FeedGrainV2.0

Feed Grain Evaluation for Lactating Dairy Cows

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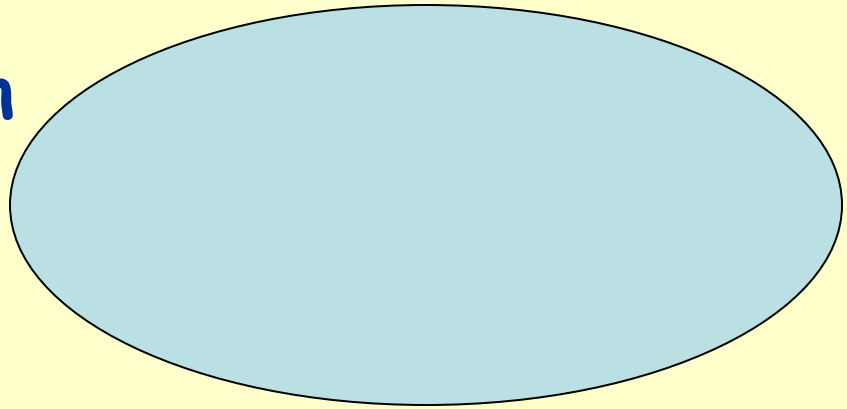
Starch Digestion in Ruminants

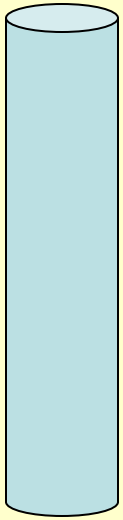
Rumen



Microbial Fermentation

- VFA
  - Propionate
  - Glucose via liver
- Microbial Protein

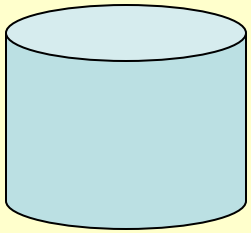
Small Intestine



Digestion (Enzymatic)

