Silage Management 101: The Basics

Limin Kung, Jr.
Dairy Nutrition & Silage Fermentation Lab
Dept. of Animal & Food Science
Cooperative Extension Service

Harvest Quality and Silo Management Have Profound Effects on Silage Quality at Feeding

Poor quality forage ->
Poor Silage Management ->
= Poor quality silage

Poor quality forage ->
Excellent Silage Management ->
= Poor quality silage

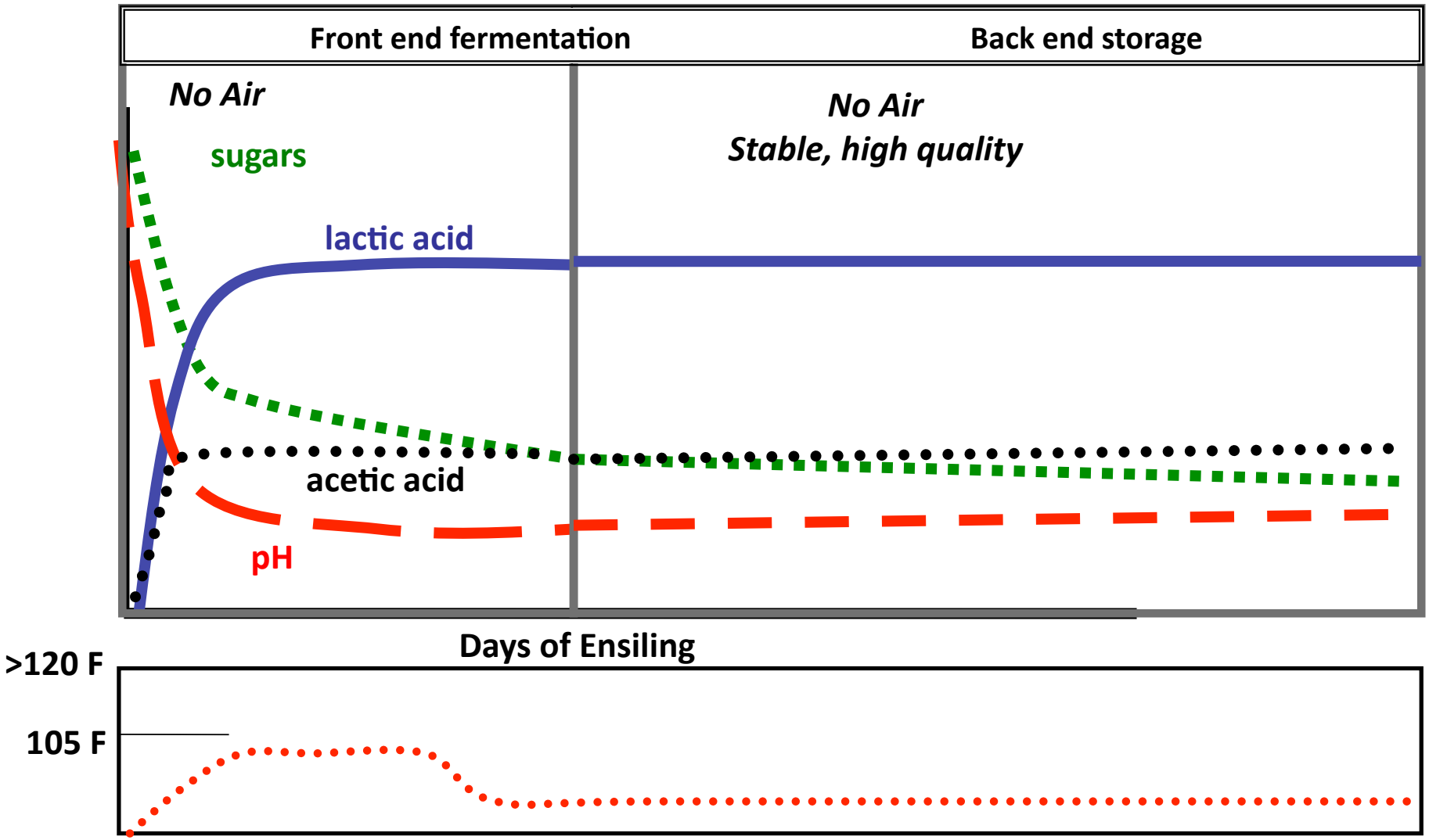
High quality forage ->
Poor Silage Management ->
= Poor quality silage

High quality forage ->
Excellent Silage Management ->
= High quality silage

Making Great Silage

- Start with high quality forage
- Harvest at correct moisture/DM
- Pack quickly and tightly to eliminate air and start fermentation
- Quick pH drop to “pickle” the system
- Keep air out during storage and feed out

