

FeedGrainV2.0



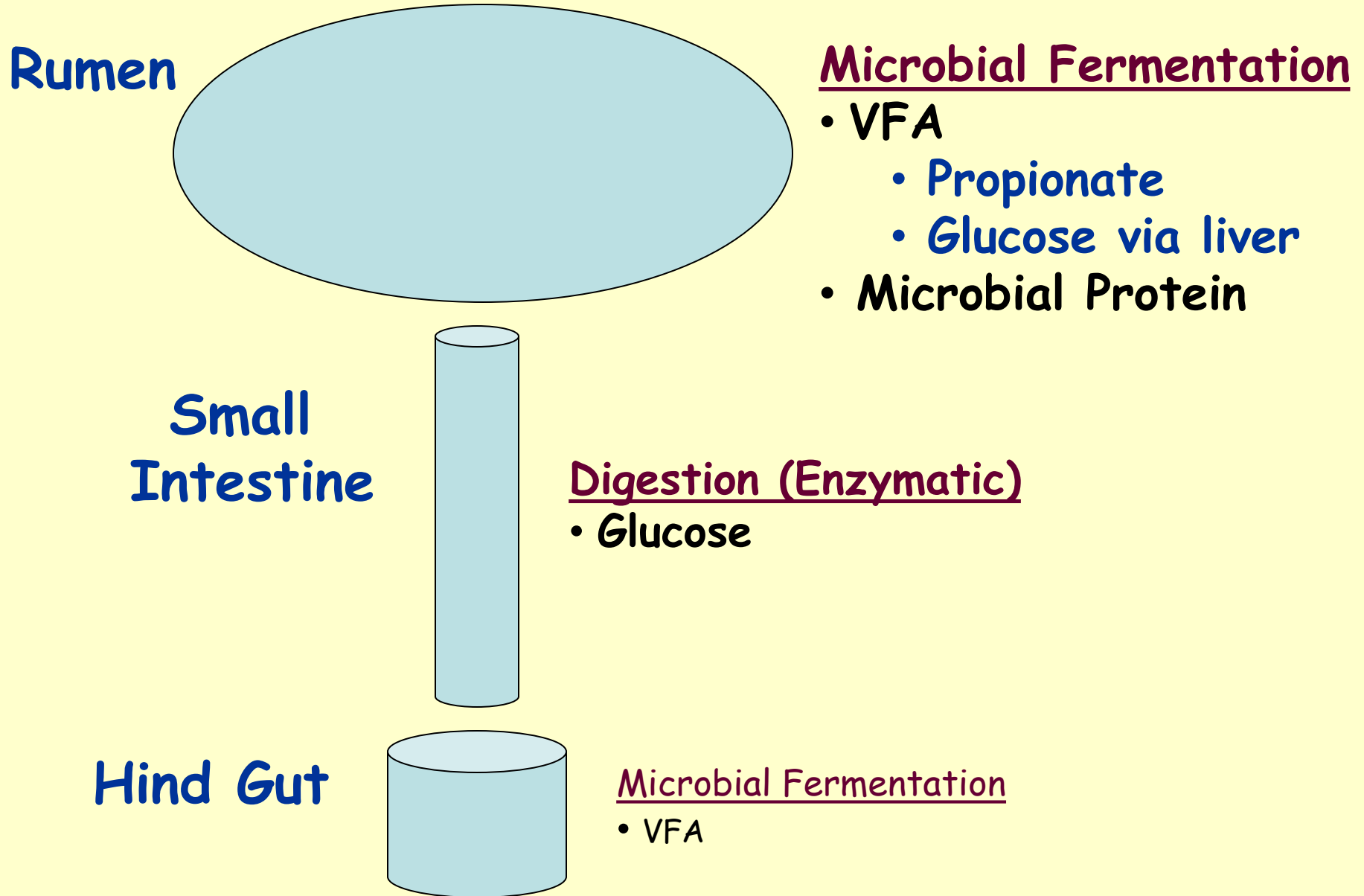
Feed Grain Evaluation for Lactating Dairy Cows

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University of Wisconsin – Madison

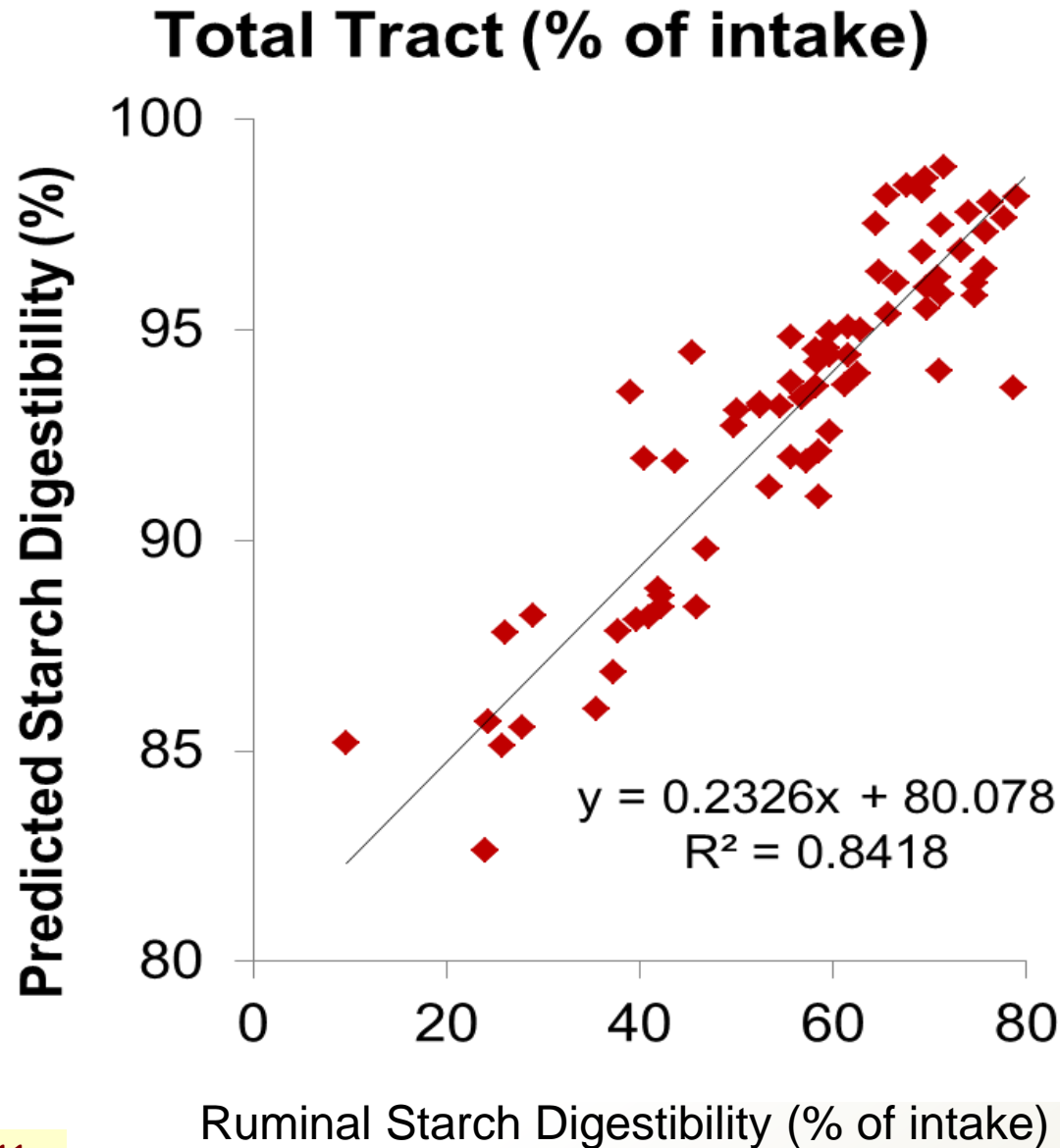


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Starch Digestion in Ruminants

