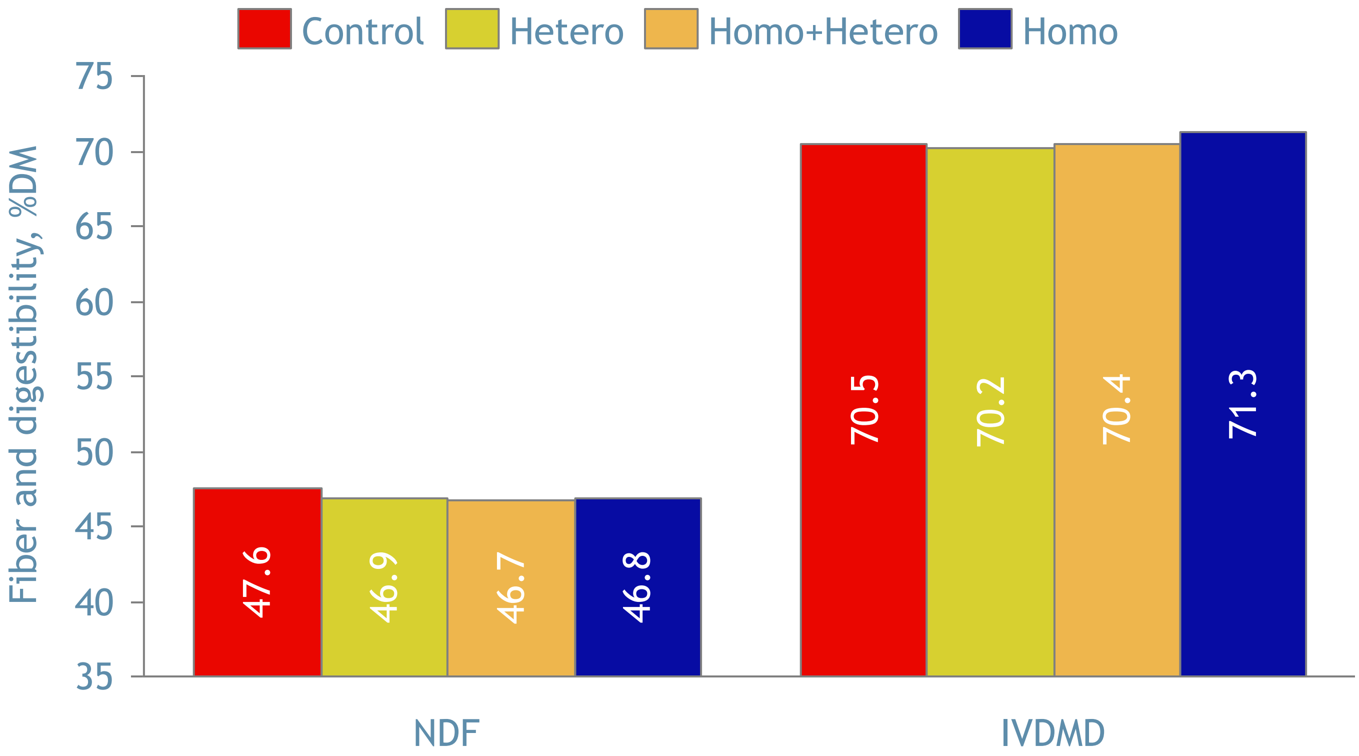
Additives and NDF and digestibility

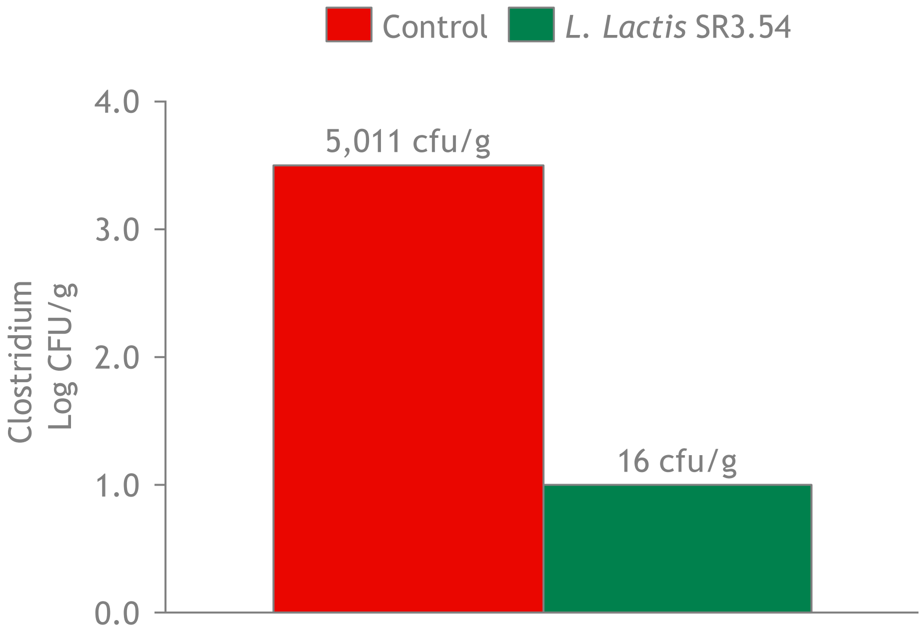


Chr Hansen data from trials 80046, 80057, 80059, 80086, 80087, 80088, 80089

Reduction of *Clostridia*

Wet silage is at risk for undesired clostridial fermentation causing protein breakdown and subsequent reduced palatability

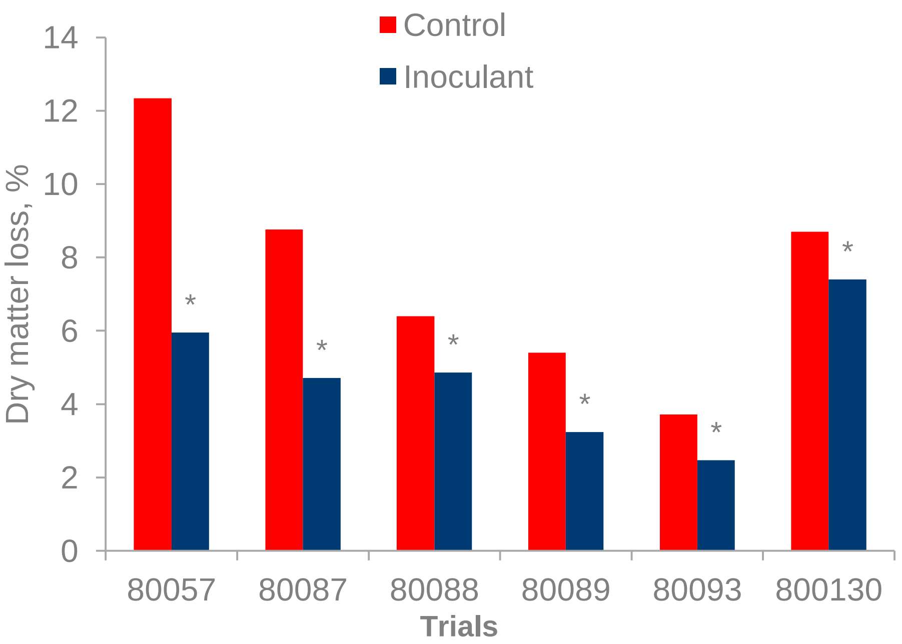
Bacteria strains which reduce clostridia



Bacteria inoculants reduce dry matter loss

Chr Hansen research: decreases dry matter loss - on average 35 %

Preservation of dry matter is essential in obtaining a good feed utilization and profitability



Six trials with grass, corn and alfalfa

Homofermentative Silage Inoculants-Summary of Published Trial Results (Muck, 2012)

- Dry Matter Recovery
  - Improved in 38% of trials (Muck and Kung, 1997)
  - Improvement when successful: 8% absolute
  - On average of all trials, 2-3% absolute improvement
  - Increased dry matter recovery will usually pay for the inoculant

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Does a small hole matter?