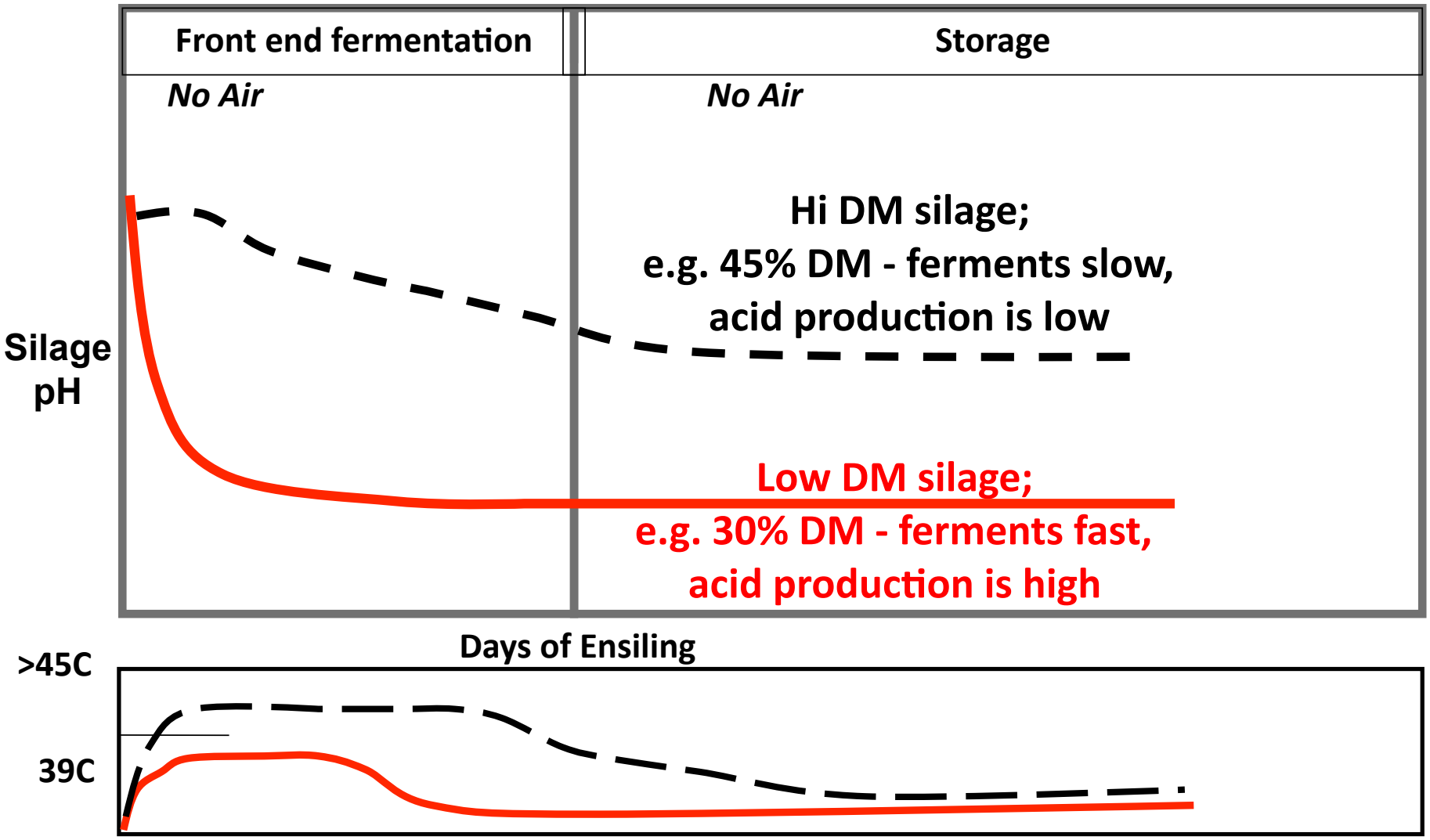
Ideal Fermentation and Good Storage



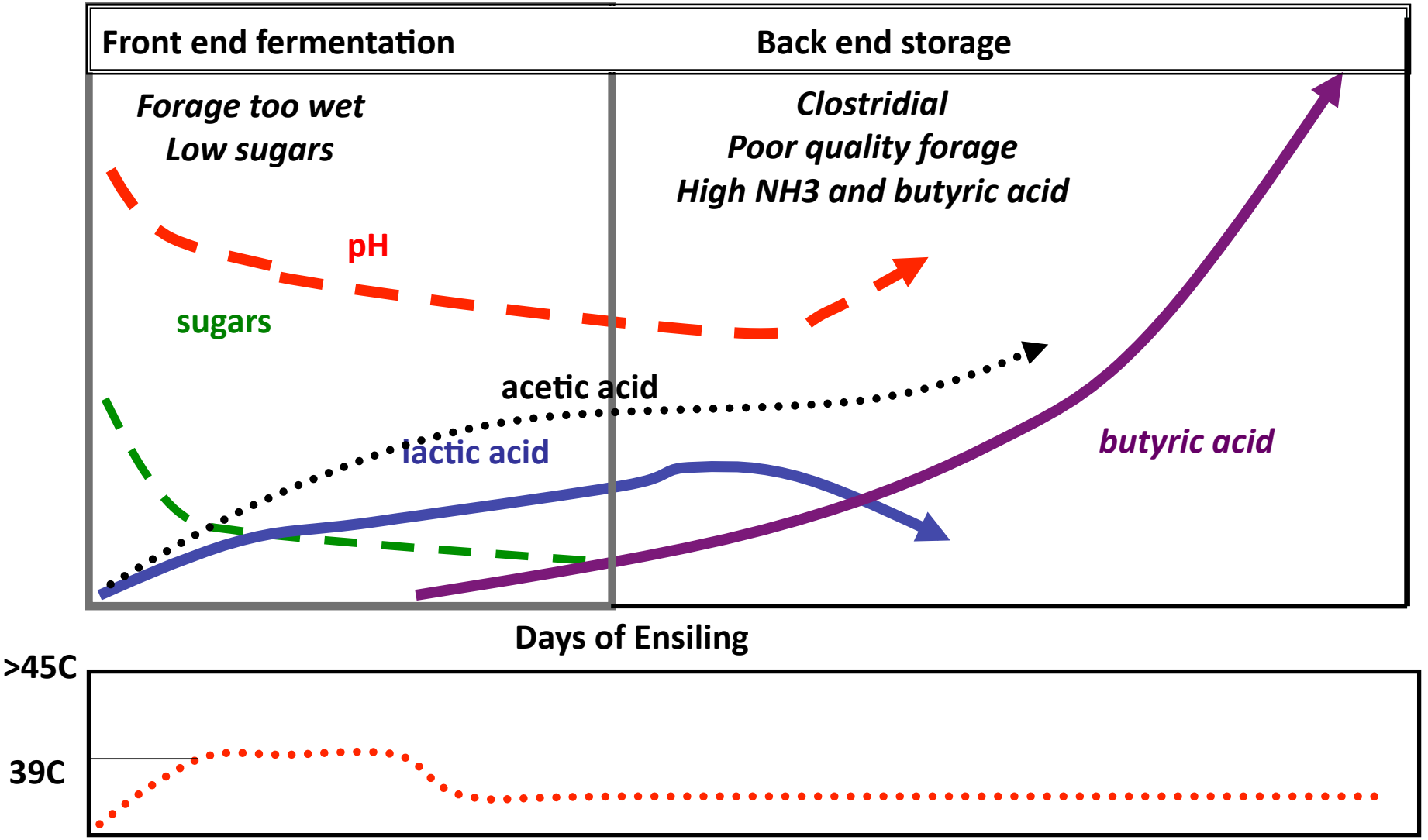
Moisture/DM Affects Silage Fermentation

- Wet silages: fast, extensive fermentation
- Dry silages: slow, restricted fermentation
- Microbes need moisture to grow
- < 50-55% moisture (>45-50% DM), insufficient water limits the growth of microbes in silage

Effect of DM (Moisture) on Silage Fermentation - this effect is more pronounced in alfalfa silage



Extremely Wet Alfalfa Silage May Lead to a Clostridial Fermentation



Consequences of Harvesting CS Too Early (Wet) or Too Late (Mature)

Too Early

(<28-30% DM)

Low [starch]

Low [energy]

Excess [acid]

