Forage Storage: Life after Harvest

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1

How to Get It Right

- Start with the right harvest conditions
- Use the best inoculant possible
- Pack until you have achieved the right density
- Cover perfectly
- Good storage is key

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Outline

- What happens during storage?
- How can we use storage to make milk?
- When storage goes wrong!

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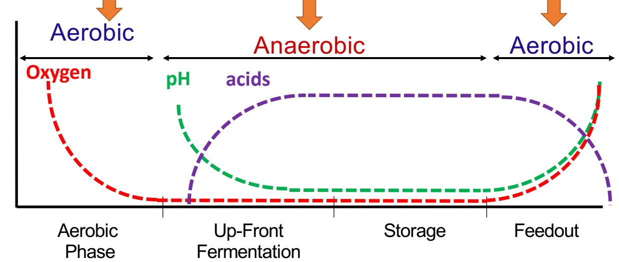
Phases of Ensiling:

- Crop is still respiring, using sugars and proteins
- Aerobic bacteria are alive and well, and they use sugars and protein; produce heat
- Fermentation cannot begin until oxygen is gone

Begins once the silo is covered and oxygen is gone; Continues so long as oxygen is absent

Begins once silage is exposed to oxygen; Also known as "spoilage"



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Stored silage may look stagnant….

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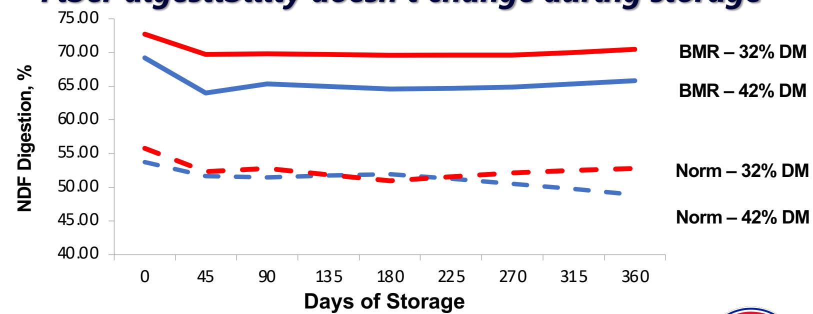
Fiber digestibility doesn't change during storage



Der Bedrosian and Kung, 2010
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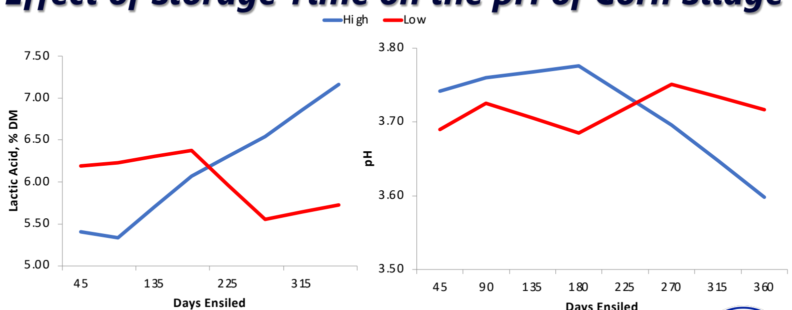
Effect of Storage Time on the pH of Corn Silage



Changes in pH reflect changes in lactic acid

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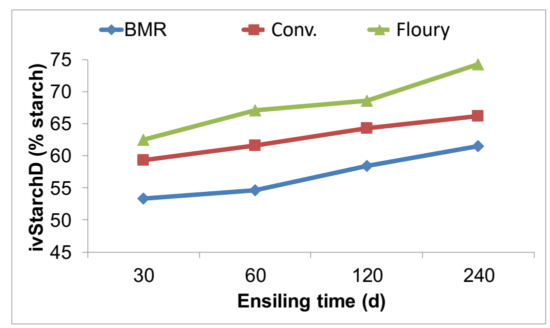
Starch digestibility increases during storage



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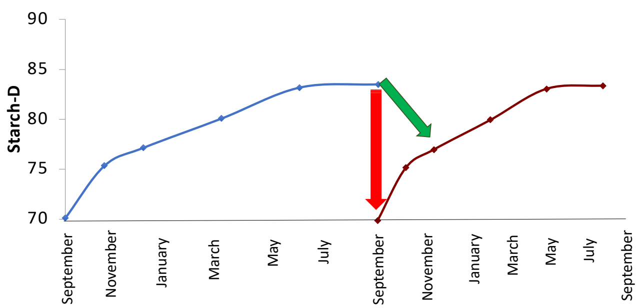
Effect of Days of Ensiling on Starch Digestion in Corn Silage