- Holes in the plastic must be repaired as soon as possible
- 1 mm hole in bale may result in 300 to 400 liters of air
- Good compaction reduces problem

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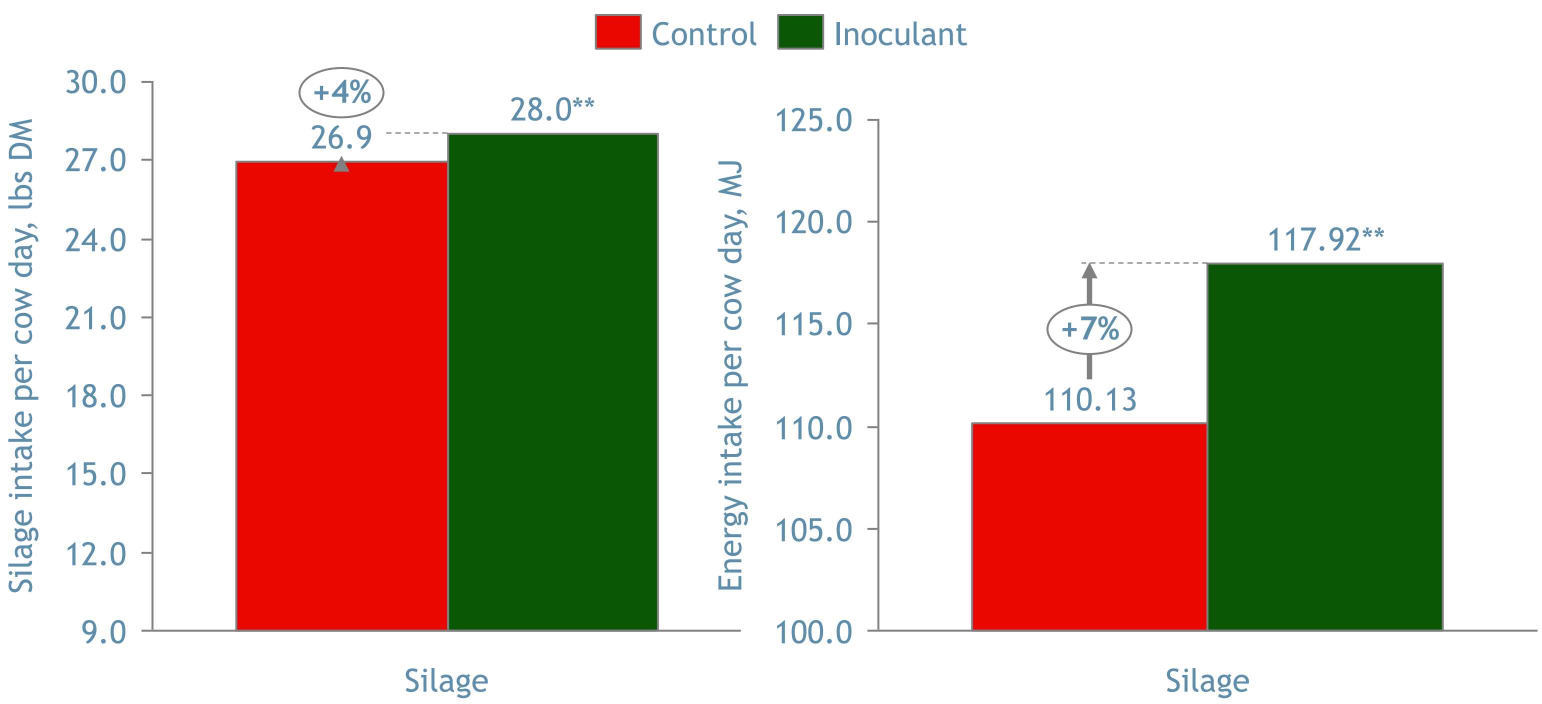
Avoid top spoilage

- Most spoilage at the top due to poor compaction
- Put plastic on side walls in bunker to reduce top spoilage

Inoculants result in higher Intake

As a consequence of reducing undesired conversions in the silage, both feed intake and the overall energy intake will increase



Grass 34.2% DM. Trial 80087

Grass 34.2% DM. Trial 80087

Do you have data with inoculated corn silage that demonstrate increased DM and energy intake?

Inoculants improve milk production

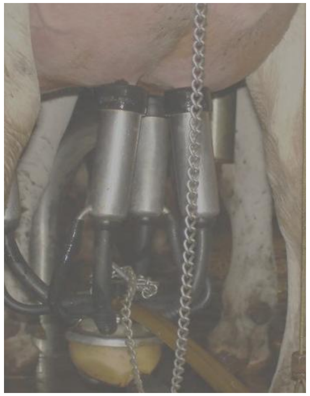
Improved feed conversion (FCM/DMI): 1.72 vs. 1.54