High 'wild' acetic

Run off

35 ± 2%

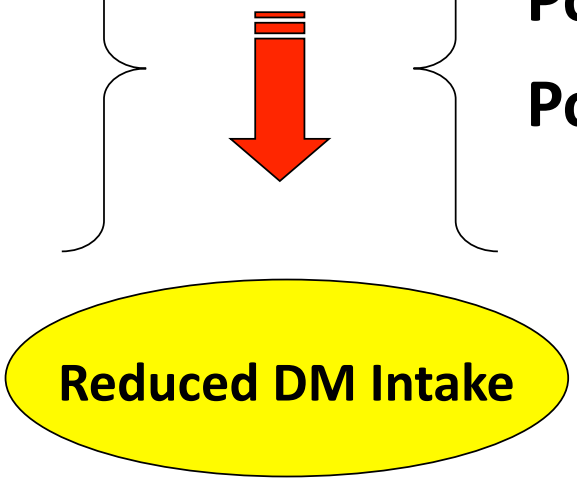
Too Late

(>37-39% DM)

Low starch digestion

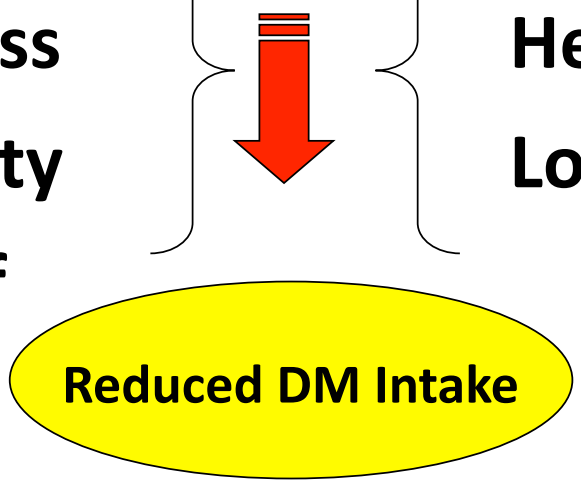
Poor packing

Poor aerobic stability



Effects of Moisture on Alfalfa Silage

Too Wet	35 to 45%	Too Dry
Clostridia		Poor stability
protein degradation		Molding
DM/energy loss		Heat damage CP
low digestibility		Low digestibility
Nutrient run off		



Set Chop Length at Harvest!!

Item	C. Silage*	Processed
Top	3-8%	~15%
Middle	45-65	
Lower	20-30	
Pan	<5	

*2002, Heinrichs. PSU

Chop Length Will Differ Based on Your Conditions - some examples:

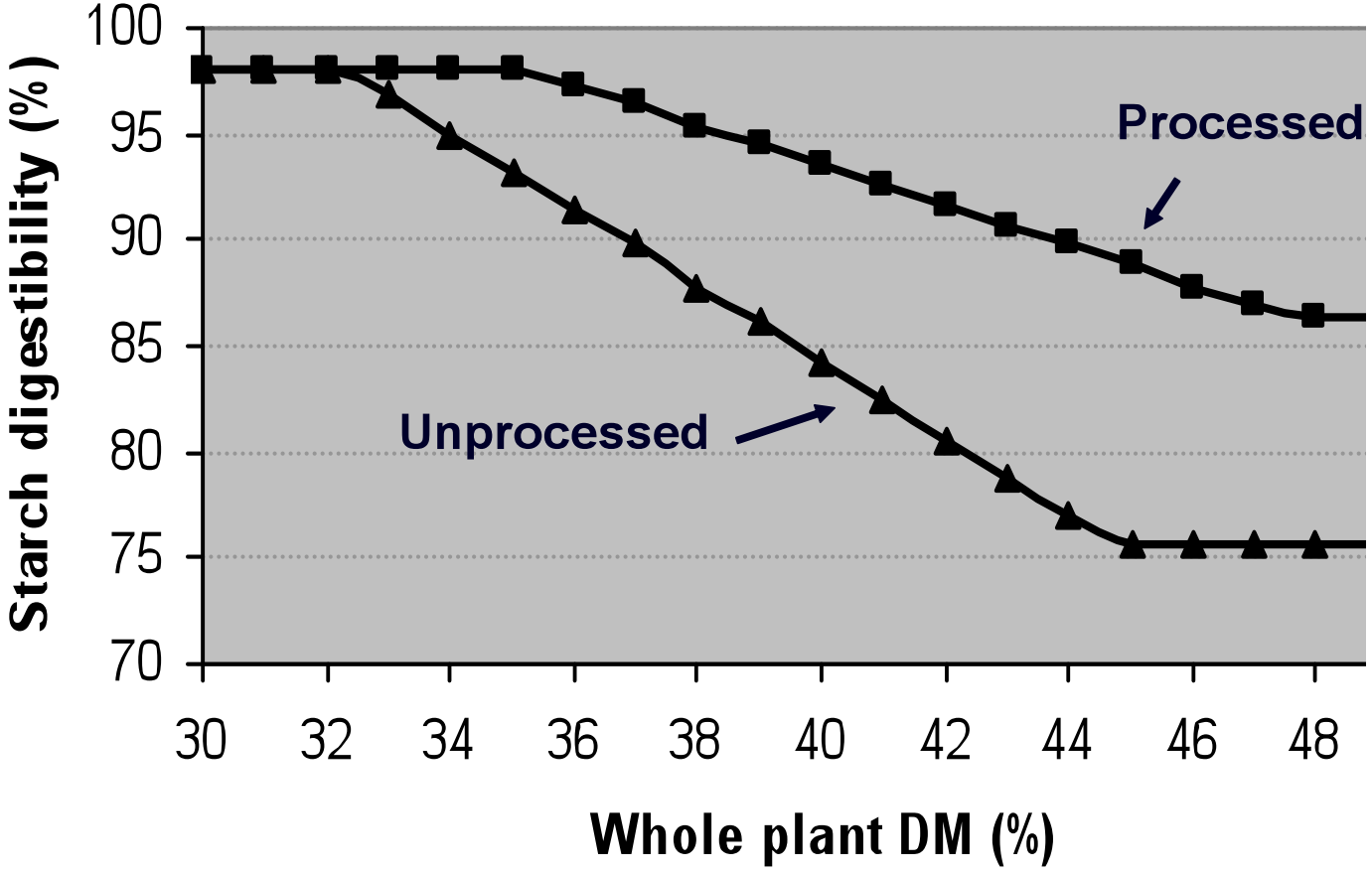
- Still feed long hay -> silage may be chopped shorter
- Feed no long hay, heavy corn silage -> chop to recommendations
- Corn silage very dry –> chop shorter to achieve a tighter pack