- Glucose

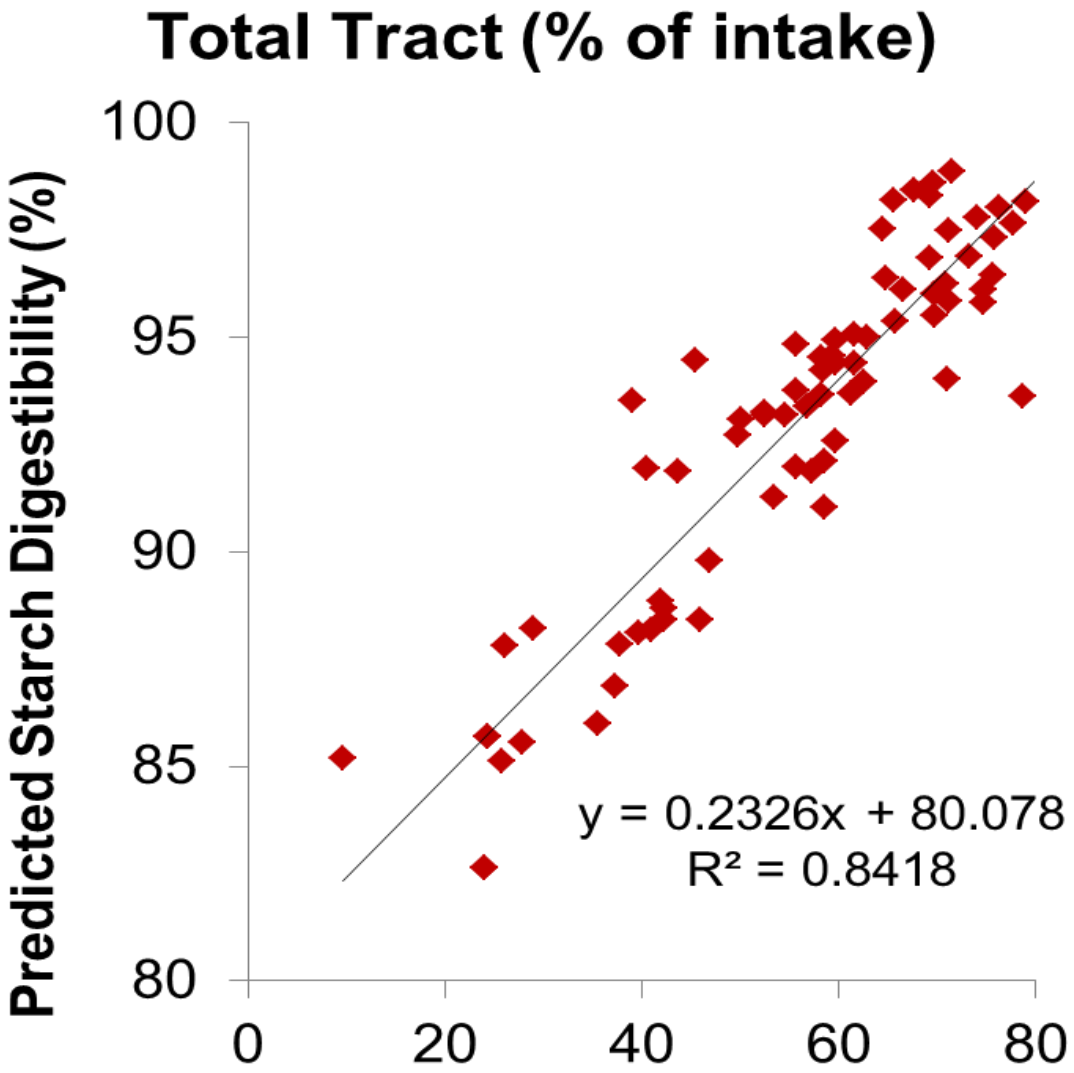
Hind Gut



Microbial Fermentation

- VFA

Starch Digestion



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

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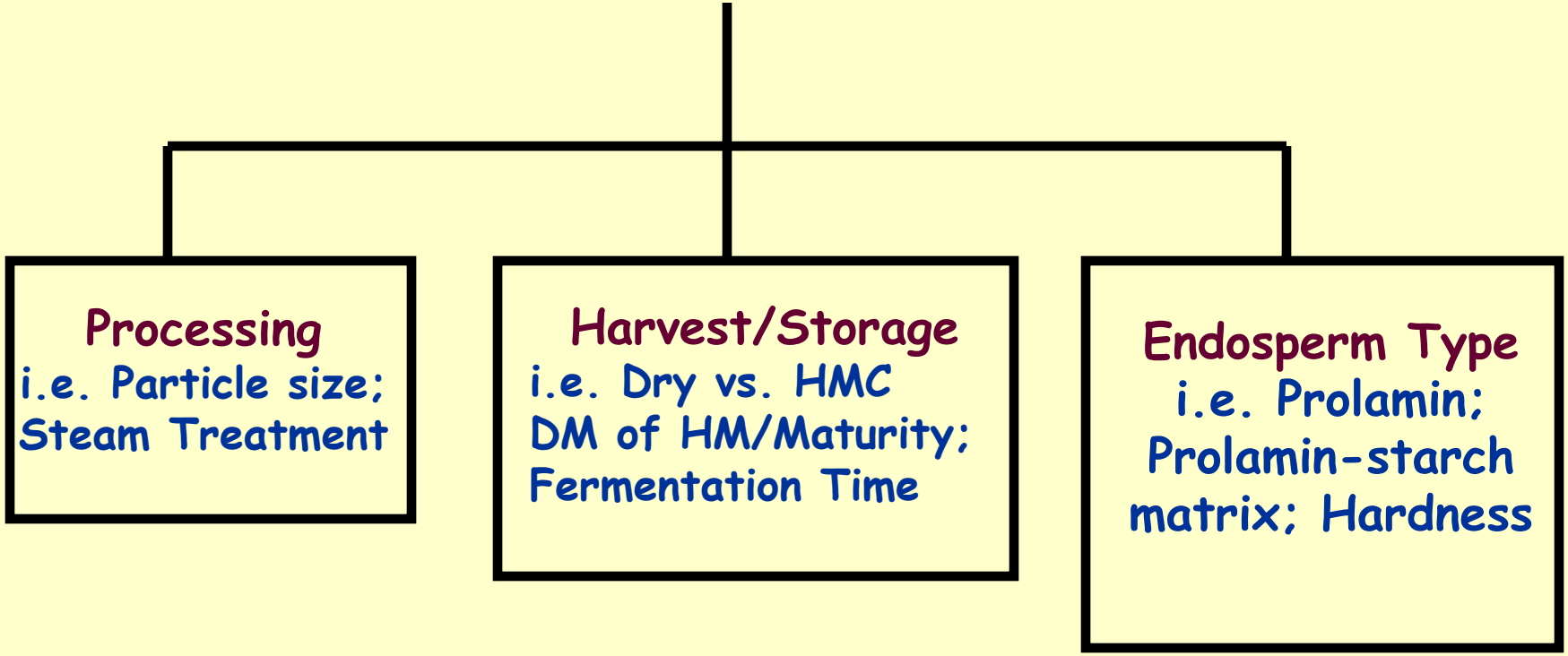
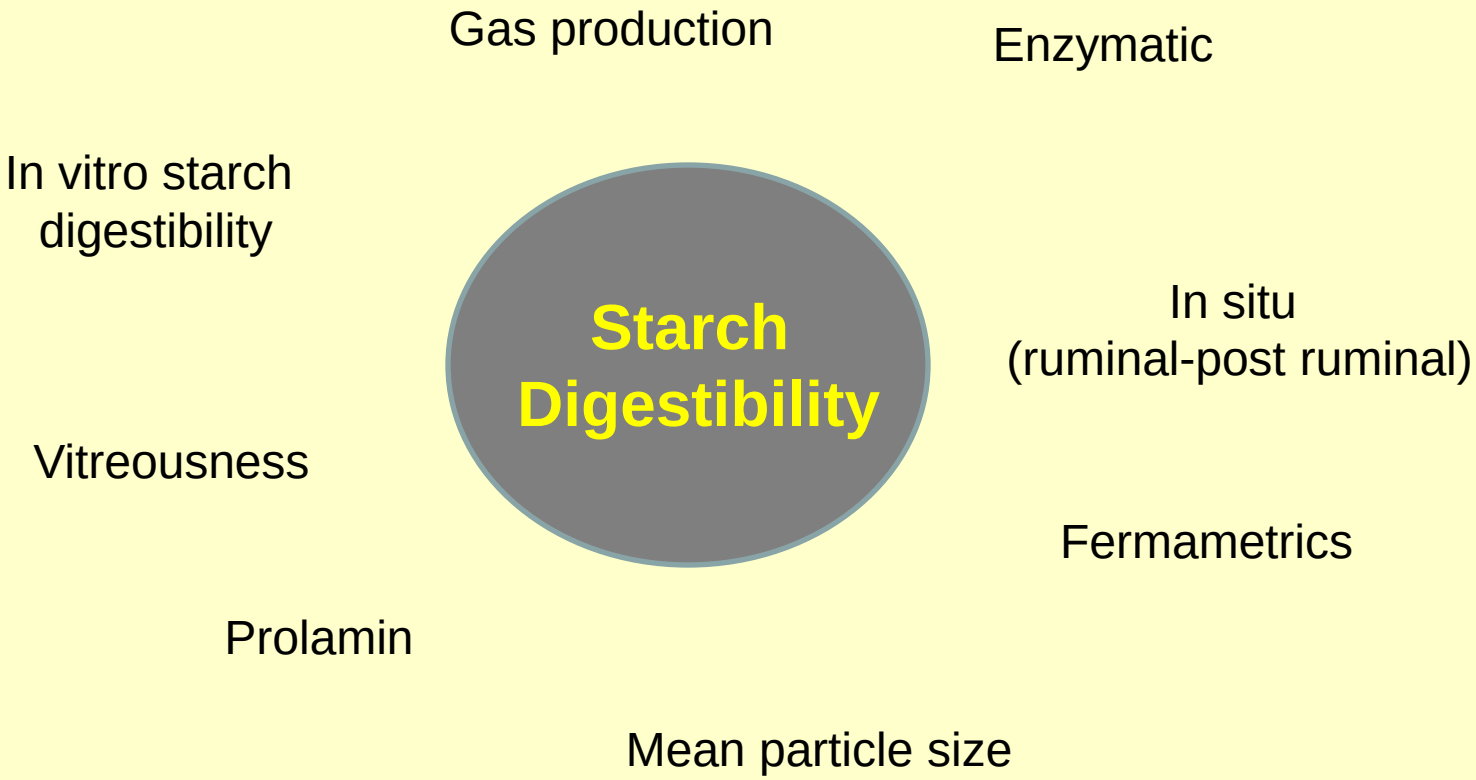
Primary Factors: Influencing Starch Digestibility in Feed Grains



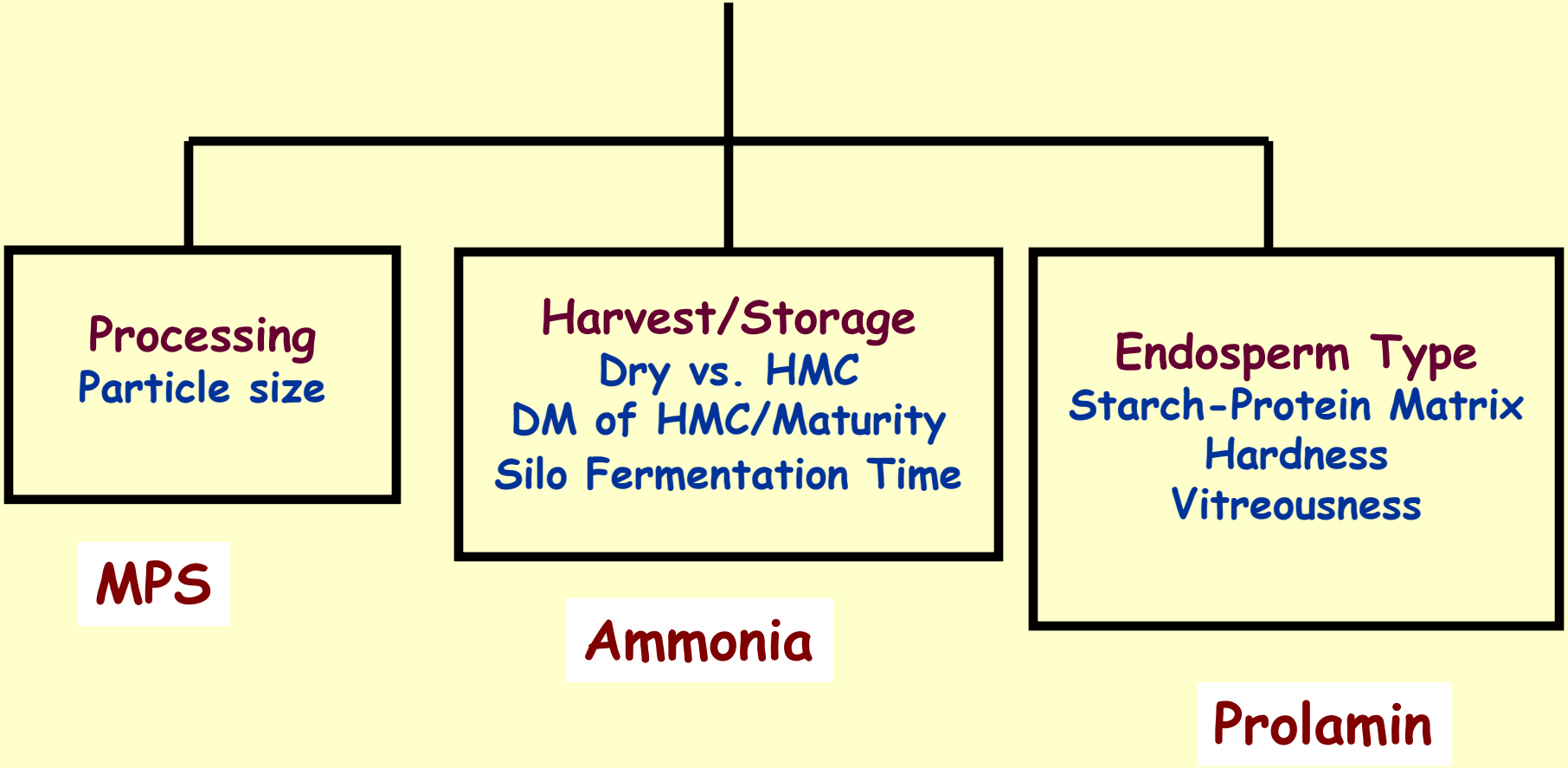
Measuring Starch Digestibility in Feed Grains is Very Confusing!