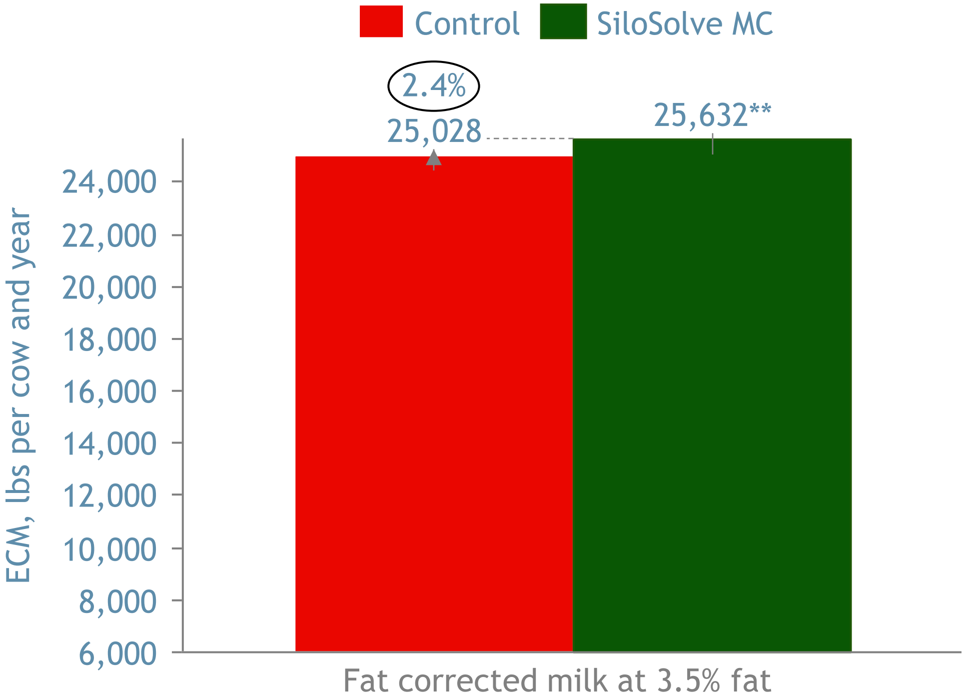
Reduced milk fat:

3.43% vs 3.48%

Reduced milk protein:

2.82% vs 2.93%





Corn silage fed to cows for >90 days. Trial 80148, Florida. Assumed 305 milking days

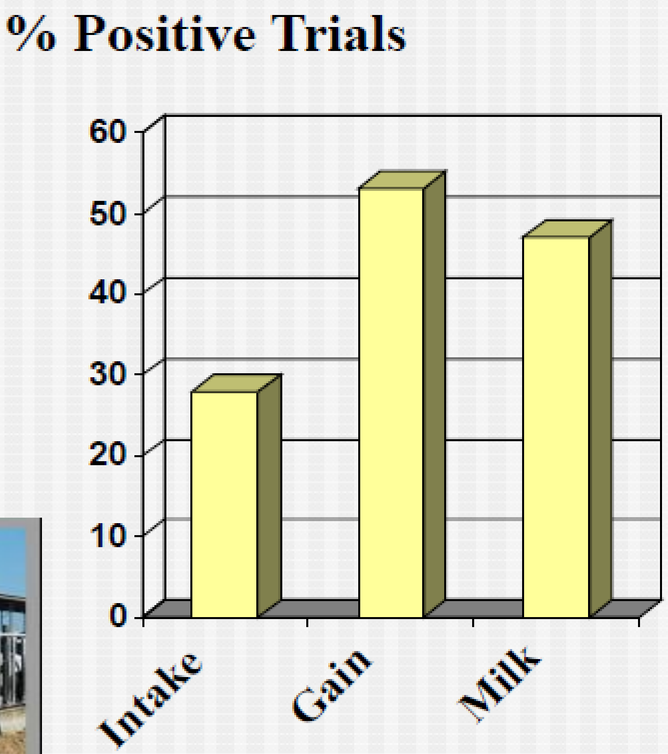
Previous slide shows ECM on x axis, but FCM on y axis??