Corn Silage Should be Processed to Improve Starch Digestion

- Processing cracks the kernel open to expose starch -> improves digestion
- Processing reduces TMR sorting
- Processing improves silage packing

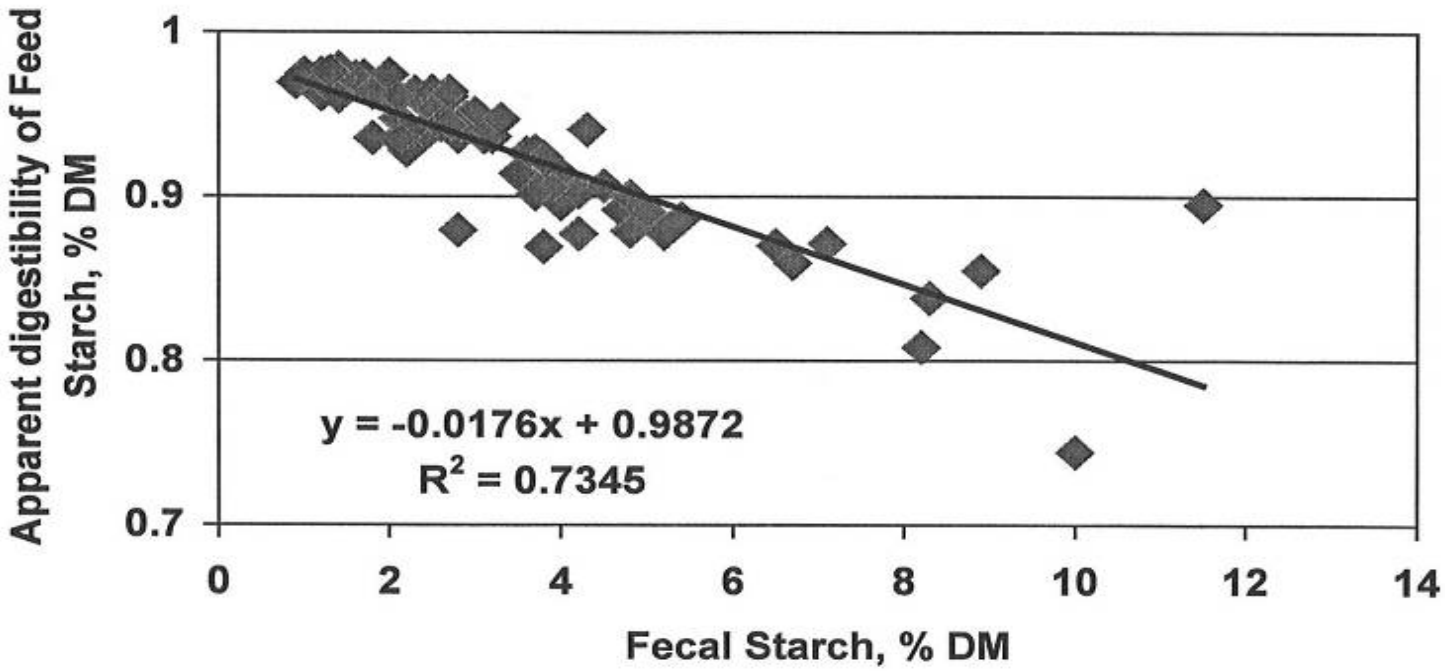
Kung, 2004

Starch Digestion as Affected by Corn Silage Maturity



Shaver, 2008

Fecal starch and digestibility

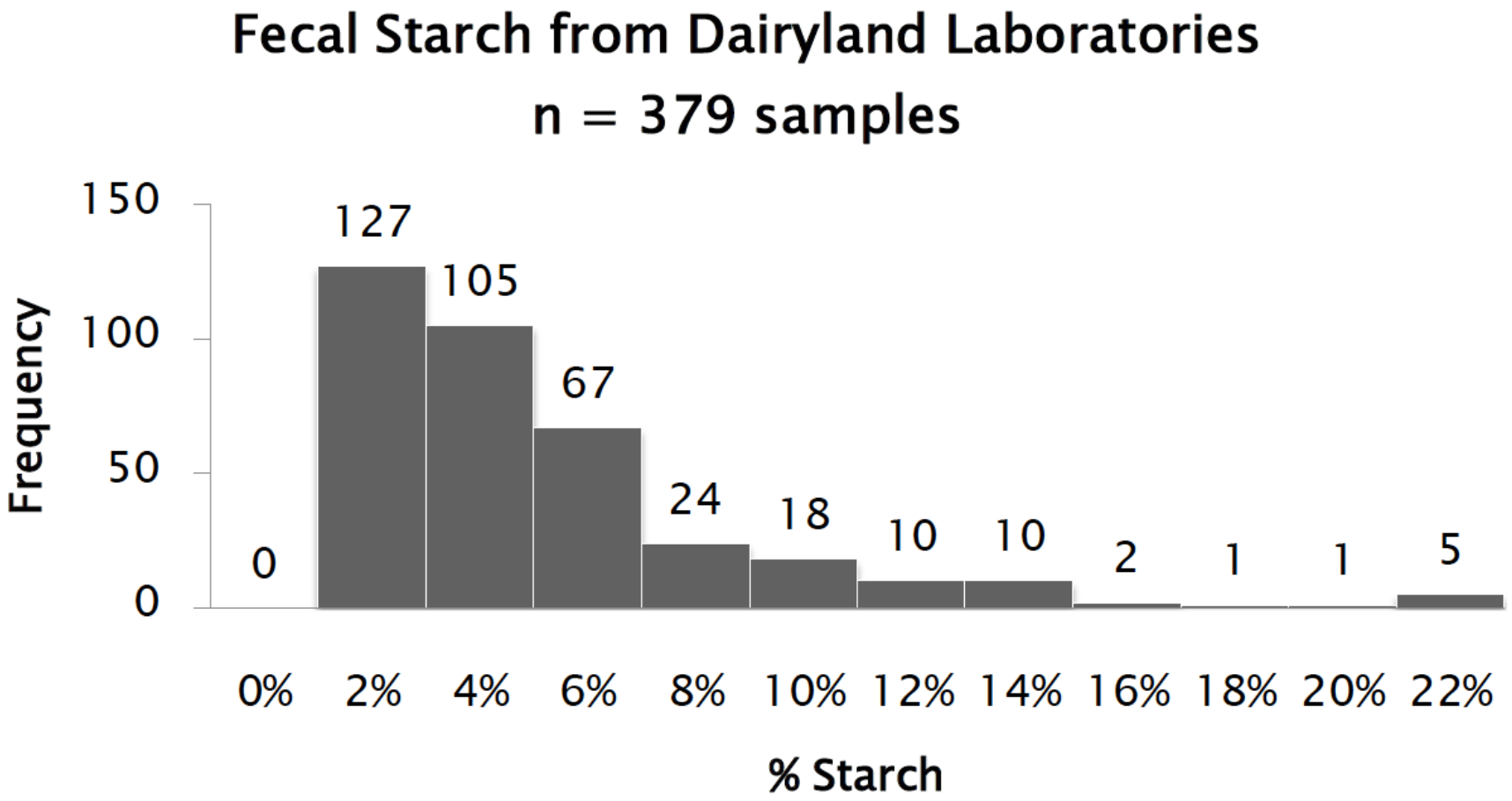


- 4.5% fecal starch ~ 90% starch digestibility
- 1%-unit decrease in fecal starch ~ 1 pound more milk
- Range in starch: 2.3 – 22.4% (Ferguson, 2006)

Fecal Starch Can Be Used as a Tool

- Less than 3% = OK
- ~4.5% = 90% starch digestion in the total tract