Measurement approaches have not been integrated

FeedGrainV2.0 Integrates

Primary Factors:
Influencing Starch Digestibility in Feed Grains

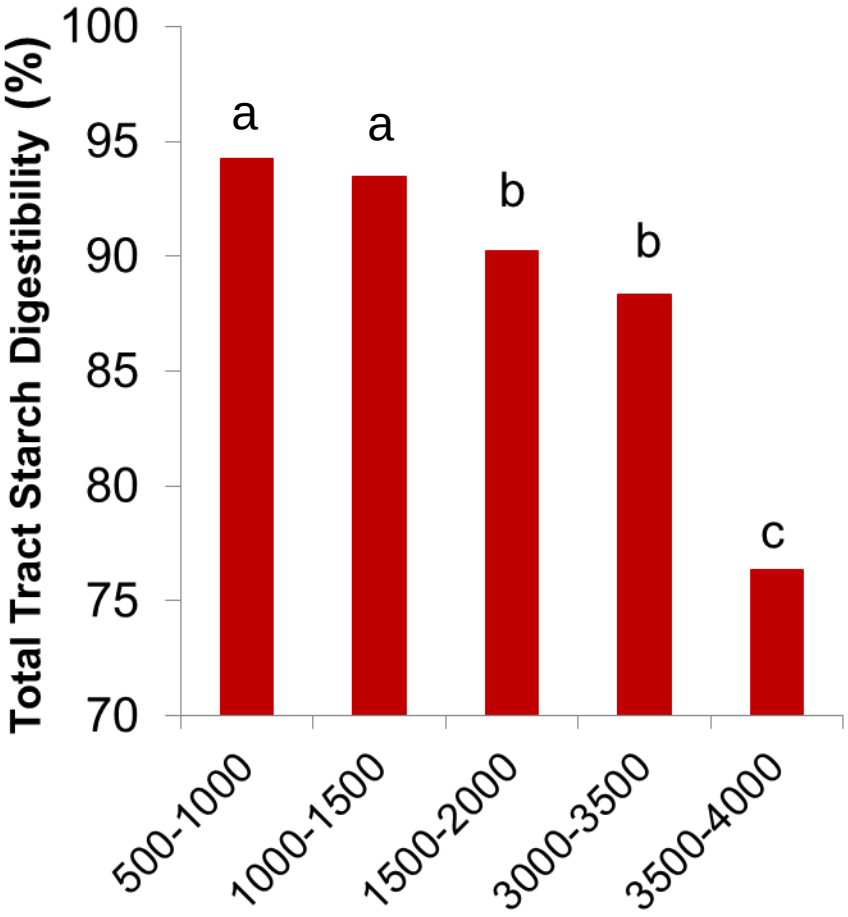


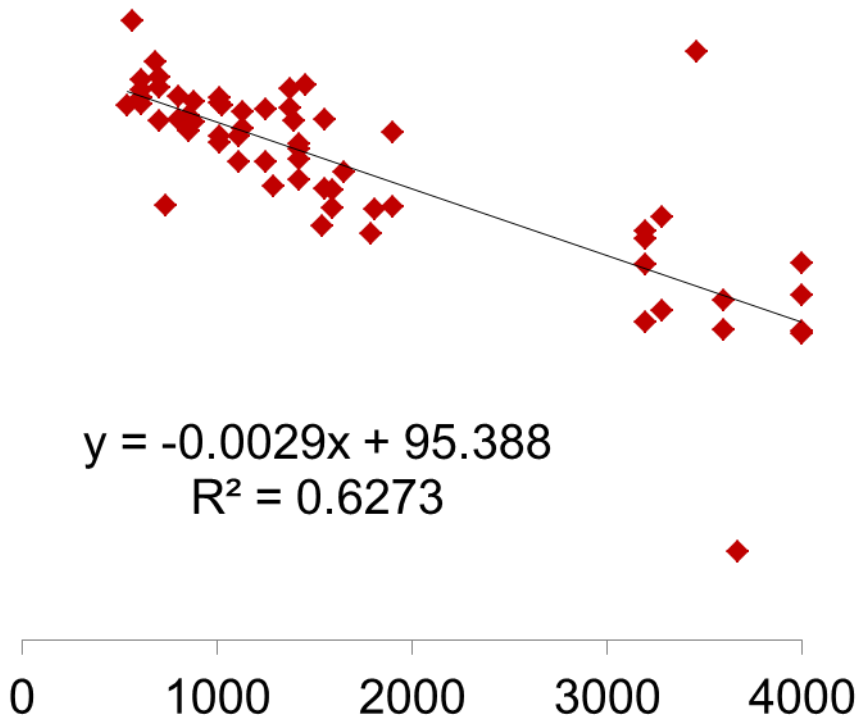
FeedGrainV2.0 :
Step 1 : Determine Mean Particle Size

- 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





Geometric Mean Particle Size (µm)

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

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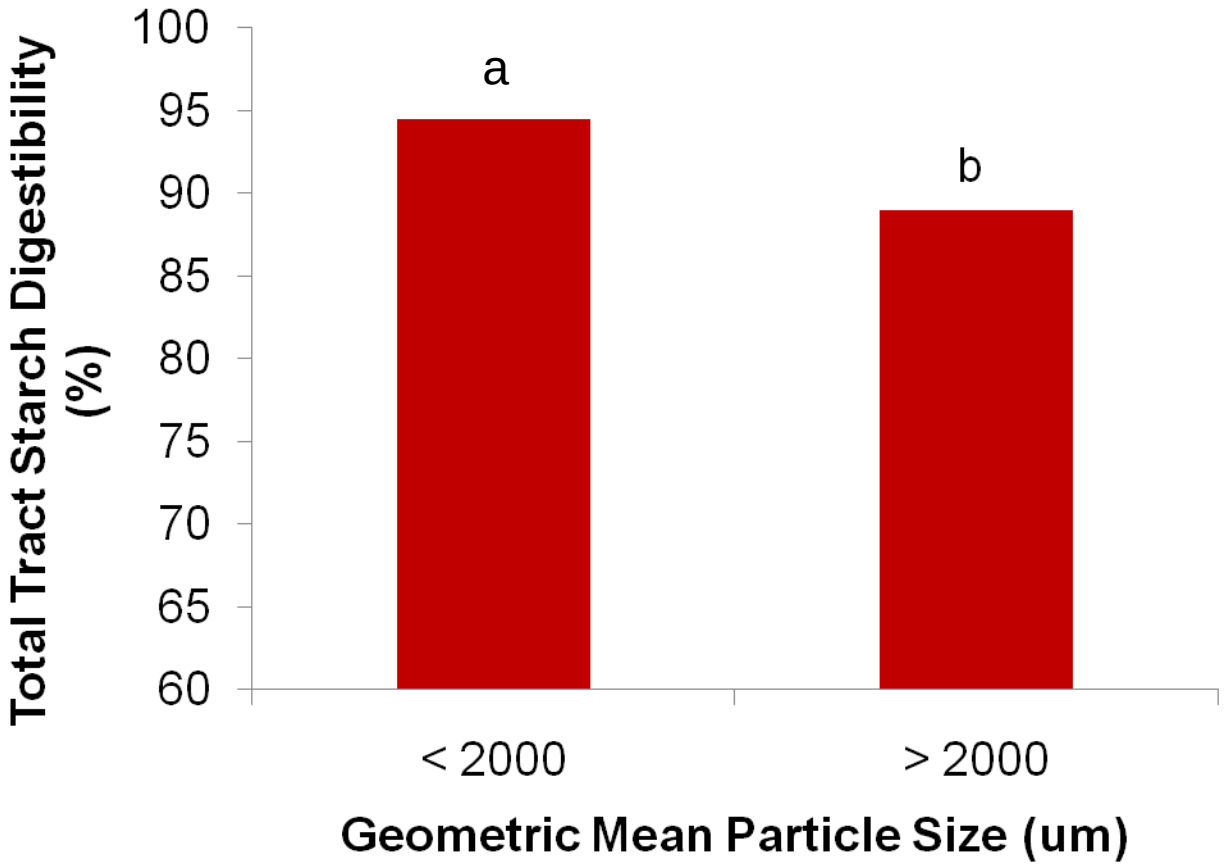
Starch Digestibility vs Corn Grain MPS - HMC



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

FeedGrainV2.0 :
Step 2 : Classify Corns as Fermented or Unfermented

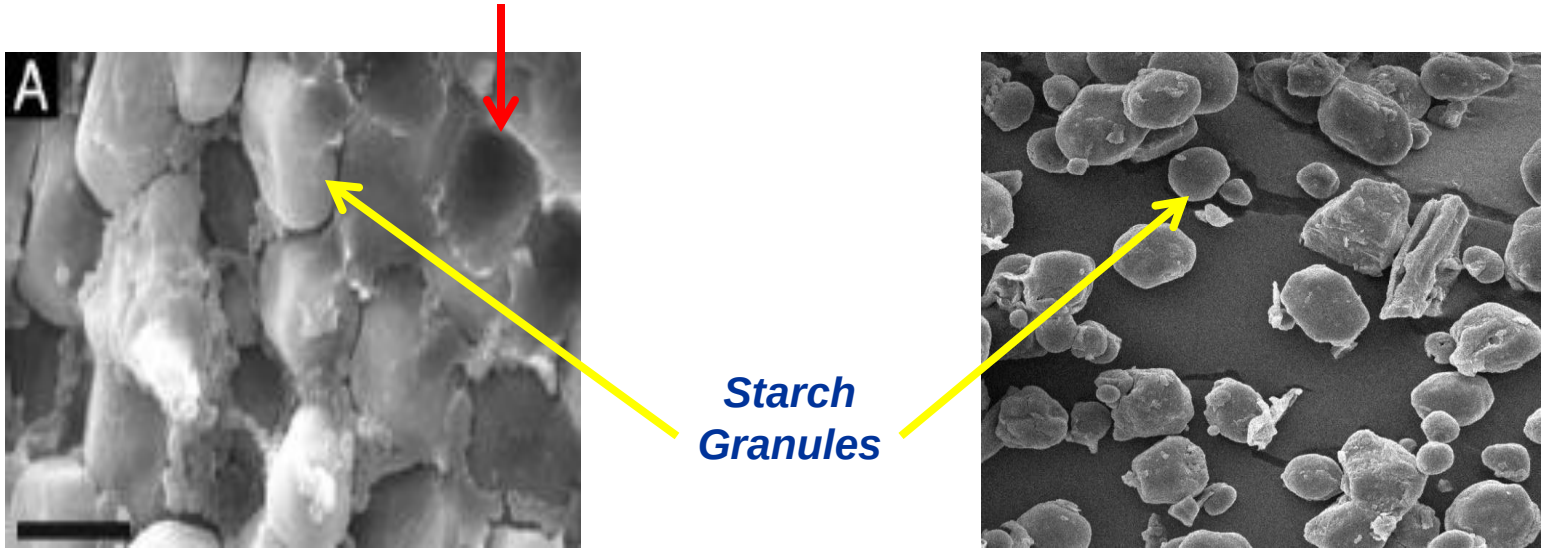
- Dry vs high moisture is abandon
- Ammonia (NH_3-N) is used
- Dry corn has no NH_3-N
- Unfermented corn has no NH_3-N
- Fermented corn has 1.0- 7.0 % of total N as NH_3-N
- NH_3-N is a marker of intensity and
- duration of fermentation
- Eliminates arbitrary classification of HM corn (i.e. 22 % moisture?)