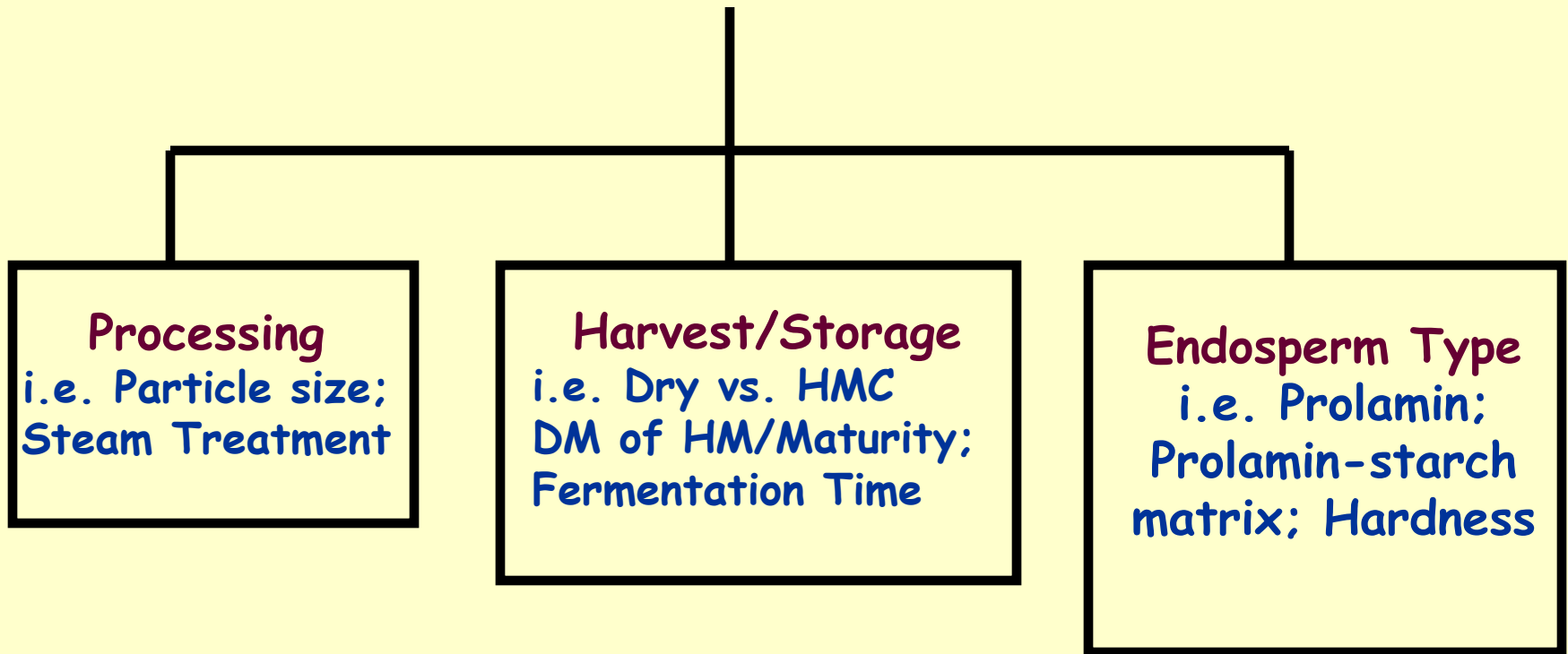


Starch Digestion

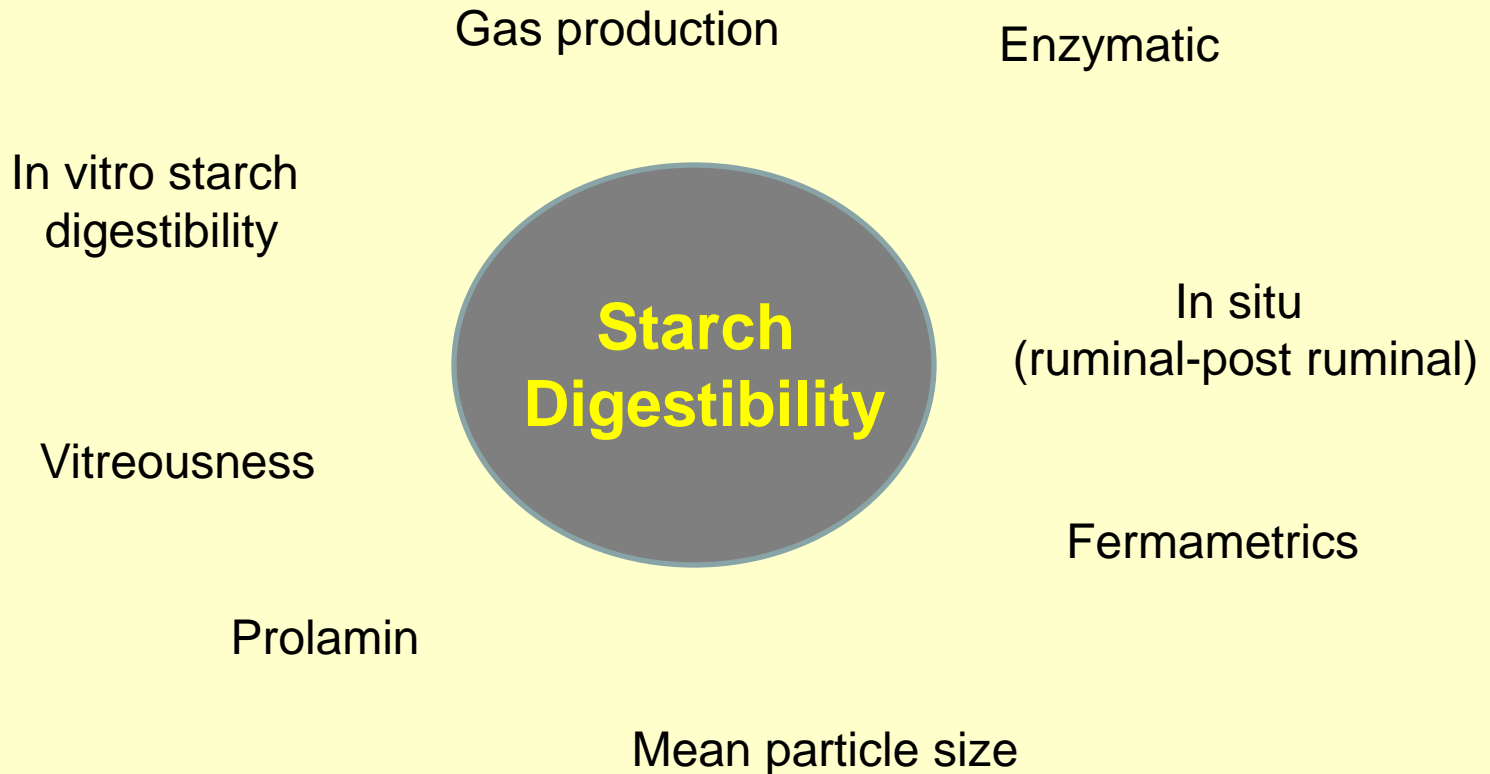


Source: Ferraretto, 2011,
UW Madison, M.S. Thesis

Primary Factors: Influencing Starch Digestibility in Feed Grains



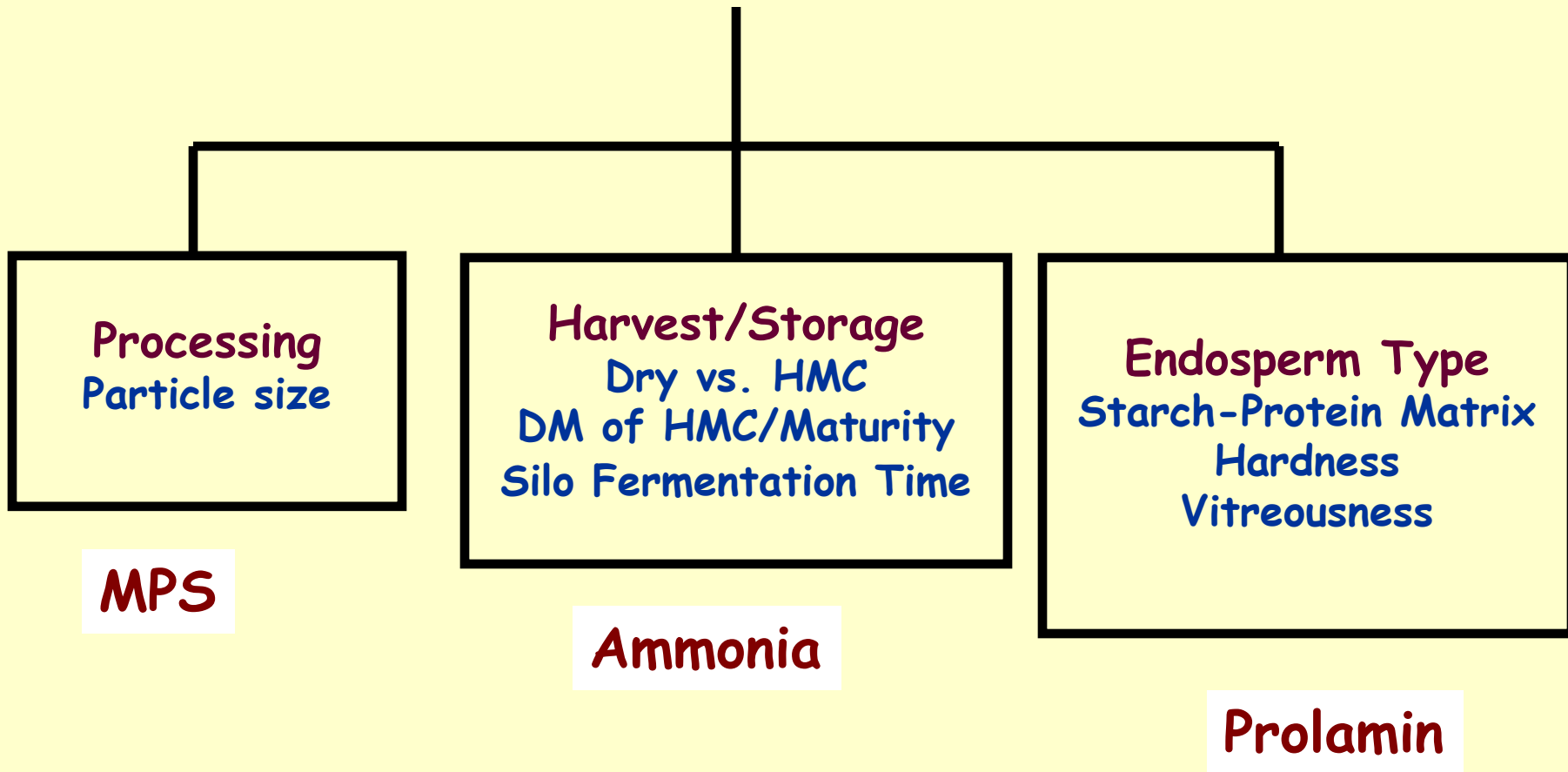
Measuring Starch Digestibility in Feed Grains is Very Confusing!