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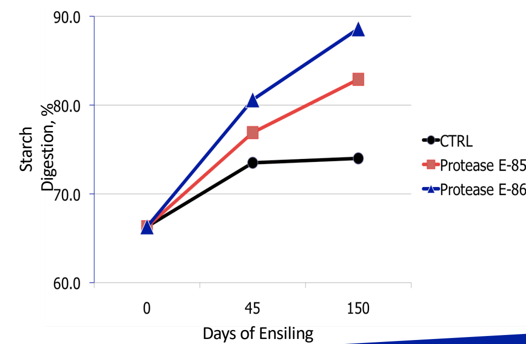
Addition of Experimental Proteases Improve In Vitro Ruminal Starch Digestion in the Silo



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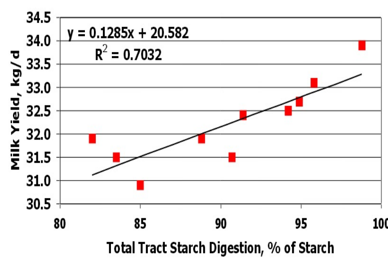
What does starch mean to the cow?

- A rich source of energy for production and metabolism (substrates for VFA and therefore energy for milk production)
- Provides energy for microbial metabolism
- However, rapidly fermentable, so holds potential to decrease rumen pH quickly



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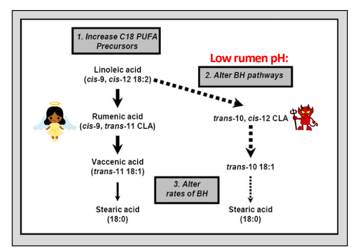
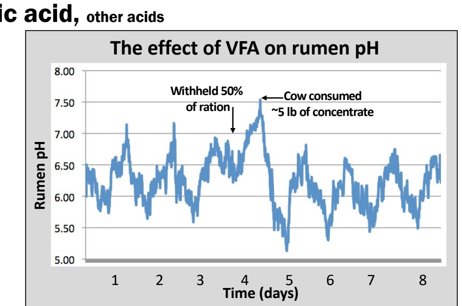
How does starch decrease pH?

- Starch → Lactic acid, propionic acid, other acids
- VFA decreases pH





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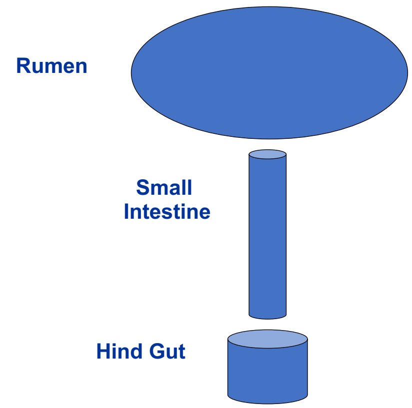
Starch Digestion in Ruminants



Microbial Fermentation
- VFA
  - Propionate
  - Glucose via liver
- Microbial Protein

Digestion (Enzymatic)
- Glucose
- Less Efficient

Microbial Fermentation
- VFA
- Minor Energy Contribution

13

Greater Proportion of Starch Digested in the Rumen

Potential Advantages	Potential Disadvantages
More energy from VFA	Low rumen pH issues
Microbial protein	Acidosis
Greater TTStarch-D	DMI
More energy for the cow	Fiber digestion
	Decreased Fat %
	Laminitis

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Greater Proportion of Starch Digested in Small Intestine

Potential Advantages	Potential Disadvantages
More energetic efficiencies	Less microbial protein
Performance benefits hard to document	Reduced total tract starch digestion or total energy
Glucose use by gut tissue	
Less rumen pH issues	

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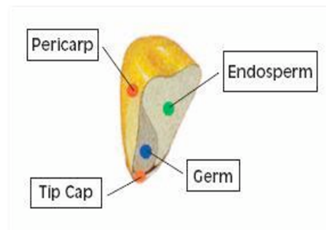
We are actually feeding rumen bacteria

- **Starch must be accessible by bacteria in the rumen**
- **Factors that limit the access to starch**
  - Pericarp
  - Protein/starch matrix



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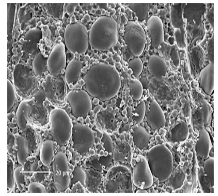
The Protein/Starch Matrix

- **Starch must be accessible by bacteria in the rumen**
- **Factors that limit the access to starch:**
  - Pericarp
  - Prolamin/starch matrix
- **Starch is embedded in a prolamin protein matrix that hinders access to starch**
- **The amount and complexity of this prolamin protein matrix increases with maturity and varies with hybrid**
- **Starch-D decreases 0.86 percentage units for each unit increase in prolamin protein content (as a percent of starch)**