- If more than 5% starch in feces = may be problems
  - check particle size
  - rate of starch digestion
- Fecal starch can be high if cows are fed high amounts of poorly processed corn silage

Modification from Hutjens, 2010


Fecal Starch from Dairyland Laboratories
n = 379 samples
Frequency
150
100
50
0
127
105
67
24
18
10
10
2
1
1
5
0
0%
2%
4%
6%
8%
10%
12%
14%
16%
18%
20%
22%
% Starch

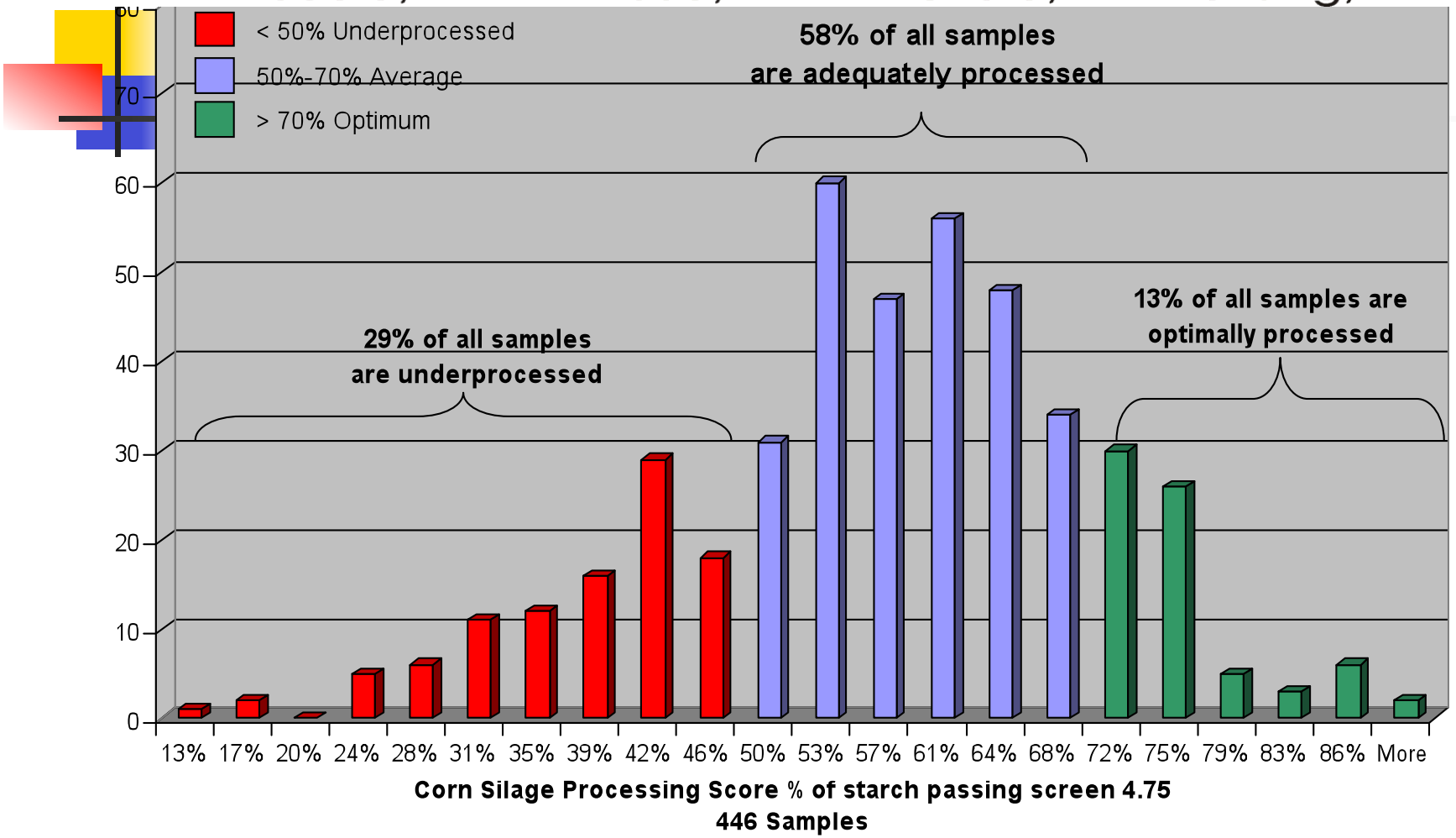
Corn Silage Processing Score

% of starch passing through a coarse screen (>4.75 mm)	Processing Rank
Greater than 70%	Optimum
70% to 50%	Average
Less than 50%	Inadequately processed

Dairyland Labs, Arcadia, WI

Dairyland Laboratories, Inc.