Advantage: NH_3-N is accurately and economically predictable by NIRS!

FeedGrainV2.0 :
Step 3 : Measure grain particle bonding strength or weakness

Unfermented = Prolamin proteins

Fermented = Ammonia (NH_3-N)



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

In fermented (HM) corns > NH_3-N = < bonding of starch.

Same hybrid harvested as Snaplage or HMC

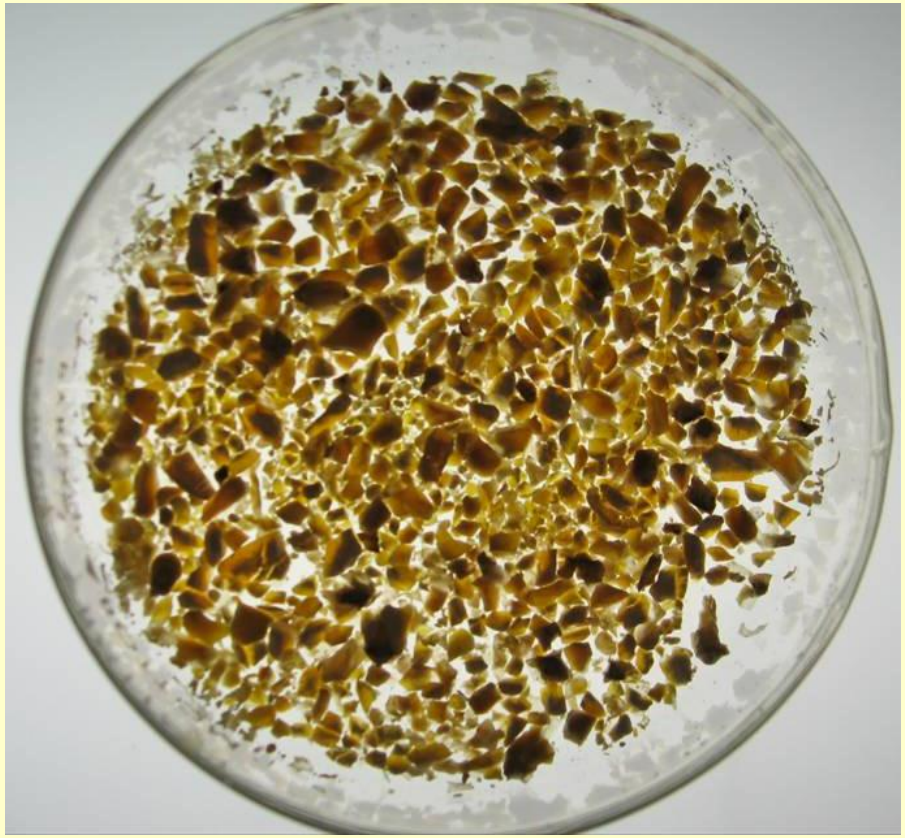
Snaplage

Ammonia = 6.0% of CP
Kernel MPS = 1456 μ

Grain Particles Completely Opaque

HMC

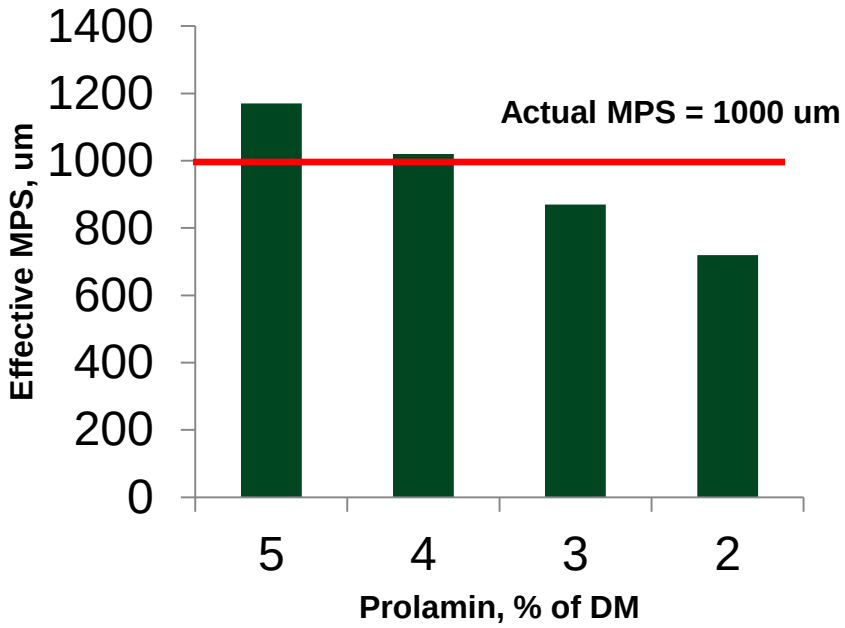
Ammonia = 1.8% of CP
MPS = 1335 μ



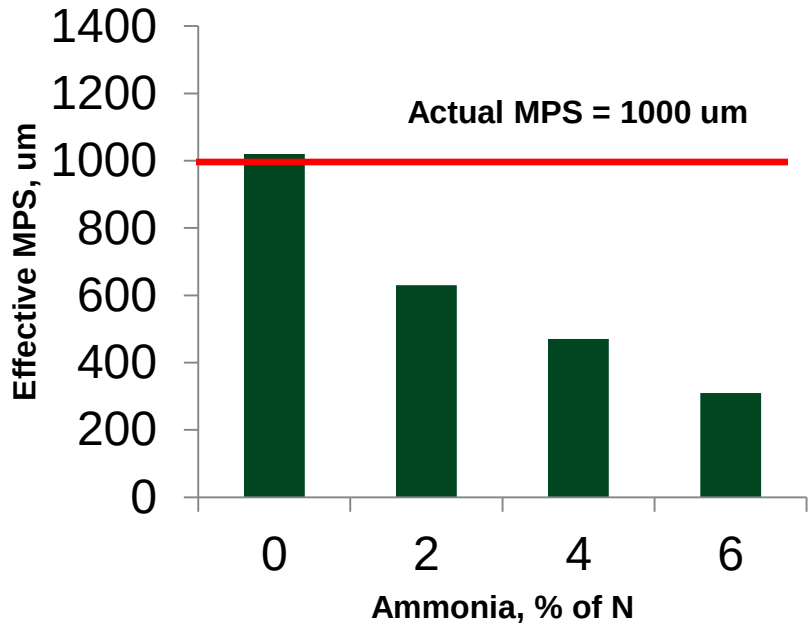
Grain Particles Still Translucent

FeedGrainV2.0 :
Step 4 : Calculate Effective Mean Particle Size

Unfermented = Prolamin proteins



Fermented = Ammonia (NH_3-N)

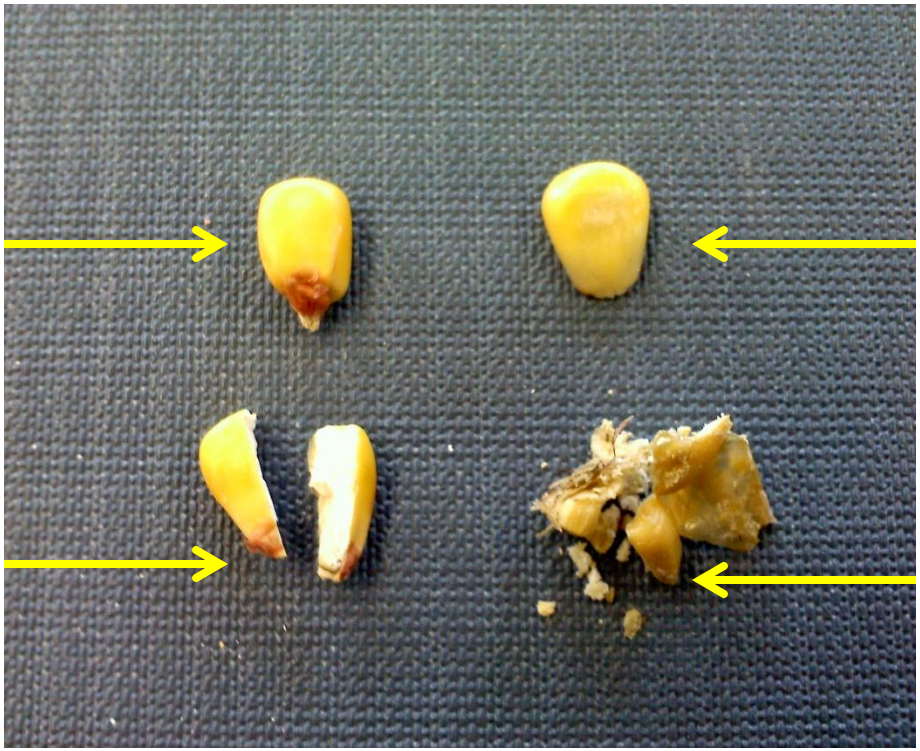


What is Effective Mean Particle Size (eMPS) ?