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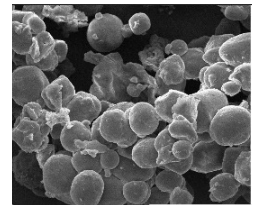
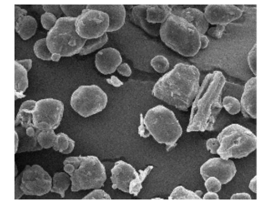
Proteolysis of the Protein/Starch Matrix During Storage Results in Increases in Starch-D

Prior to ensiling



After 240 d of ensiling



Hoffman et al., 2011

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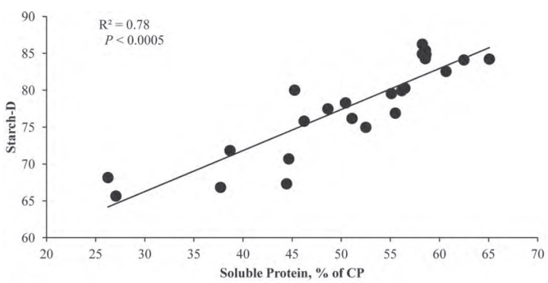
There is a Strong Correlation Between Soluble Protein and Starch-D



Der Bedrosian et al., 2012

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Starch Digestibility vs Sol CP……..General Benchmarks

Corn Silage

Soluble CP, % of CP	Kernel Protein Status	Starch Digestion Potential
< 30 %	Minimal Degradation	Slow
30-40 %	Protein Degradation Starting	Slow-Moderate
40-50 %	Moderate Protein Degradation	Moderate
50-60 %	Extensive Protein Degradation	Moderate-Fast
60 %	Proteins Degraded	Fast-Moderate
> 70 %	Proteins Fully Degraded	Fast

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Starch Digestion Rates (kd) are a function of surface area...........

Starch surface area is altered by

1- Mechanical reduction

2- Particle Decay

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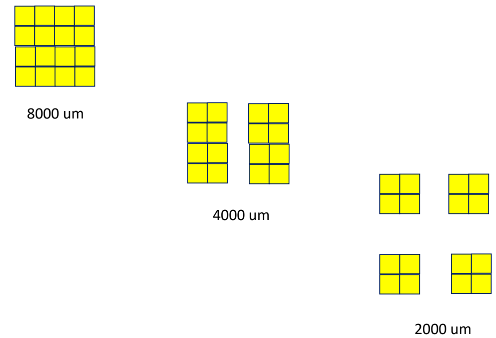
1- Mechanical processing (MPS) = i.e. Kernel processing



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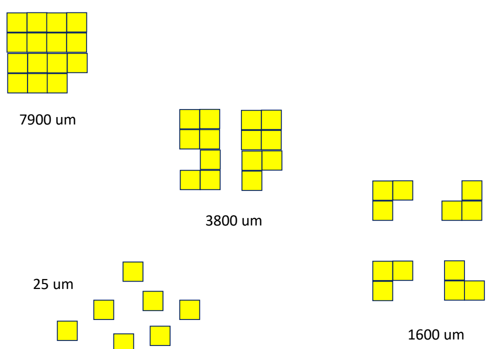
2 - Fermentation = Particle Decay



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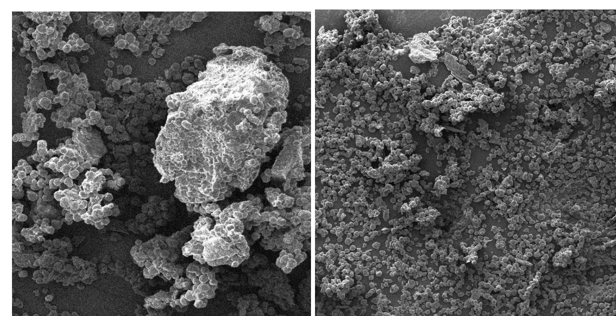
Particle Decay – Electron Microscope (Hoffman et al., 2010)



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In Summary, have the conversation:

25

What is the minimum amount of time to store silage before feeding?

- Corn Silage: 3 months
- Alfalfa Silage: 3 weeks

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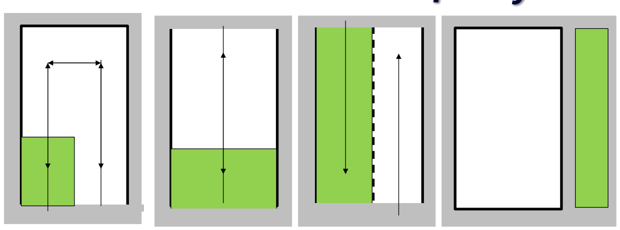
Where will you put the new feed to ensure there is 3-4 months of carryover?



Time of storage is more important than processing score

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Check the silo for holes...

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Feed out with only one face...

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Keep Plastic Down at the Feeding Face

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Thank you!

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31