Could you show daily fat and protein yield in lbs. and not %

Homofermentative Silage Inoculants - Results

Animal Performance

- Typical improvements when worked: 3 to 5%

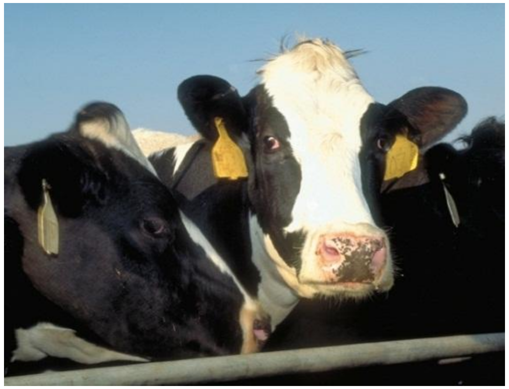


Ref. Muck and Kung, 1997

Does inoculant affect cow performance?

"The effects of inoculants on gain or milk production in livestock have been greater than expected (Weinberg and Muck, 1996). In fact, there are a significant number of reported cases where animal performance has been increased even though there was either no or only minor changes in pH or silage fermentation products. ….. However, beyond scientific curiosity, improvements in animal performance provide a bigger return to the farmer than improvements in DM recovery. So there is incentive both scientifically and in helping farmers choose effective inoculants to understand how LAB silage inoculants affect livestock."

Quote by Dr. Richard Muck-USDA Forage Lab, Madison, WI
International Silage Conference, 2012



Silage Inoculants and Fiber Digestibility and Fermentation of Corn Silage

Treatment	pH	Lactic Acid	Acetic Acid	Soluble Protein	Lactate: Acetate	NDF Digestibility
		------------ % DM	------------	------------	Ideal >3:1	%
Control	3.91	4.1	1.60	3.65	2.6	52,8
Inoculant	3.79	4.6	1.41	3.42	3.3	55.6

+ 5.3% in vivo NDF Digestibility

K.S. Bolsen – Kansas State University

Inoculants improve milk production

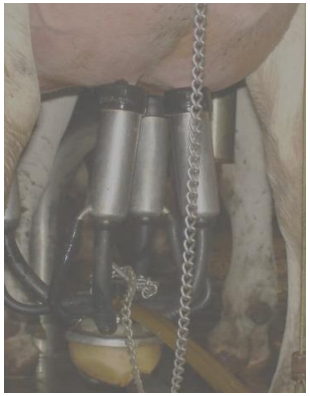
Improved feed conversion (ECM/DMI): 1.40 vs. 1.36

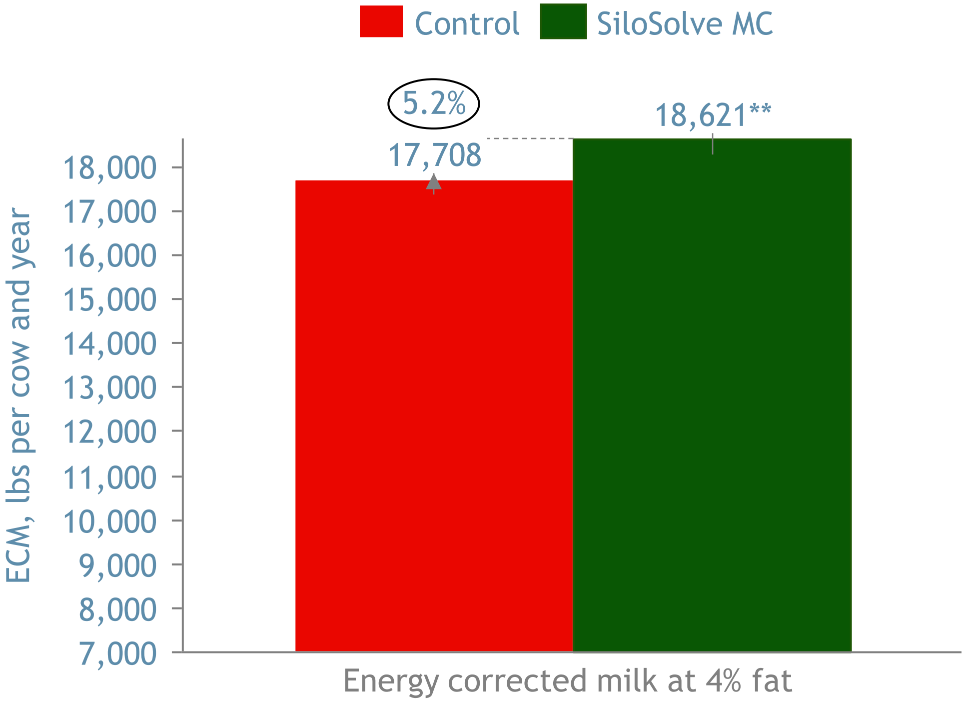
Increased milk fat:

4.24% vs 4.16%

Increased milk protein:

3.17% vs 3.15%





Alfalfa silage fed to cows for 92 days. Trial 80087, Lithuania. Assumed 305 milking days

The Lithuania trial results are too low and the data will be dismissed. Prefer we delete this trial.