A visual example

MPS = 4000 um
Dry corn
kernel

4000 um are Effective



MPS = 4000 um
HM corn
kernel
(*prior to ensiling*)

3080 um are Not Effective
(after 1 yr fermentation)

eMPS = 4000 um **eMPS = 920 um**

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 um eMPS = 920 um

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

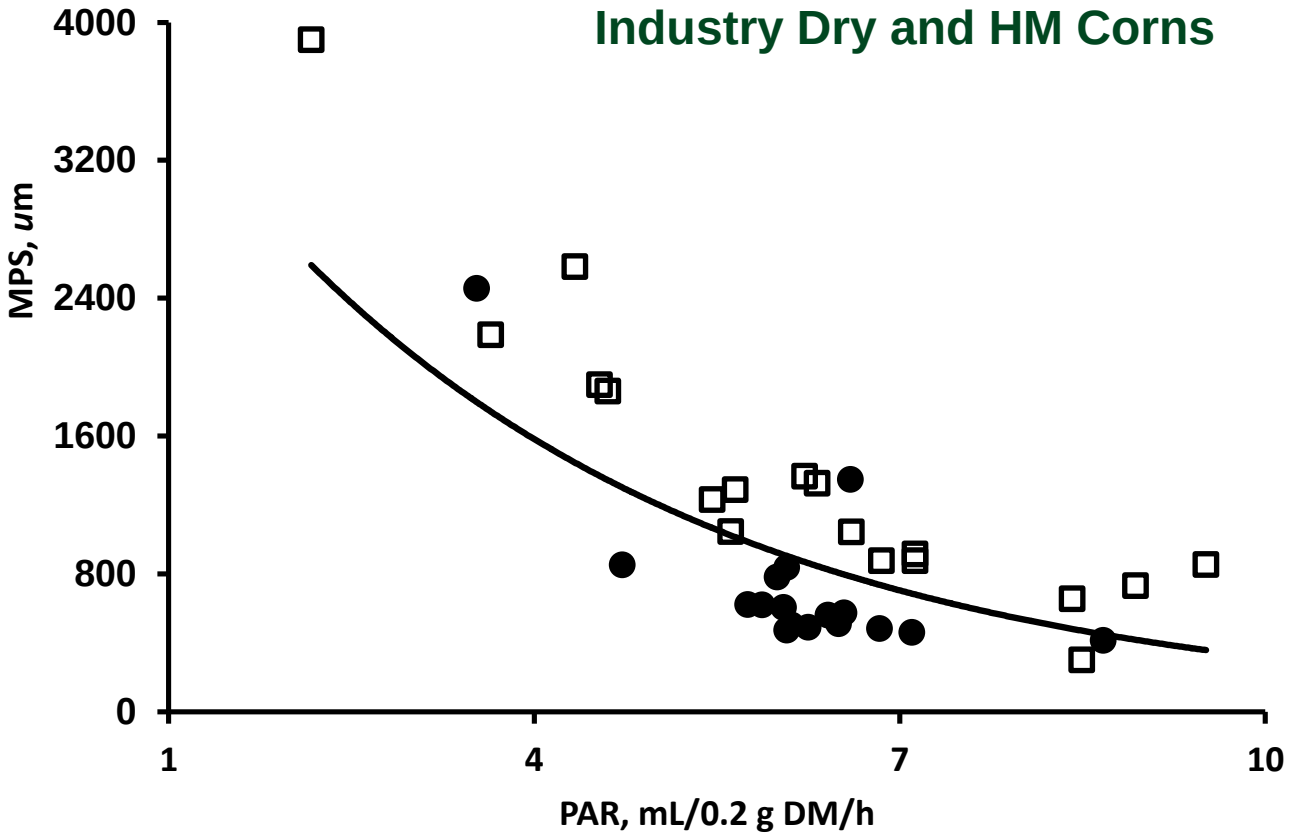
eMPS integrates the primary factor of MPS, plus secondary chemical or nutritional factors that also influence starch digestibility

MPS vs Fermentation Potential

Hoffman et al., 2012

$R^2 = 0.50$

Industry Dry and HM Corns



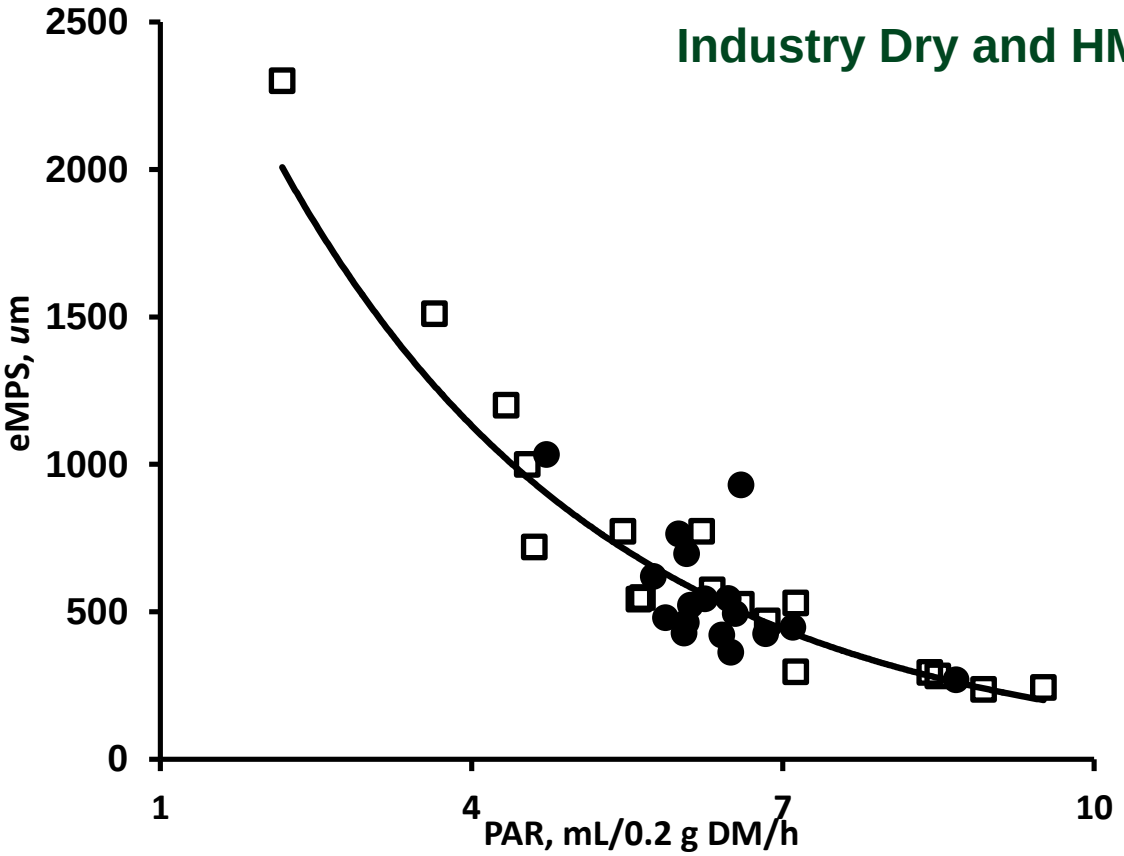
Speed of gas production in rumen fluid

Effective MPS vs Fermentation Potential

Hoffman et al., 2012

$R^2 = 0.84$

Industry Dry and HM Corns



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]Deptartment 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[1]
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
NH_3-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 Size[2]	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	Mcals/lb	0.88	C
Net Energy Maintenance	NE_M	Mcals/lb	0.94	C
Net Energy Gain	NE_G	Mcals/lb	0.64	C
Metabolizable Energy, 3X	ME	Mcals/lb	1.37	C
Relative Grain Quality	RGQ		150	C

11/2011 Marshfield Lab sample – Fresh 2011 Harvest

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1.00	Ground Dry Corn		High Moisture Shelled Corn	x
	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 [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

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For use with the feed grains listed below.