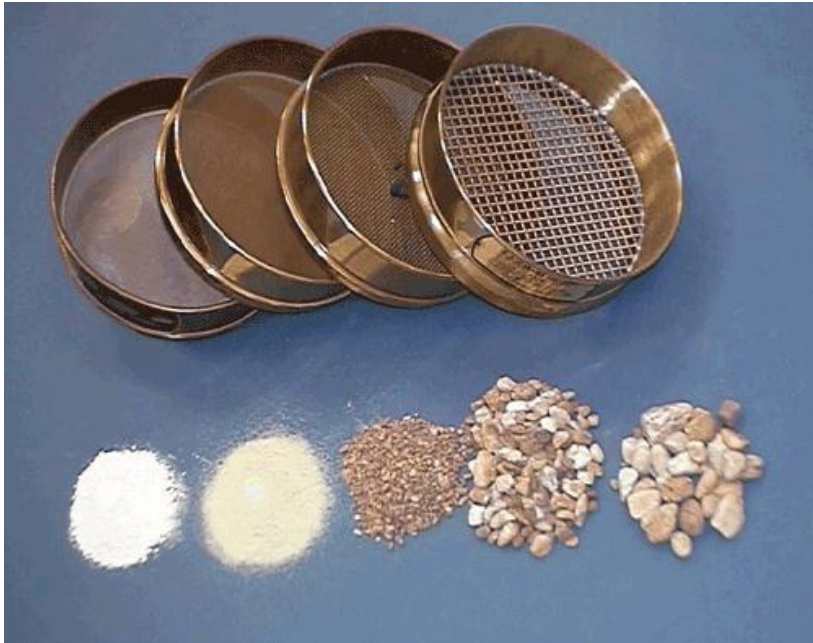
Measurement approaches have not been integrated

FeedGrainV2.0 Integrates

Primary Factors:
Influencing Starch Digestibility in Feed Grains



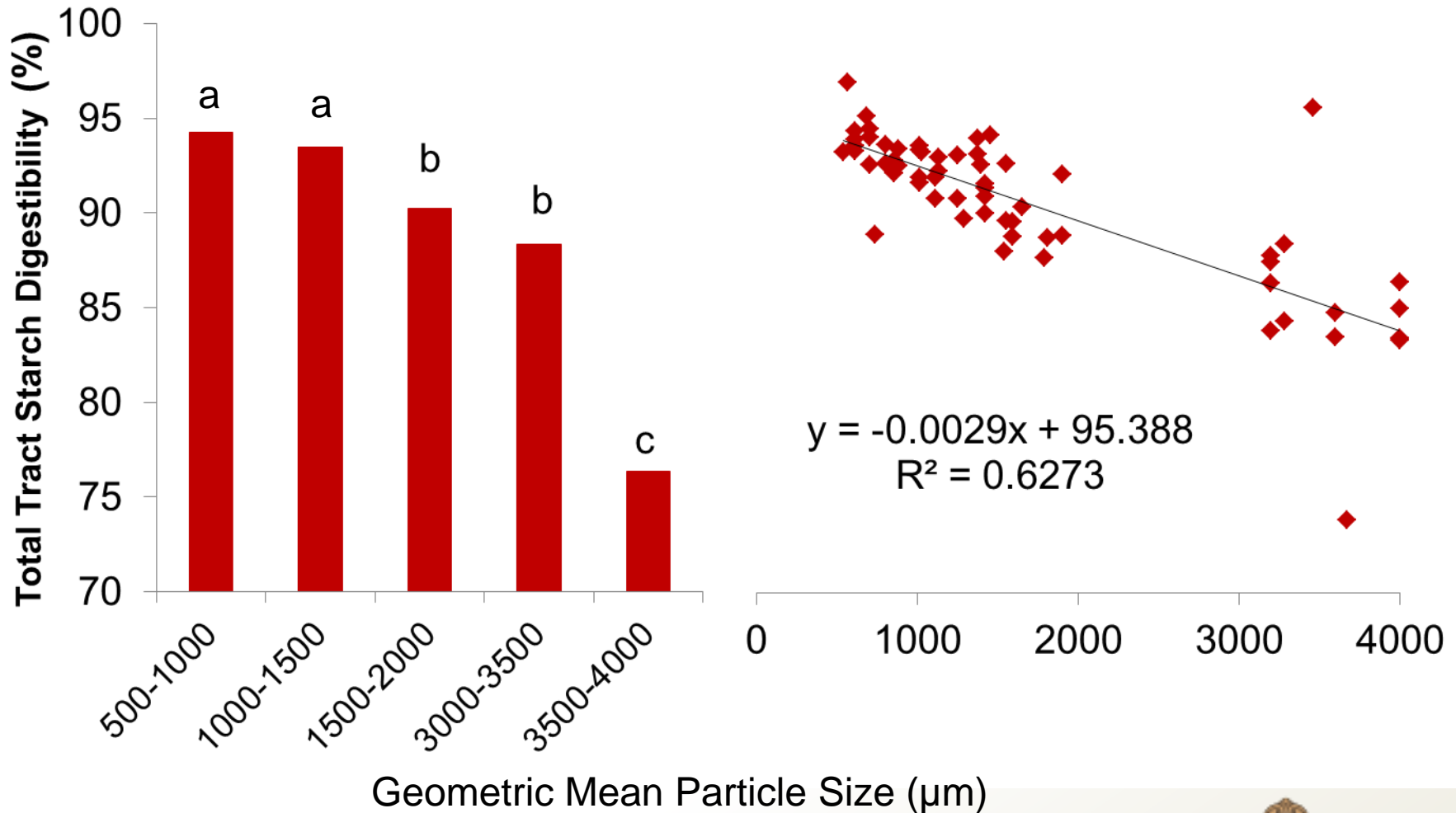
FeedGrainV2.0 :
Step 1 : Determine Mean Particle Size



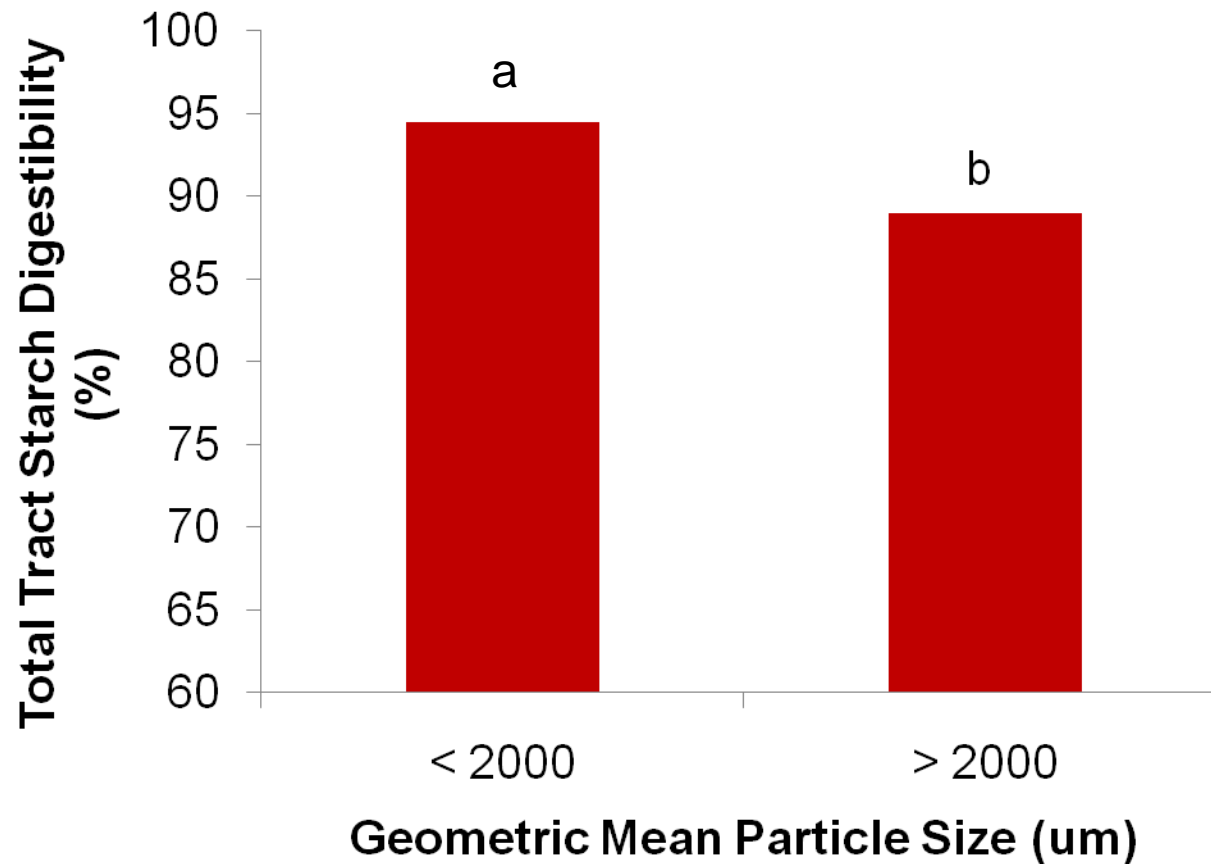
- ASAE Methods (2008)
- 14 Sieves + Pan
- Available @ Commercial Labs
- Shake 10 m + tapping

Caution: On farm determination of high moisture corn (wet) MPS results in a large overestimation of MPS (> 500 um)!

Corn Grain MPS - DRY



Starch Digestibility vs Corn Grain MPS - HMC



FeedGrainV2.0 :

Step 2 : Classify Corns as Fermented or Unfermented



- Dry vs high moisture is abandon
- Ammonia ($\text{NH}_3\text{-N}$) is used
- Dry corn has no $\text{NH}_3\text{-N}$
- Unfermented corn has no $\text{NH}_3\text{-N}$
- Fermented corn has 1.0- 7.0 % of total N as $\text{NH}_3\text{-N}$
- $\text{NH}_3\text{-N}$ is a marker of intensity and duration of fermentation
- Eliminates arbitrary classification of HM corn (i.e. 22 % moisture?)