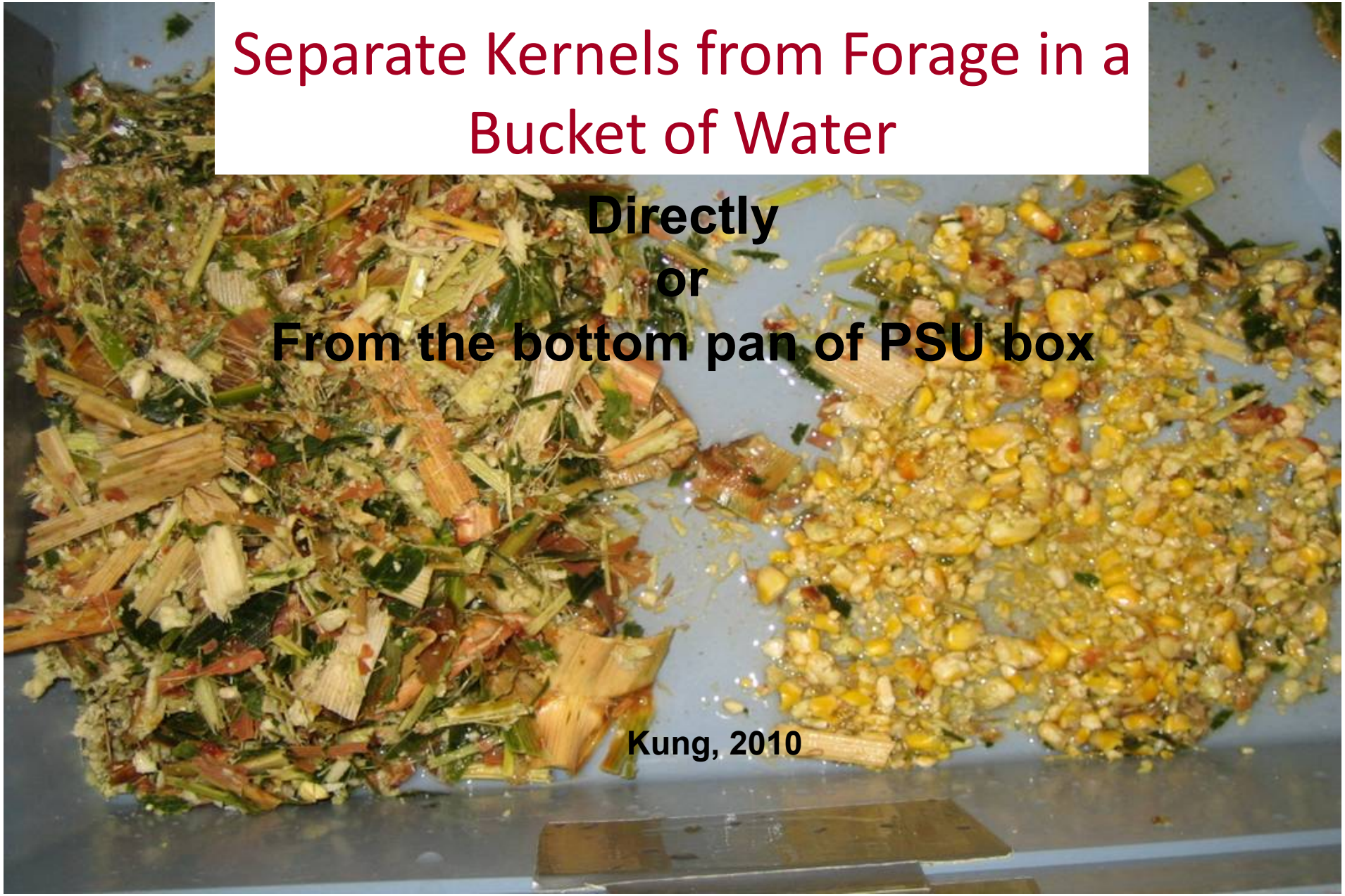
Arcadia, WI • St Cloud, MN • Stratford, WI • Lansing, MI



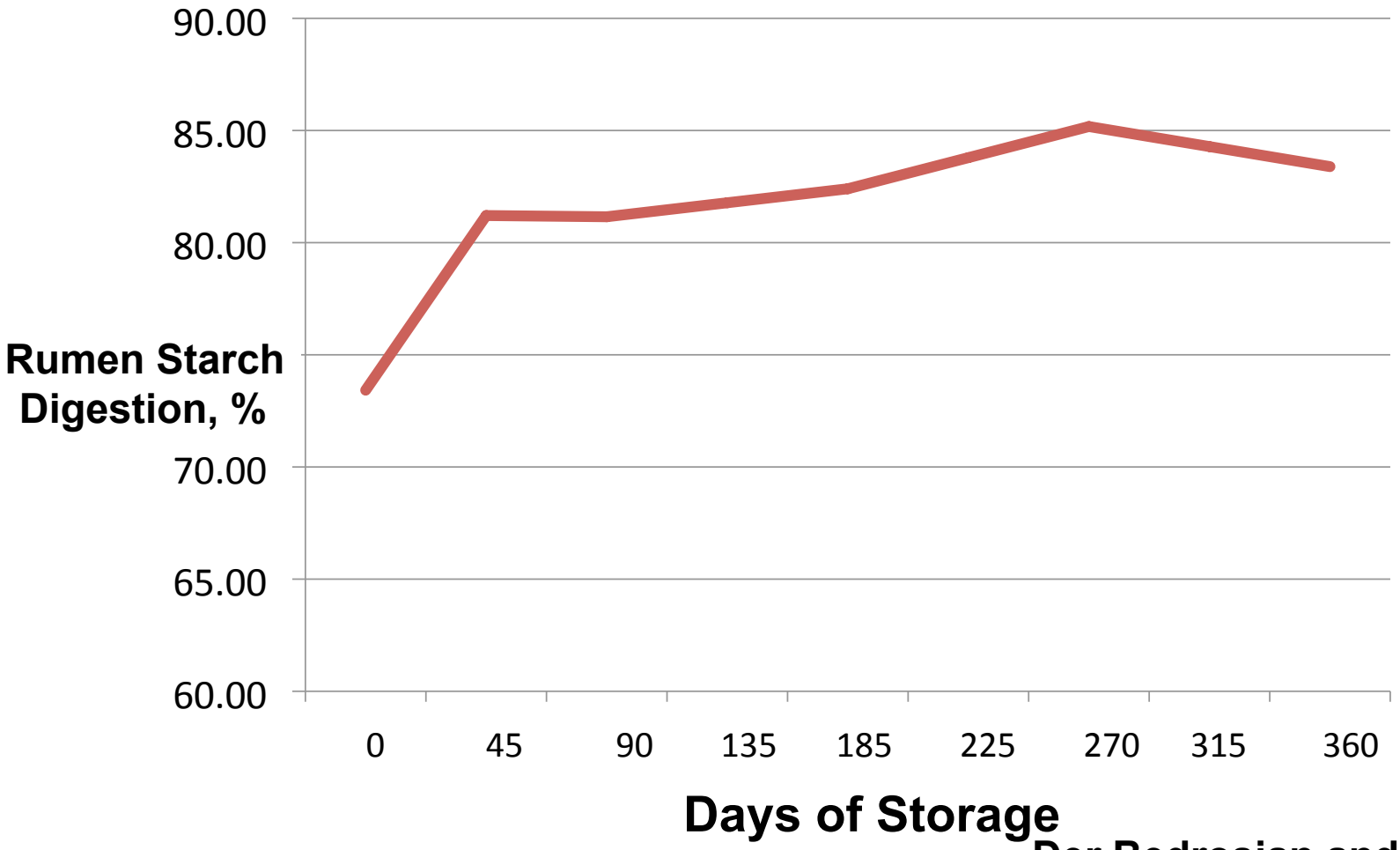
Thumb Rules for Assessing the Degree of Processing