1.00	Ground Dry Corn		High Moisture Shelled Corn	x
	High Moisture Ear Corn		Snaplage	
	Whole Corn (Unprocessed)			

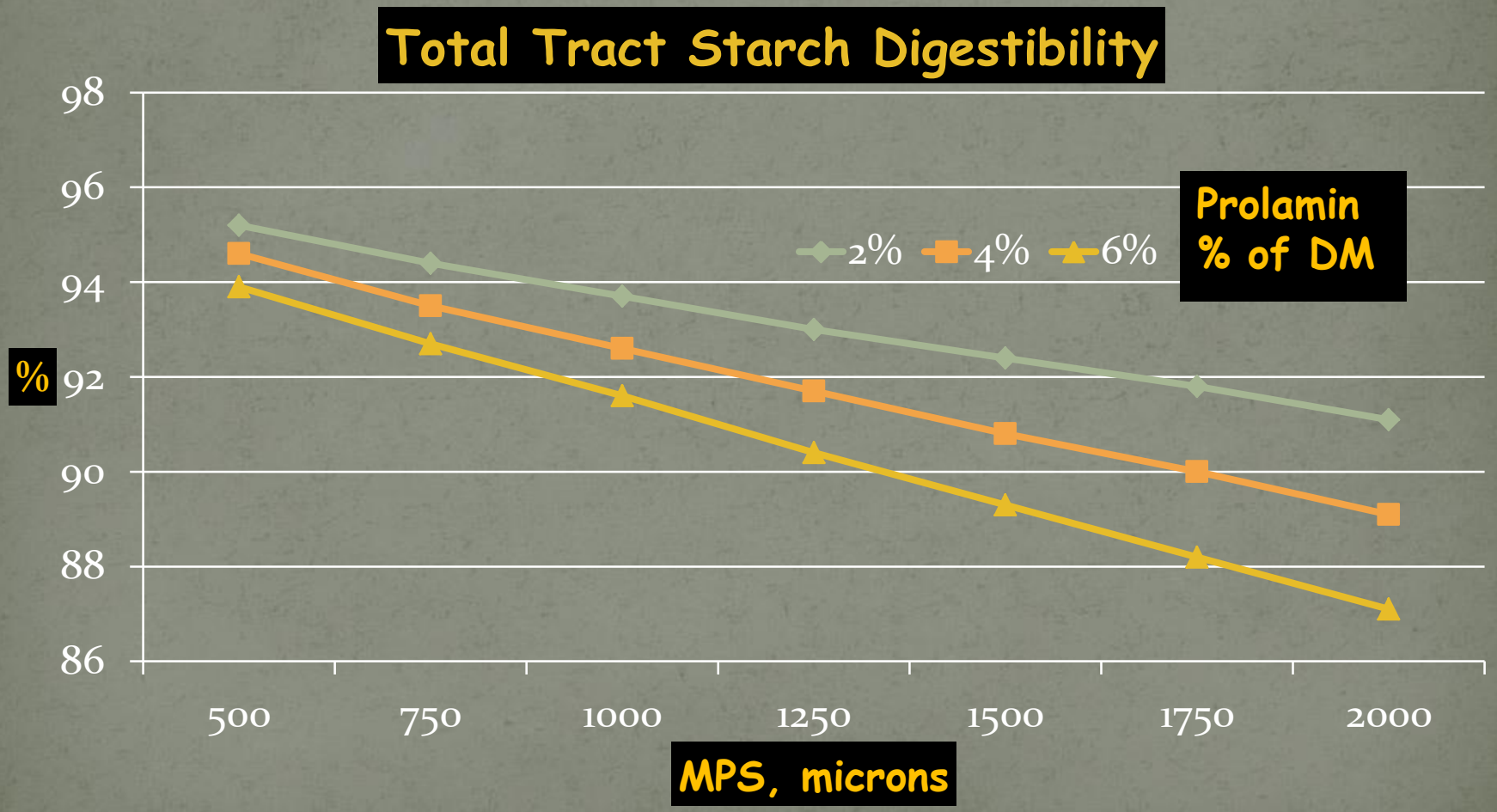
Input categories are shown in red. Output values are shown blue

1.00

Item	Abbreviation	Unit	Result	Method [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



Dry Corn Simulation

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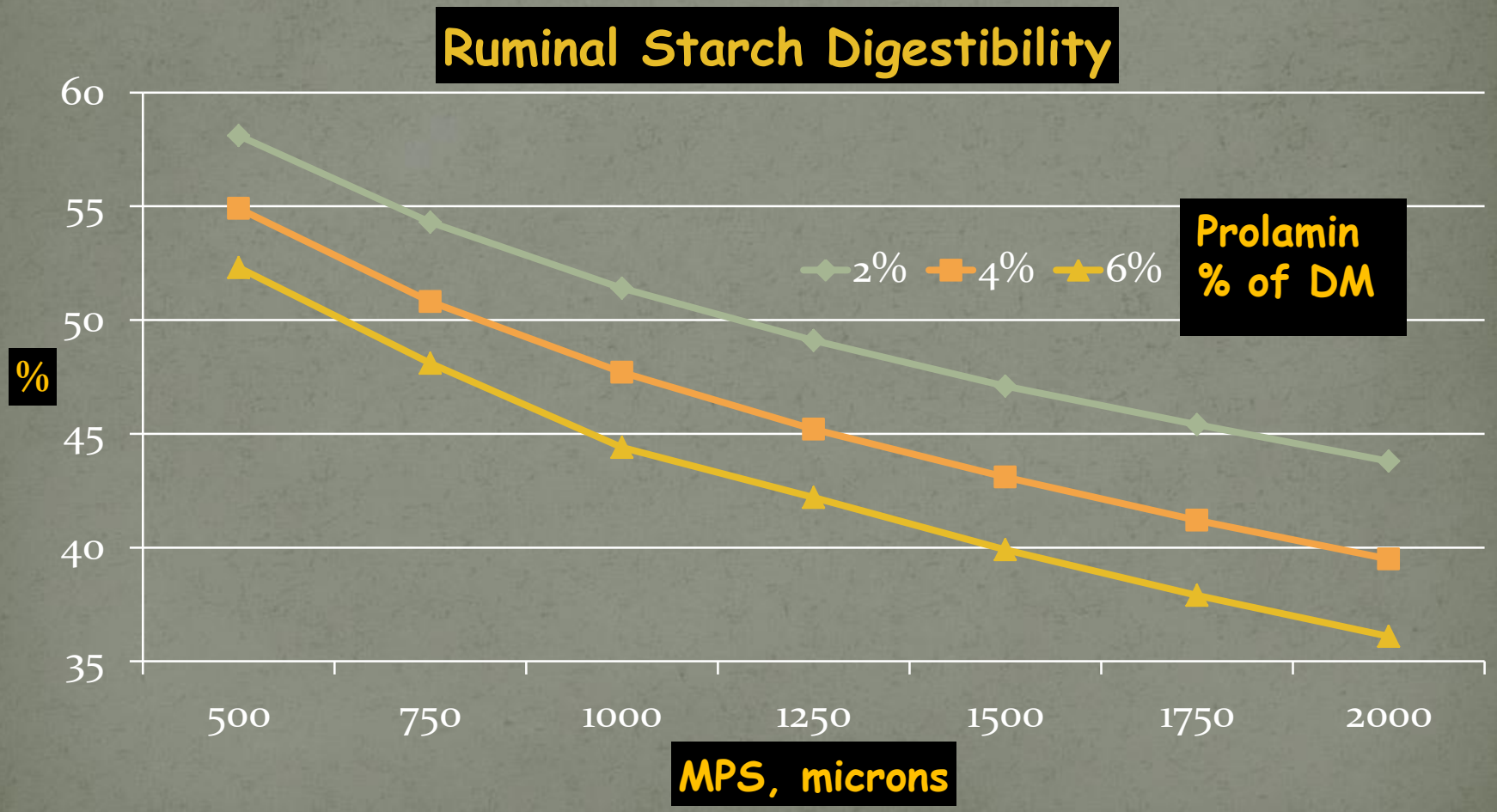