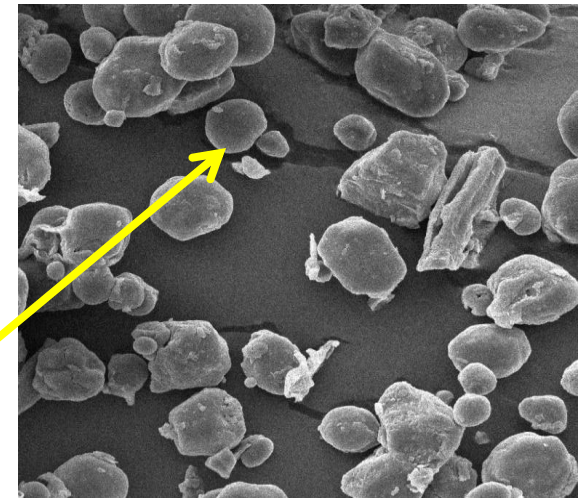
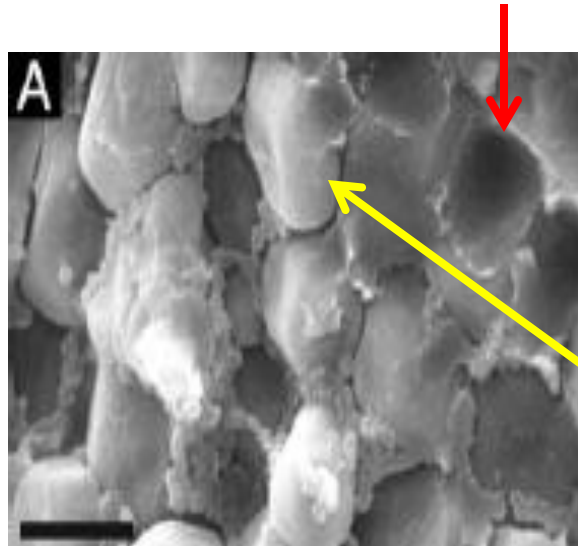
Advantage: $\text{NH}_3\text{-N}$ is accurately and economically predictable by NIRS!

FeedGrainV2.0 :

Step 3 : Measure grain particle bonding strength or weakness

Unfermented = Prolamin proteins

Fermented = Ammonia ($\text{NH}_3\text{-N}$)



**Starch
Granules**

In unfermented (dry) corns > prolamin proteins = > bonding of starch

In fermented (HM) corns > $\text{NH}_3\text{-N}$ = < bonding of starch.

Same hybrid harvested as Snaplage or HMC

Snaplage

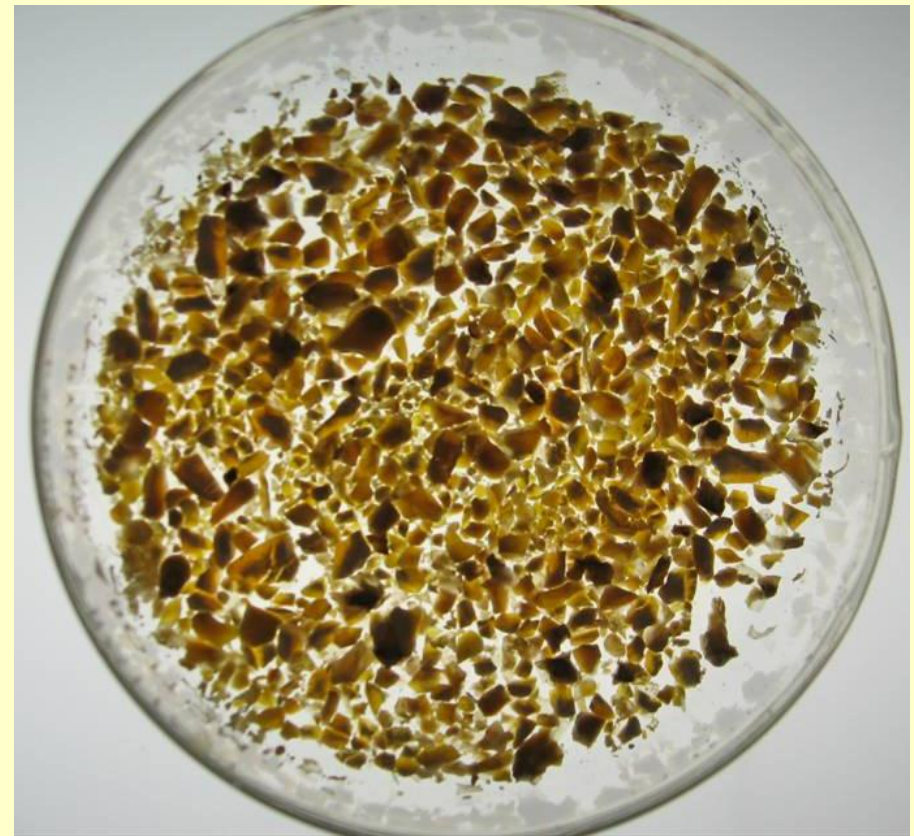
Ammonia = 6.0% of CP
Kernel MPS = 1456 μ



Grain Particles Completely Opaque

HMC

Ammonia = 1.8% of CP
MPS = 1335 μ



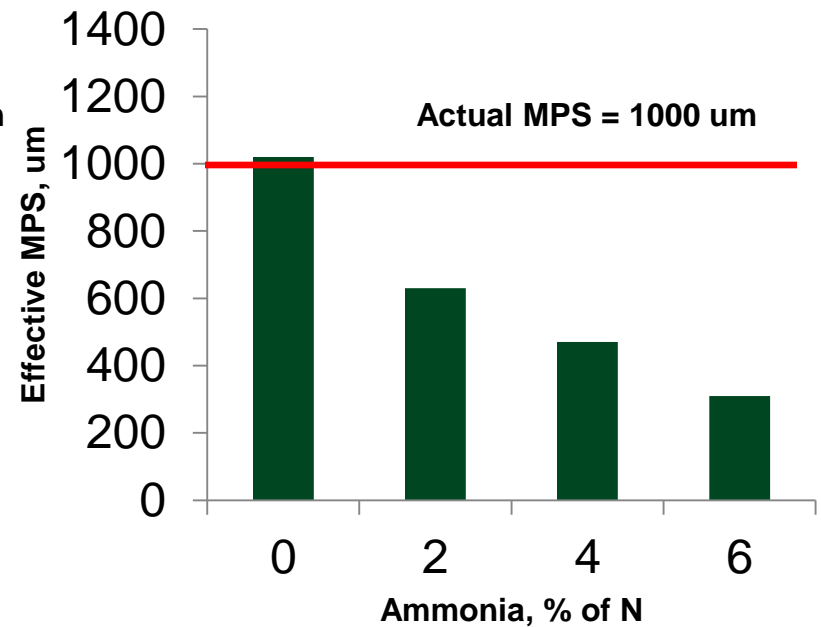
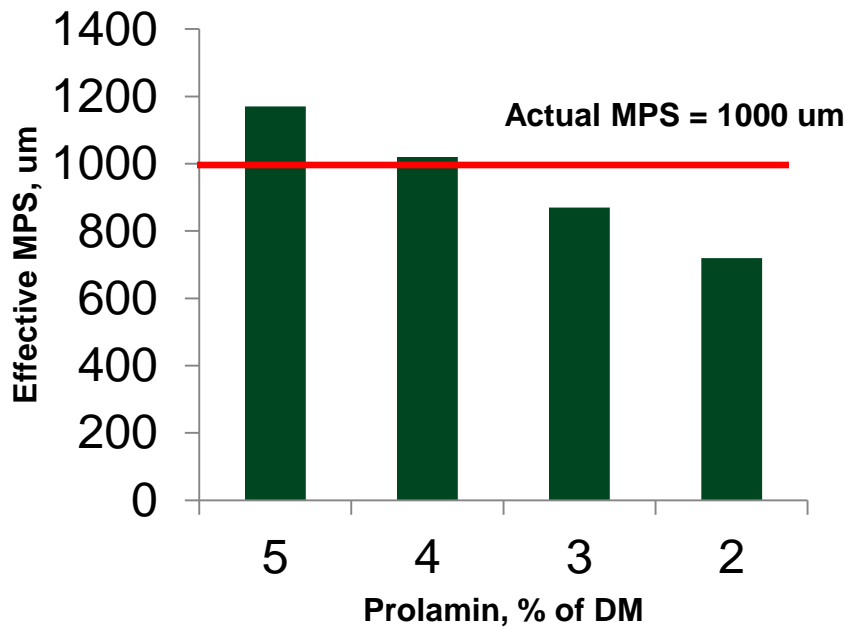
Grain Particles Still Translucent

FeedGrainV2.0 :

Step 4 : Calculate Effective Mean Particle Size

Unfermented = Prolamin proteins

Fermented = Ammonia (NH₃-N)



What is Effective Mean Particle Size (eMPS) ?

A visual example

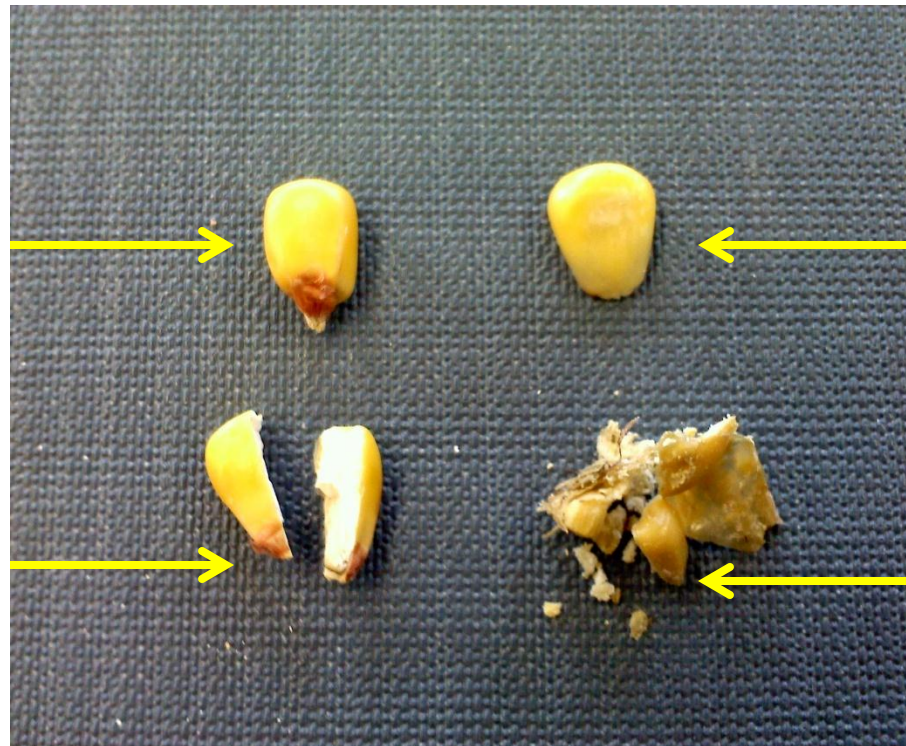
MPS = 4000 μm
Dry corn
kernel

MPS = 4000 μm
HM corn
kernel
(prior to ensiling)

4000 μm are
Effective

3080 μm
are Not
Effective

(after 1 yr fermentation)



eMPS = 4000 μm

eMPS = 920 μm

MPS means: The physical size of the particle

eMPS means: The effective size of the particle at which it ferments
in the rumen

What is Effective Mean Particle Size (eMPS) ?