- > 95% of kernels cracked (70% smaller than ¼ kernel size)
- Nicking and just crushing is not enough
- Cob should be broken to >8 pieces (no silver dollar cob pieces)

Separate Kernels from Forage in a Bucket of Water

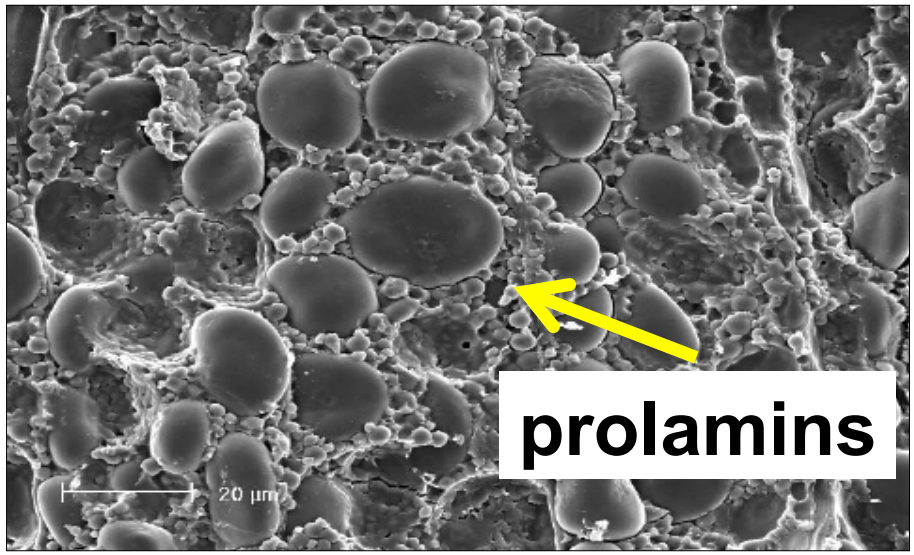


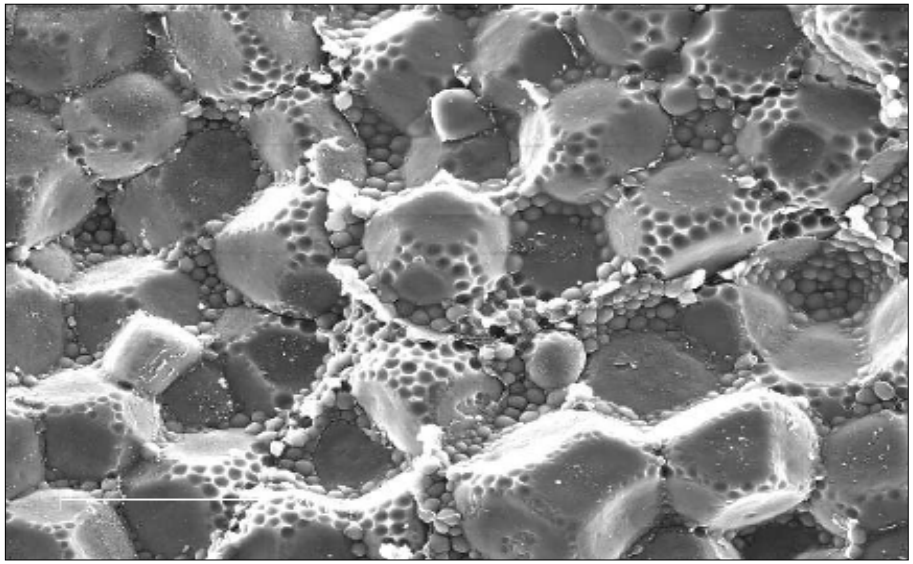
In Vitro Starch Digestion of Corn Silage As Affected by Time in the Silo



Der Bedrosian and Kung, 2010

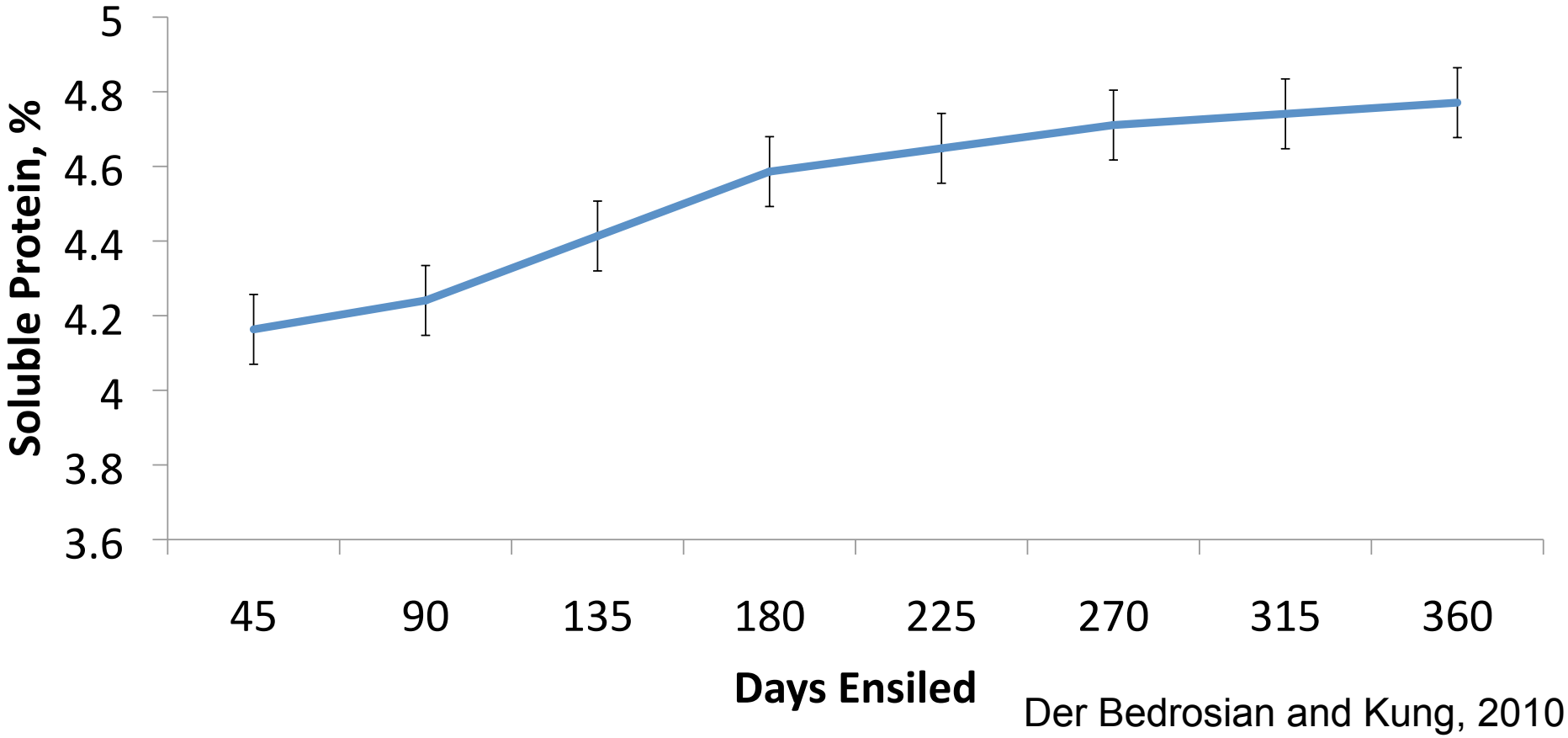
Why does moisture and time of storage affect starch digestion?