Dry Corn Simulation

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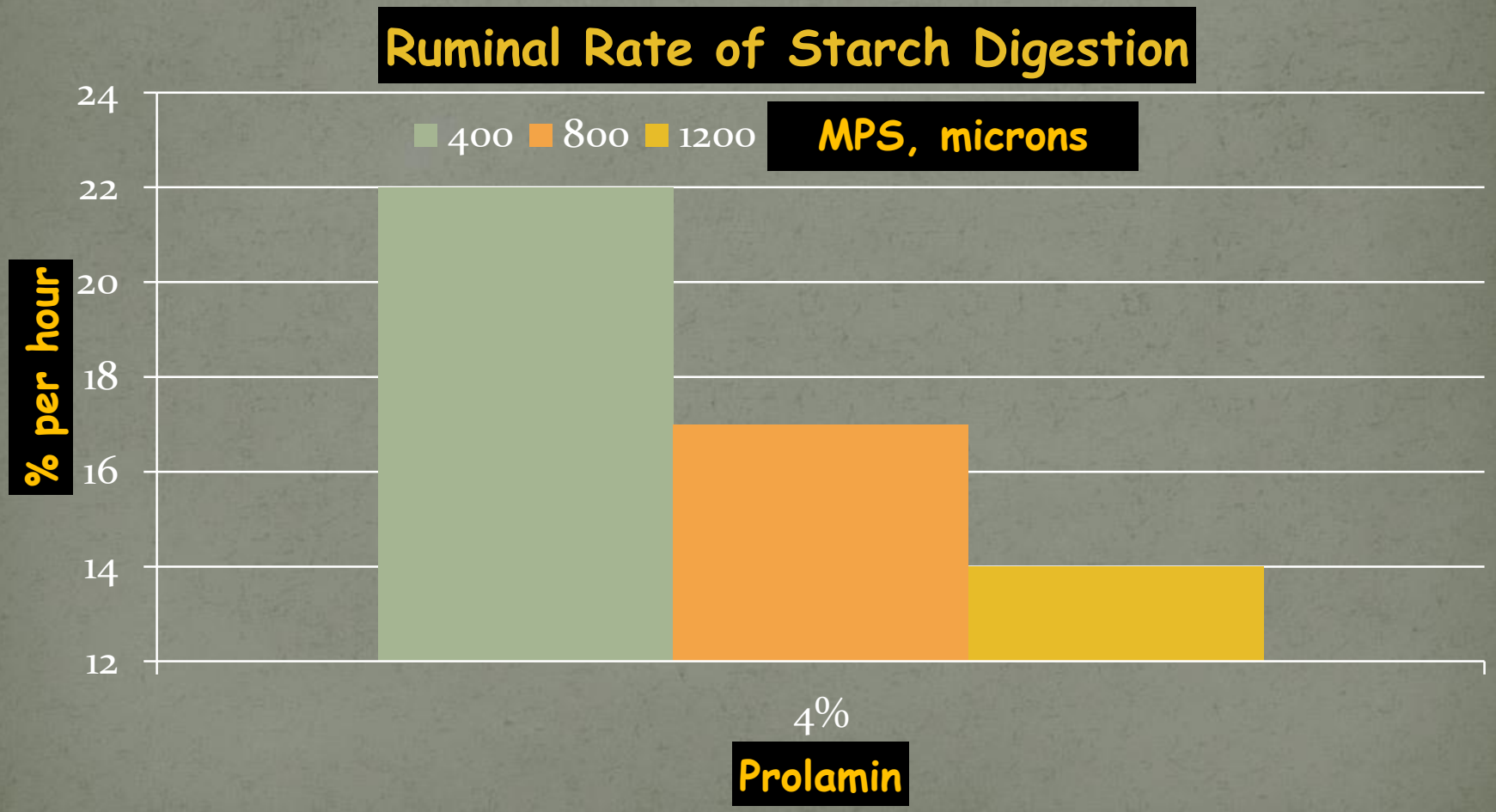
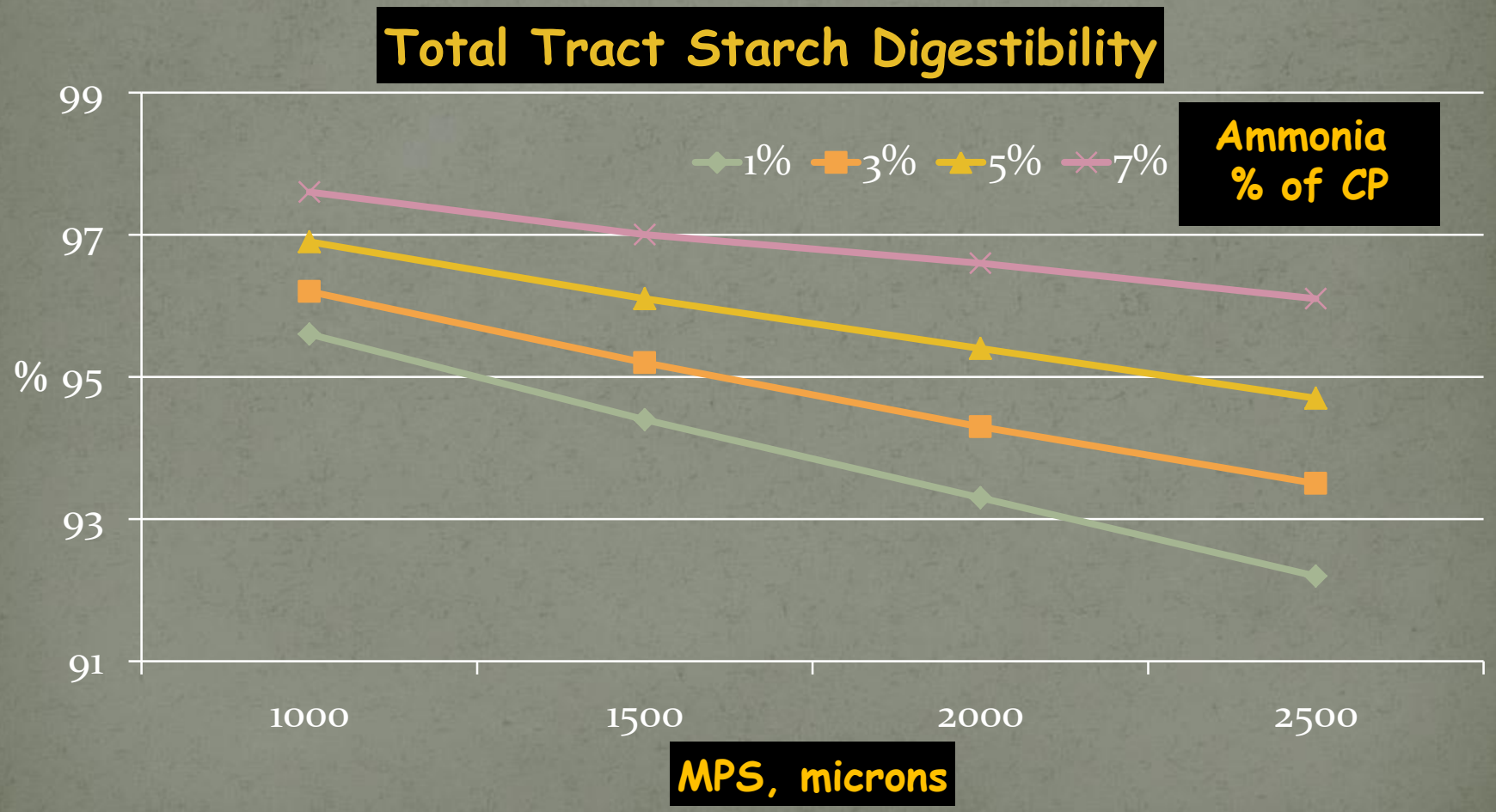


HM Corn Simulation

Feed Grainv2.0 Evaluation System



HM Corn Simulation

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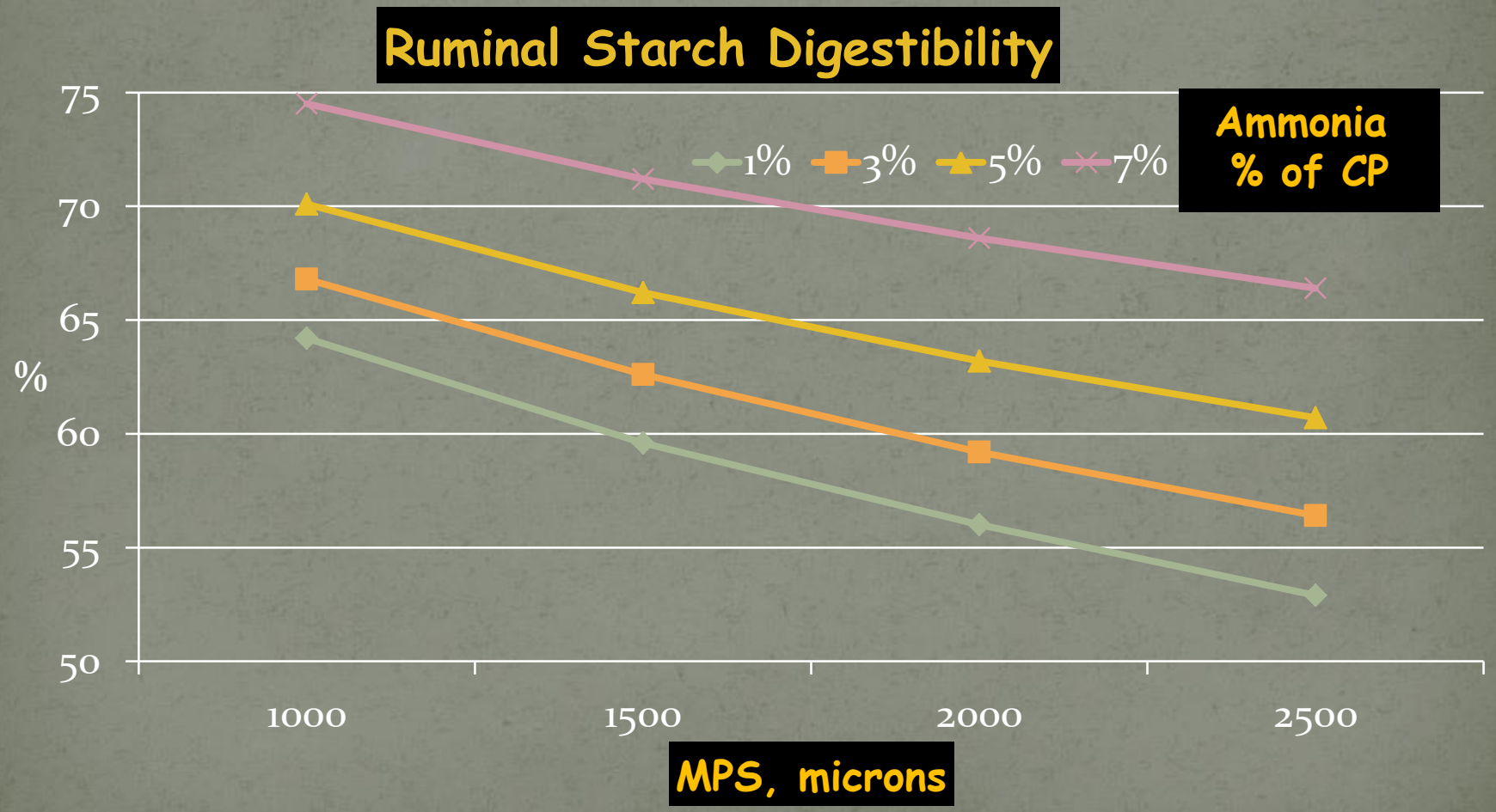