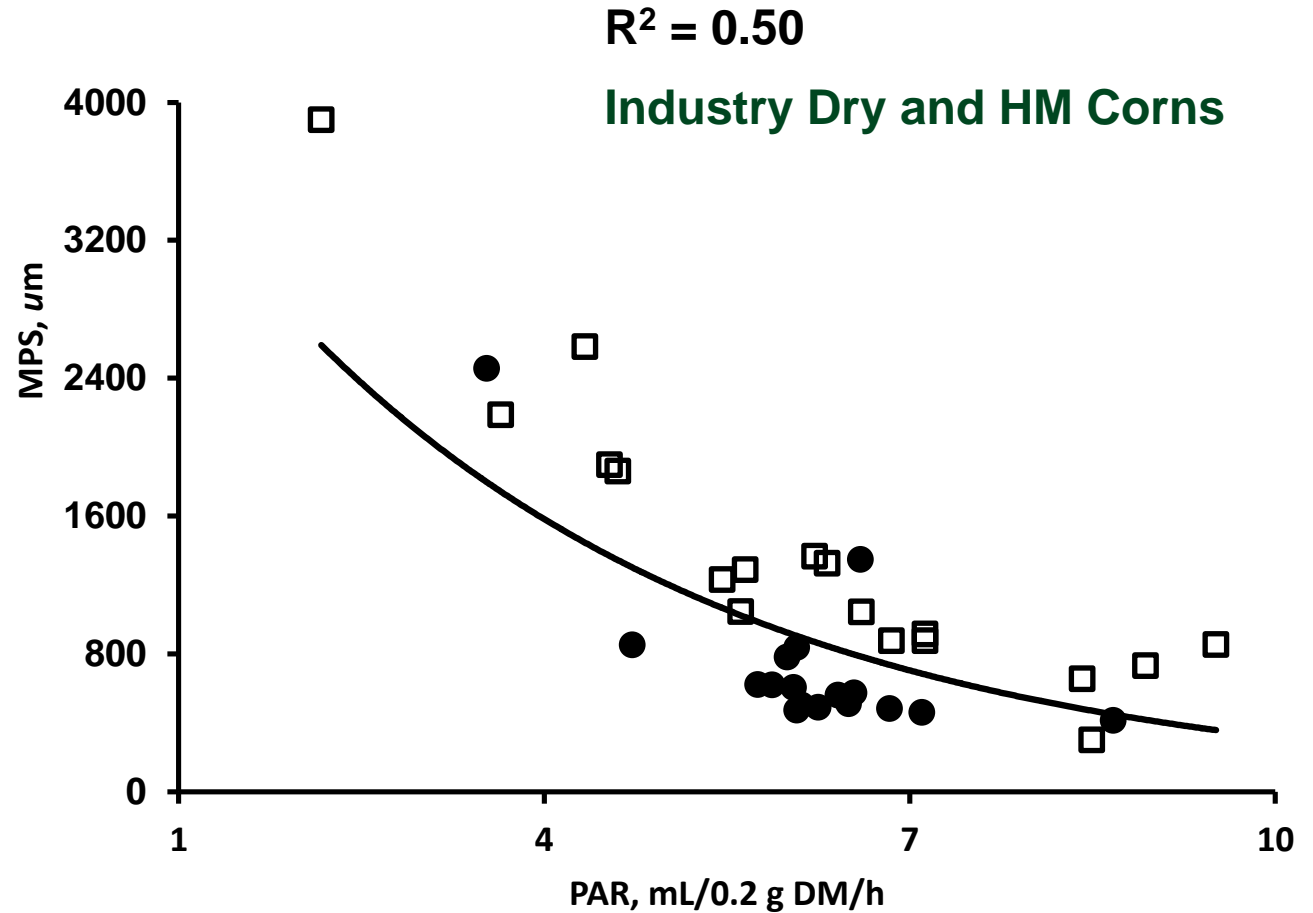
eMPS = 4000 μm eMPS = 920 μm

Wisconsin researchers observed that **eMPS** is better related to fermentation potential as compared with **MPS**. (Hoffman et al., 2012)

eMPS integrates the primary factor of MPS, plus secondary chemical or nutritional factors that also influence starch digestibility

MPS vs Fermentation Potential

Hoffman et al., 2012

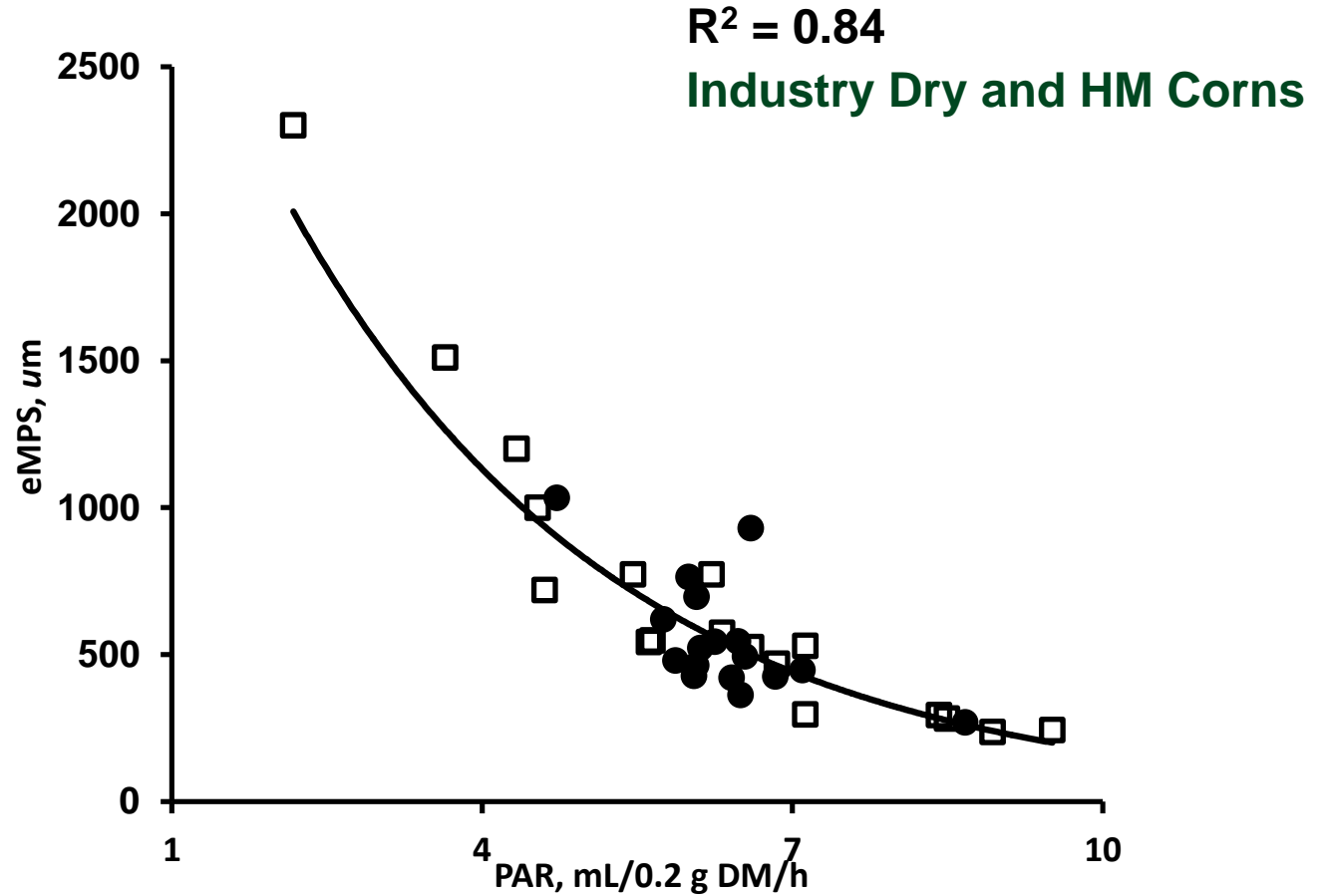


Speed of gas production in rumen fluid



Effective MPS vs Fermentation Potential


Hoffman et al., 2012



Speed of gas production in rumen fluid

FeedGrainV2.0 :

Step 5: Do the math

Feed Grainv2.0 Evaluation System					
Authors: Patrick C. Hoffman ¹ , Dr. Randy Shaver ¹ , and Dr. David Mertens ² , ¹ Department of Dairy Science, University of Wisconsin-Madison, ² Mertens Innovation & Research, LLC.					
1.00 For use with the feed grains listed below.					
	Ground Dry Corn	x	High Moisture Shelled Corn		
	High Moisture Ear Corn		Snaplage		
	Whole Corn (Unprocessed)				
Input categories are shown in red. Output values are shown blue					
1.00					
Item	Abbreviation	Unit	Result	Method [†]	
Input					
Dry Matter	DM	% as fed	85.0	WC	
Mean Particle Size (*Examples below)	MPS	microns	850	ASAE	
Starch		% of DM	70.5	NIR	
Crude Protein	CP	% of DM	9.1	NIR	
NH₃-N (**Examples below)		% of CP	0.0	NIR	
Prolamin Protein (***)Examples below)		% of DM	4.0	WC	
Neutral Detergent Fiber	aNDF	% of DM	9.0	NIR	
Fat		% of DM	3.6	NIR	
Ash		% of DM	2.3	NIR	
Output					
Moisture		% as fed	15.0	C	
Effective Mean Particle Size²	eMPS	microns	867	C	
Starch Fermentation Rate (As Fed)	kd	%/hour	19.4	C	
Ruminal Starch Digestibility	RSD	% of starch	56.5	C	
Starch Digestibility (Total Tract)	TTSD	% of starch	93.2	C	
Non Fiber Carbohydrate	NFC	% of DM	76.7	C	
Nonstarch NFC		% of DM	6.2	C	
Total Digestible Nutrients, 1X	TDN	% of DM	86.2	C	
Net Energy Lactation, 3X	NE_L	Mcal/lb	0.88	C	
Net Energy Maintenance	NE_M	Mcal/lb	0.94	C	
Net Energy Gain	NE_G	Mcal/lb	0.64	C	
Metabolizable Energy, 3X	ME	Mcal/lb	1.37	C	
Relative Grain Quality	RGQ		150	C	



11/2011 Marshfield Lab sample - Fresh 2011 Harvest

Feed Grain^{v2.0} Evaluation System



Authors: Patrick C. Hoffman¹, Dr. Randy Shaver¹, and Dr. David Mertens², ¹ Department of Dairy Science, University of Wisconsin-Madison, ² Mertens Innovation & Research, LLC.