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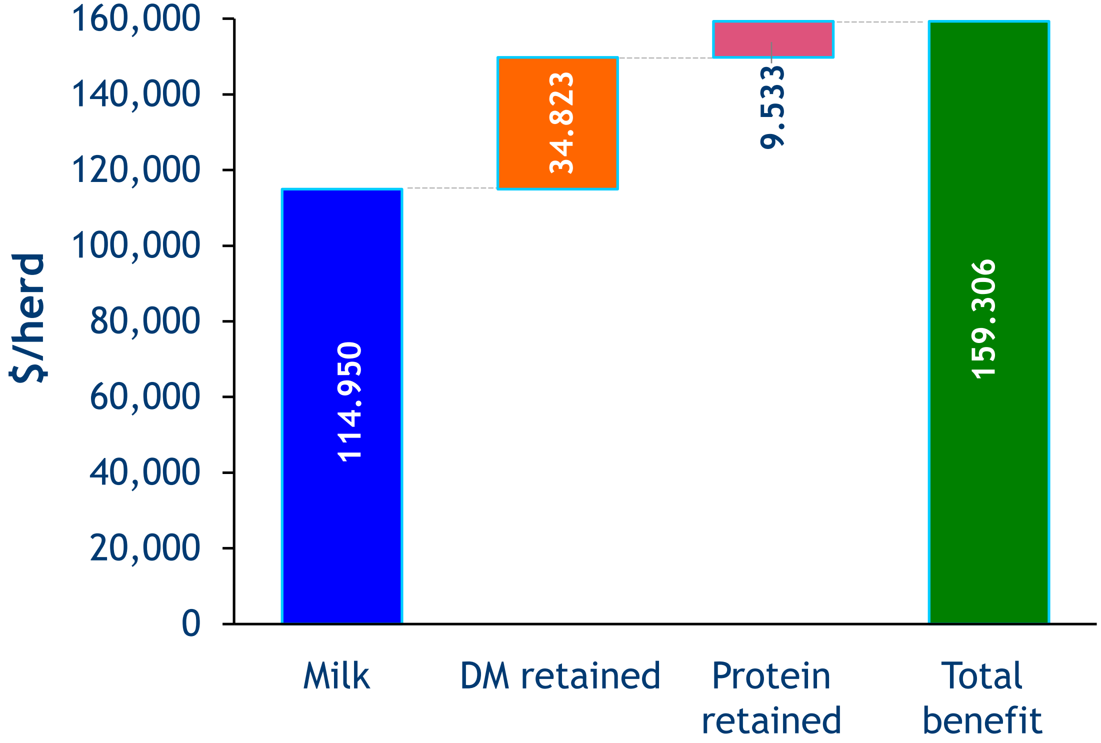
Economic value of silage inoculants - Assumptions

Parameters	Value
Dairy herd size	1000
Milk price, $/100 lbs	19
Price of silage, $/wet ton	90
Price of 49% SBM, $/ton	400
Price of silage additive, $/ton	0.90 – 1.20

Parameters	Control	Inoculant
Dry matter, %	34.5	36.5
DM loss, %	5	2
CP, %DM	8.05	8.25
NH_3-value, %TN	9.1	7.8
FCM, lbs/cow year	25,028	25,632

Corn silage treated with SiloSolve MC and used in a dairy trial at the University of Florida, Gainsville

Benefits of using inoculant, 1000 cows



ROI ranges between 7.7 and 10

Additive cost ranges between $13,582 and $15,293

Conclusions-Science-based Bacteria Inoculants will:

- Provide consistent performance
- Increase in silo dry matter recovery on average of 2-3%
- Increases production by 3-5%
- Increase fiber digestibility

Most money in using inoculants from increased milk yield

Future challenges

- Better knowledge of mode of action of lactic acid bacteria in silage
- Better prediction of changes in silage quality during fermentation
- Improve consistency of bacterial efficacy
- Better correlation between silage analyses and animal performance

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Thank You!