HM Corn Simulation

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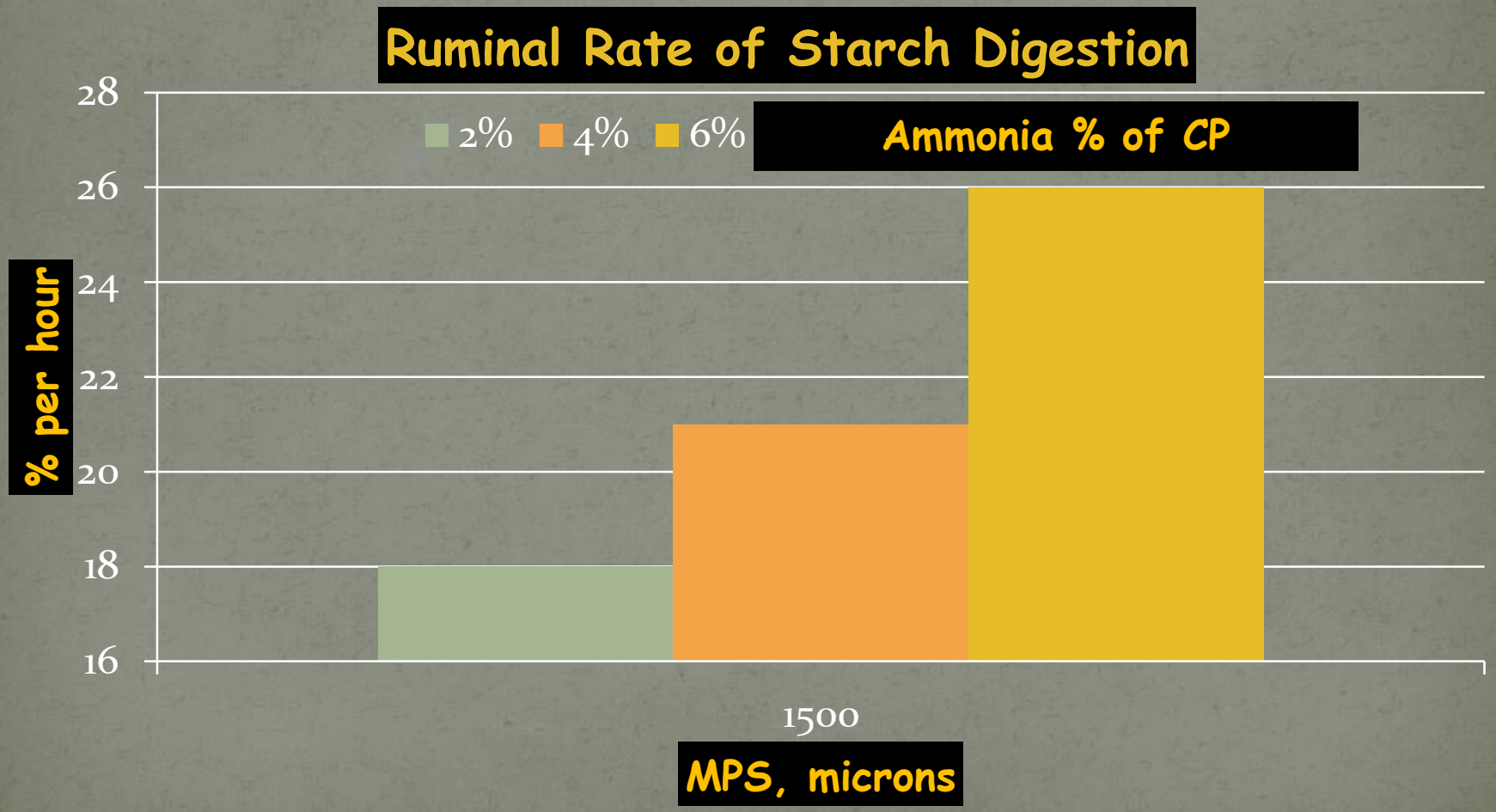
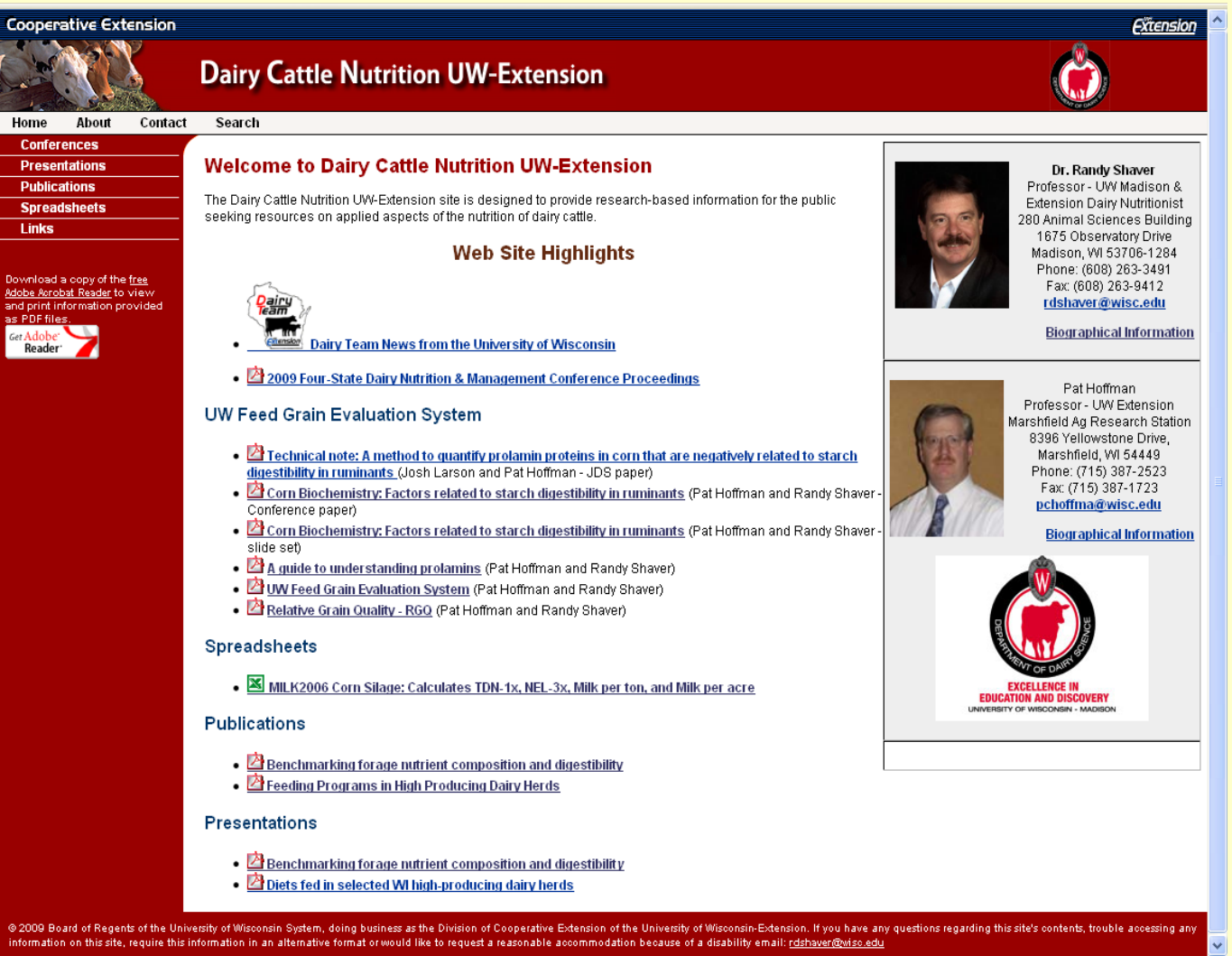


Visit UW Extension Dairy Cattle Nutrition Website

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



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