For use with the feed grains listed below.

- 1.00 Ground Dry Corn
High Moisture Ear Corn
Whole Corn (Unprocessed)

- High Moisture Shelled Corn
Snaplage

X



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Input categories are shown in red. Output values are shown blue

Item	Abbreviation	Unit	Result	Method ¹
Input				
Dry Matter	DM	% as fed	78.0	WC
Mean Particle Size (*Examples below)	MPS	microns	1082	ASAE
Starch		% of DM	71.3	NIR
Crude Protein	CP	% of DM	8.8	NIR
NH ₃ -N (**Examples below)		% of CP	0.0	NIR
Prolamin Protein (***)Examples below)		% of DM	3.9	WC
Neutral Detergent Fiber	aNDF	% of DM	7.8	NIR
Fat		% of DM	3.2	NIR
Ash		% of DM	1.4	NIR
Output				
Moisture		% as fed	22.0	C
Effective Mean Particle Size ²	eMPS	microns	1087	C
Starch Fermentation Rate (As Fed) ³	kd	% /hour	17.4	C
Ruminal Starch Digestibility	RSD	% of starch	53.9	C
Starch Digestibility (Total Tract)	TTSD	% of starch	92.5	C

11/2011 Marshfield Lab sample - Fermented 2010 Harvest

Feed Grainv2.0 Evaluation System



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For use with the feed grains listed below.

- 1.00 Ground Dry Corn
High Moisture Ear Corn
Whole Corn (Unprocessed)

- High Moisture Shelled Corn
Snaplage

X



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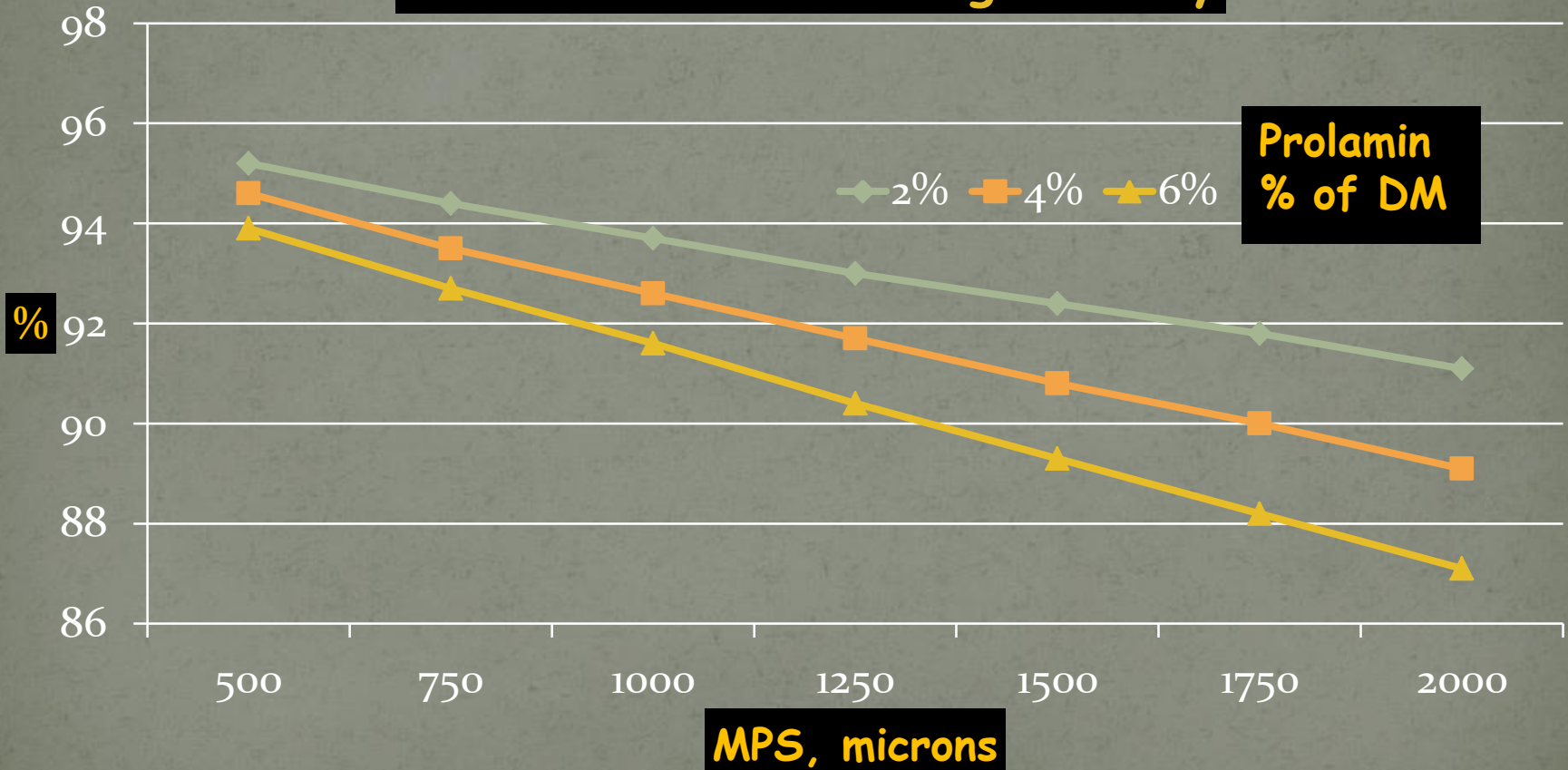
Input categories are shown in red. Output values are shown blue

Item	Abbreviation	Unit	Result	Method ¹
Input				
Dry Matter	DM	% as fed	55.4	WC
Mean Particle Size (*Examples below)	MPS	microns	847	ASAE
Starch		% of DM	71.2	NIR
Crude Protein	CP	% of DM	7.7	NIR
NH ₃ -N (**Examples below)		% of CP	6.7	NIR
Prolamin Protein (***)Examples below)		% of DM	2.5	WC
Neutral Detergent Fiber	aNDF	% of DM	4.5	NIR
Fat		% of DM	3.8	NIR
Ash		% of DM	1.4	NIR
Output				
Moisture		% as fed	44.6	C
Effective Mean Particle Size ²	eMPS	microns	215	C
Starch Fermentation Rate (As Fed) ³	kd	% /hour	40.0	C
Ruminal Starch Digestibility	RSD	% of starch	77.1	C
Starch Digestibility (Total Tract)	TTSD	% of starch	97.0	C

Dry Corn Simulation

Feed Grainv2.0 Evaluation System

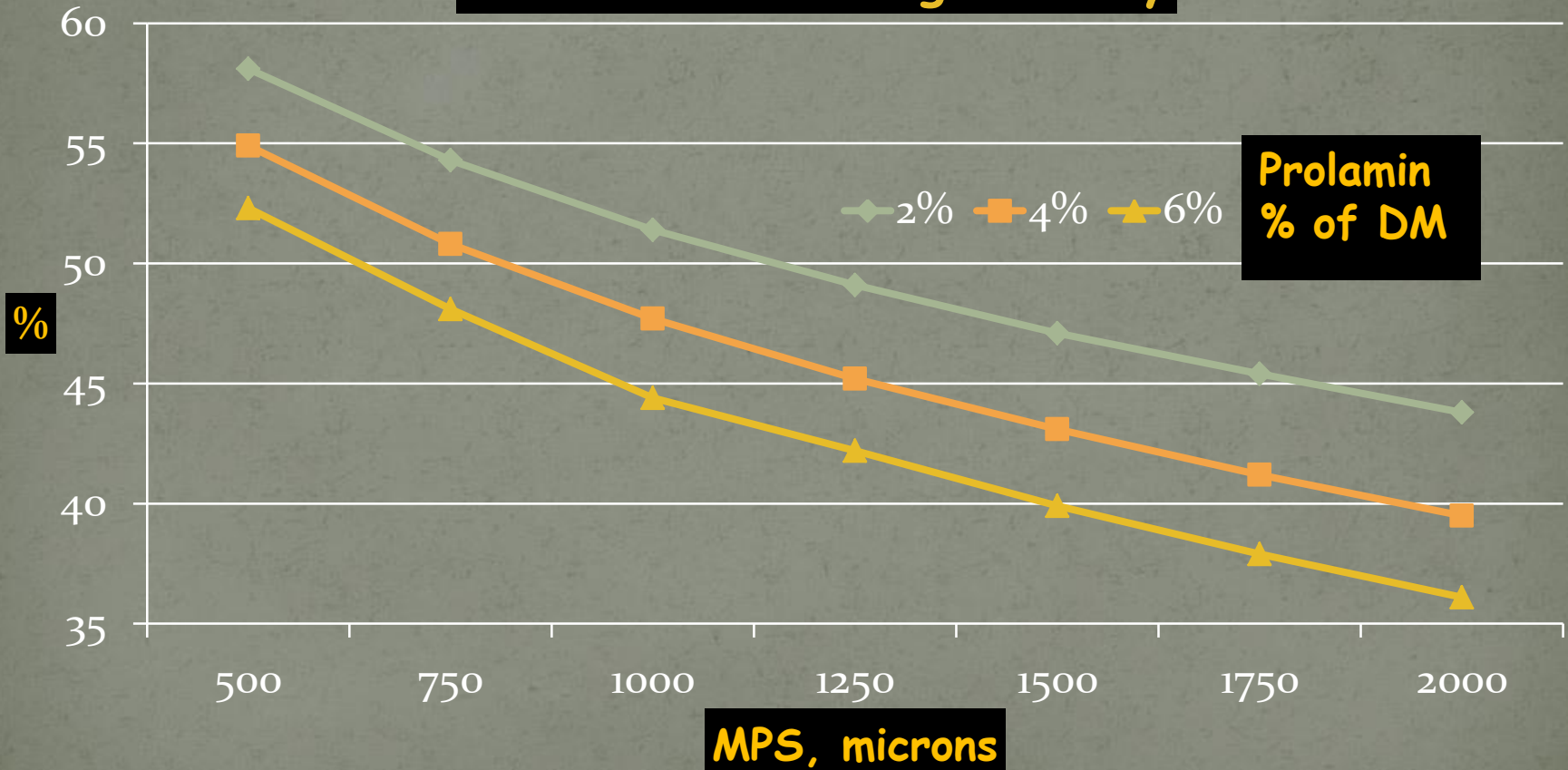
Total Tract Starch Digestibility



Dry Corn Simulation

Feed Grainv2.0 Evaluation System

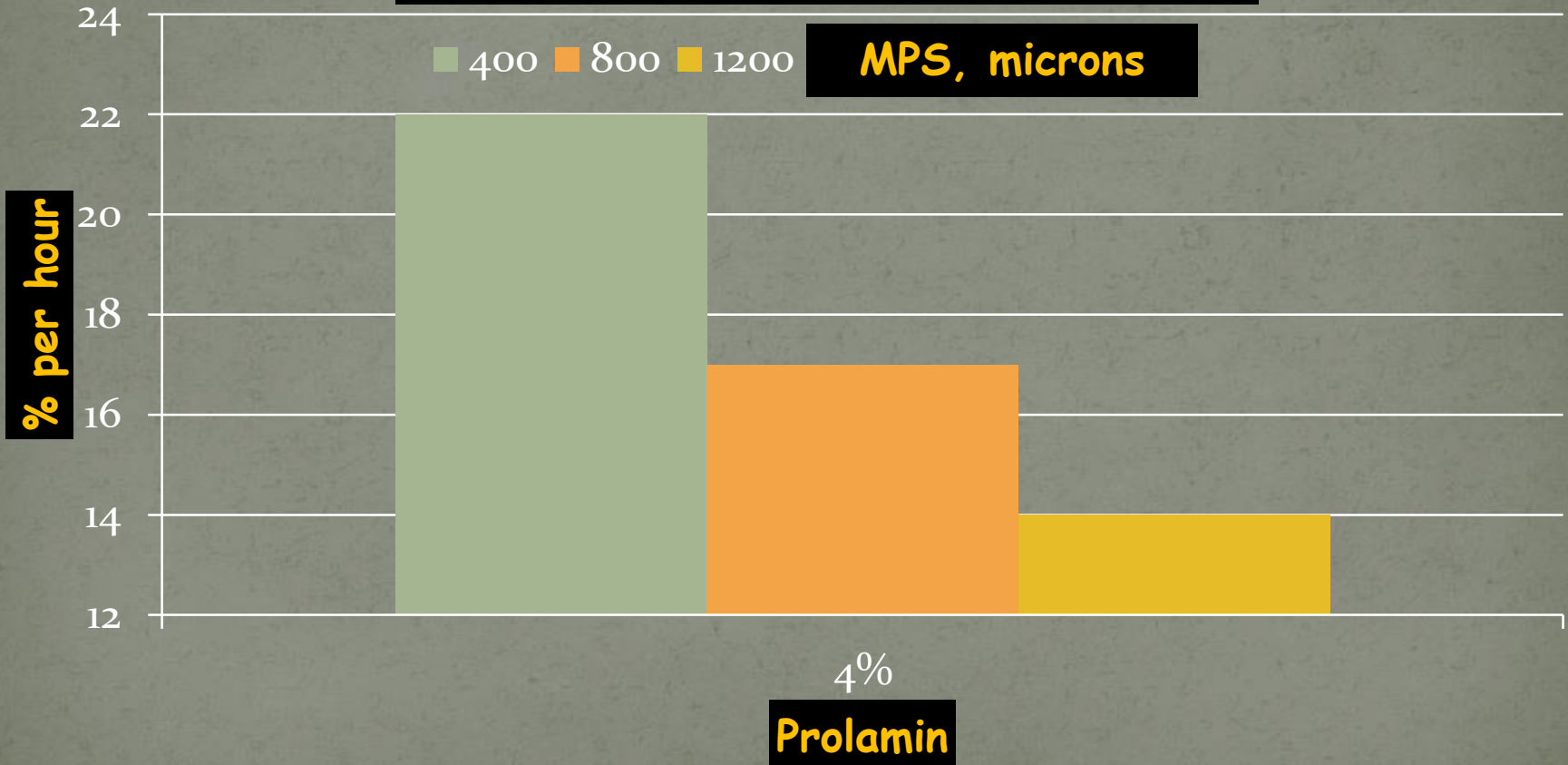
Ruminal Starch Digestibility



Dry Corn Simulation

Feed Grainv2.0 Evaluation System

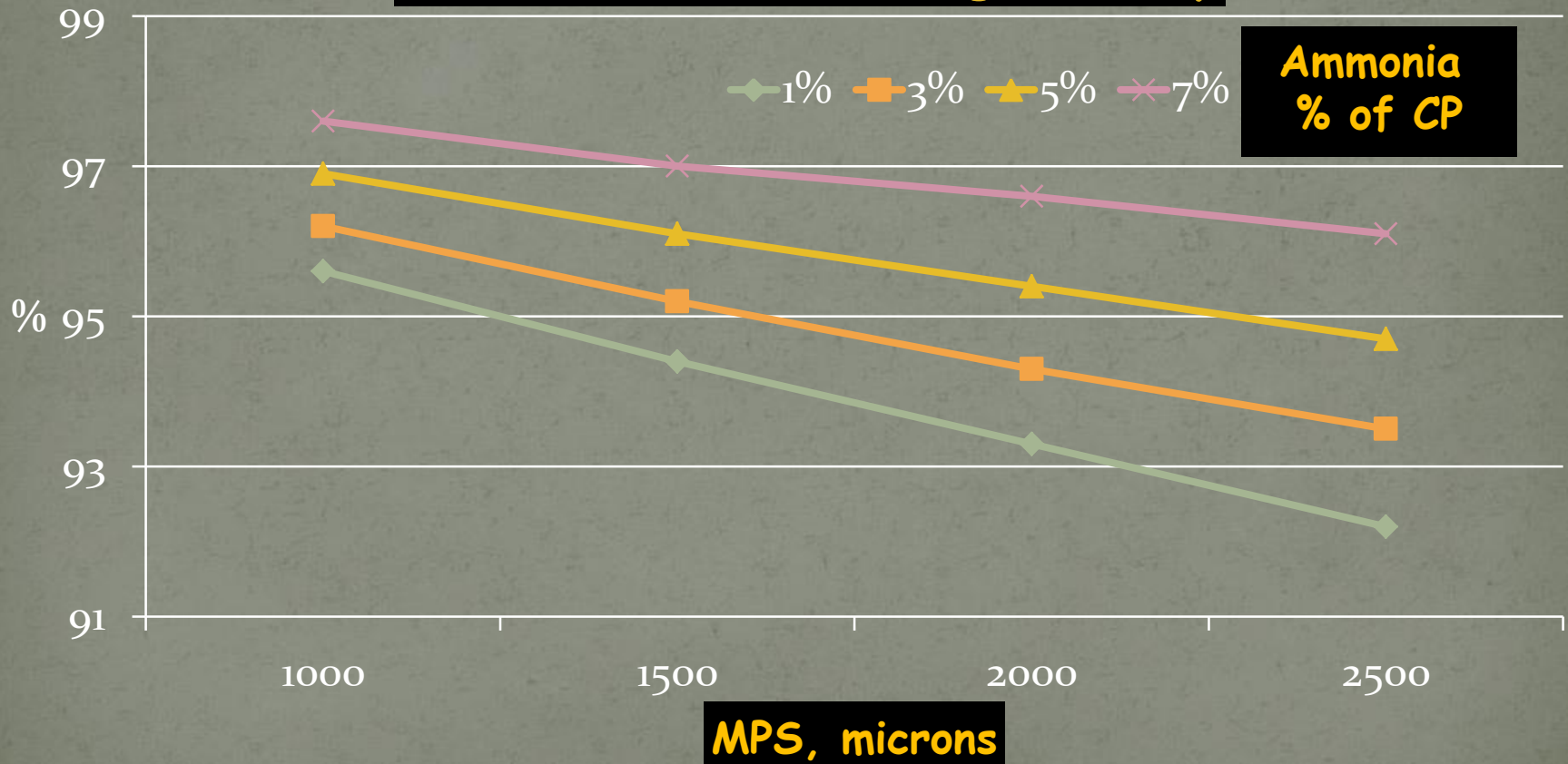
Ruminal Rate of Starch Digestion



HM Corn Simulation

Feed Grainv2.0 Evaluation System

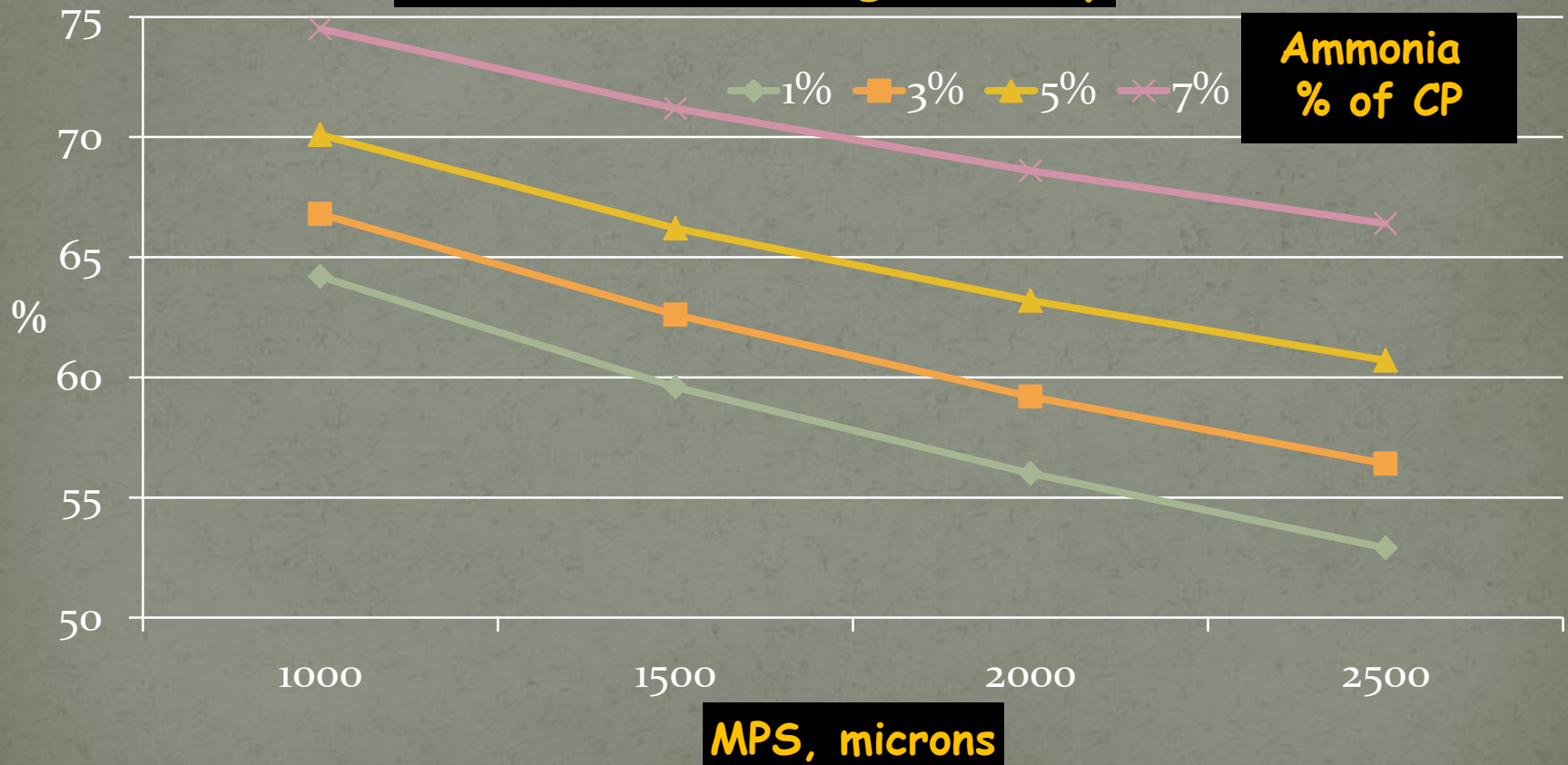
Total Tract Starch Digestibility



HM Corn Simulation

Feed Grainv2.0 Evaluation System

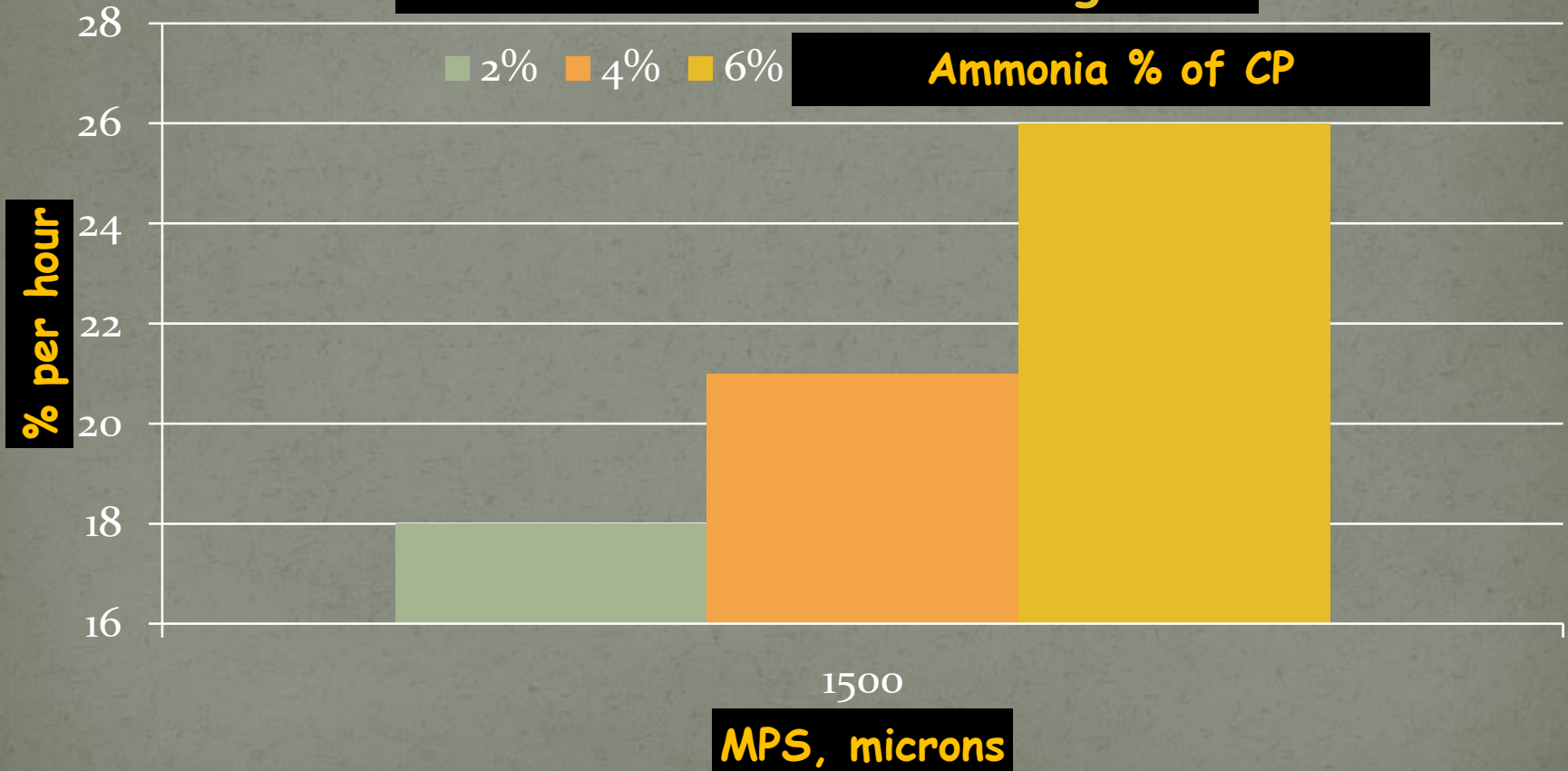
Ruminal Starch Digestibility



HM Corn Simulation

Feed Grainv2.0 Evaluation System

Ruminal Rate of Starch Digestion



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<http://www.uwex.edu/ces/dairynutrition/>

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The Dairy Cattle Nutrition UW-Extension site is designed to provide research-based information for the public seeking resources on applied aspects of the nutrition of dairy cattle.


Web Site Highlights

-  [Dairy Team News from the University of Wisconsin](#)
-  [2009 Four-State Dairy Nutrition & Management Conference Proceedings](#)



UW Feed Grain Evaluation System

-  [Technical note: A method to quantify prolamin proteins in corn that are negatively related to starch digestibility in ruminants](#) (Josh Larson and Pat Hoffman - JDS paper)
-  [Corn Biochemistry: Factors related to starch digestibility in ruminants](#) (Pat Hoffman and Randy Shaver - Conference paper)
-  [Corn Biochemistry: Factors related to starch digestibility in ruminants](#) (Pat Hoffman and Randy Shaver - slide set)
-  [A guide to understanding prolamins](#) (Pat Hoffman and Randy Shaver)
-  [UW Feed Grain Evaluation System](#) (Pat Hoffman and Randy Shaver)
-  [Relative Grain Quality - RGQ](#) (Pat Hoffman and Randy Shaver)



Spreadsheets


-  [MILK2006 Corn Silage: Calculates TDN-1x, NEL-3x, Milk per ton, and Milk per acre](#)

Publications

-  [Benchmarking forage nutrient composition and digestibility](#)
-  [Feeding Programs in High Producing Dairy Herds](#)


Presentations

-  [Benchmarking forage nutrient composition and digestibility](#)
-  [Diets fed in selected WI high-producing dairy herds](#)




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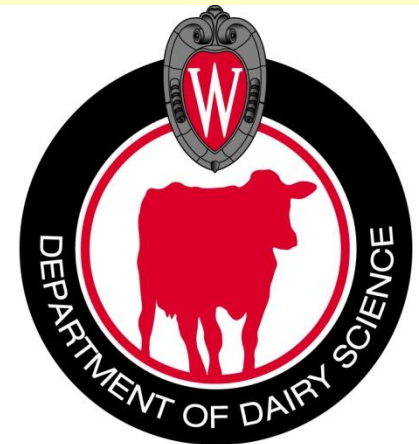
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