-Probably due to microbial proteolysis

Indicator That Proteolysis Continues in the Silo - Corn Silage



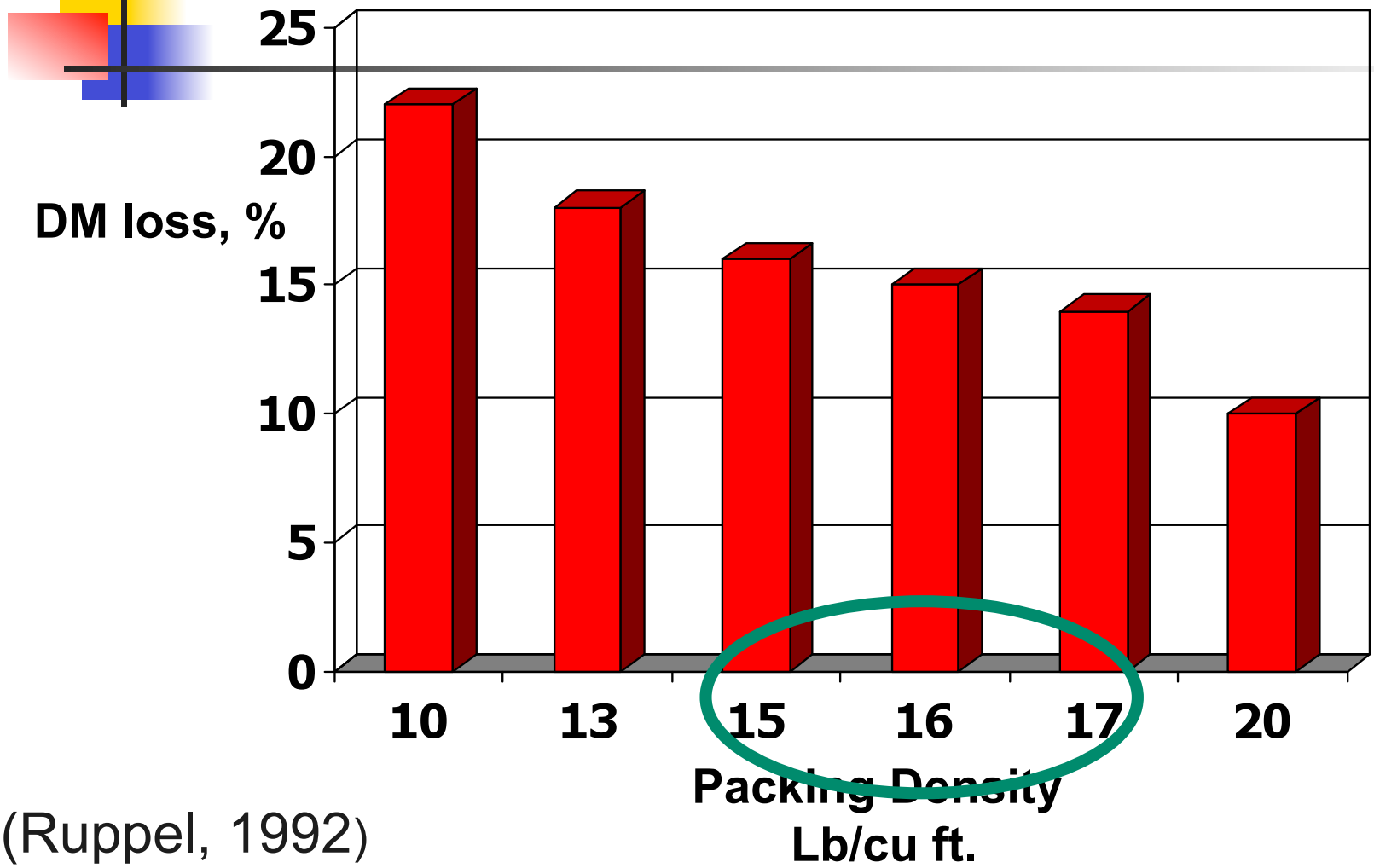
Der Bedrosian and Kung, 2010

Keys to Good Silo Filling

- *Fill quickly*
- *Pack tightly*
  - *15-16 lb DM/cu ft*
- *6-8 inch layers*
- *Minimize mud from tires*
- *Heavy tractors*

Pack tractor wt/800 = tons/hr

Target Packing Density



(Ruppel, 1992)


Avoid the California Shaped Pile!!!!
Kung, 2004

Tight Packing Density

- Decreases DM losses
- Improves stability
- Improves inventory space

Managing Silo Walls

Plastic on the Sidewalls

Cover With Plastic and Weights As Soon As Possible

- White plastic better than black
- 8 > 6 > 4 mil
- Small bunks – consider 2 layers? (thinner on bottom OK)
- More weight on seams/ edges

Research on O_2 Barrier Plastics for Covering Bunker Silos

- All plastic “bleeds”
- New research with “oxygen barrier plastics”

Research on O_2 Barrier Plastics for Covering Bunker Silos
(Silo Stop – One Step)

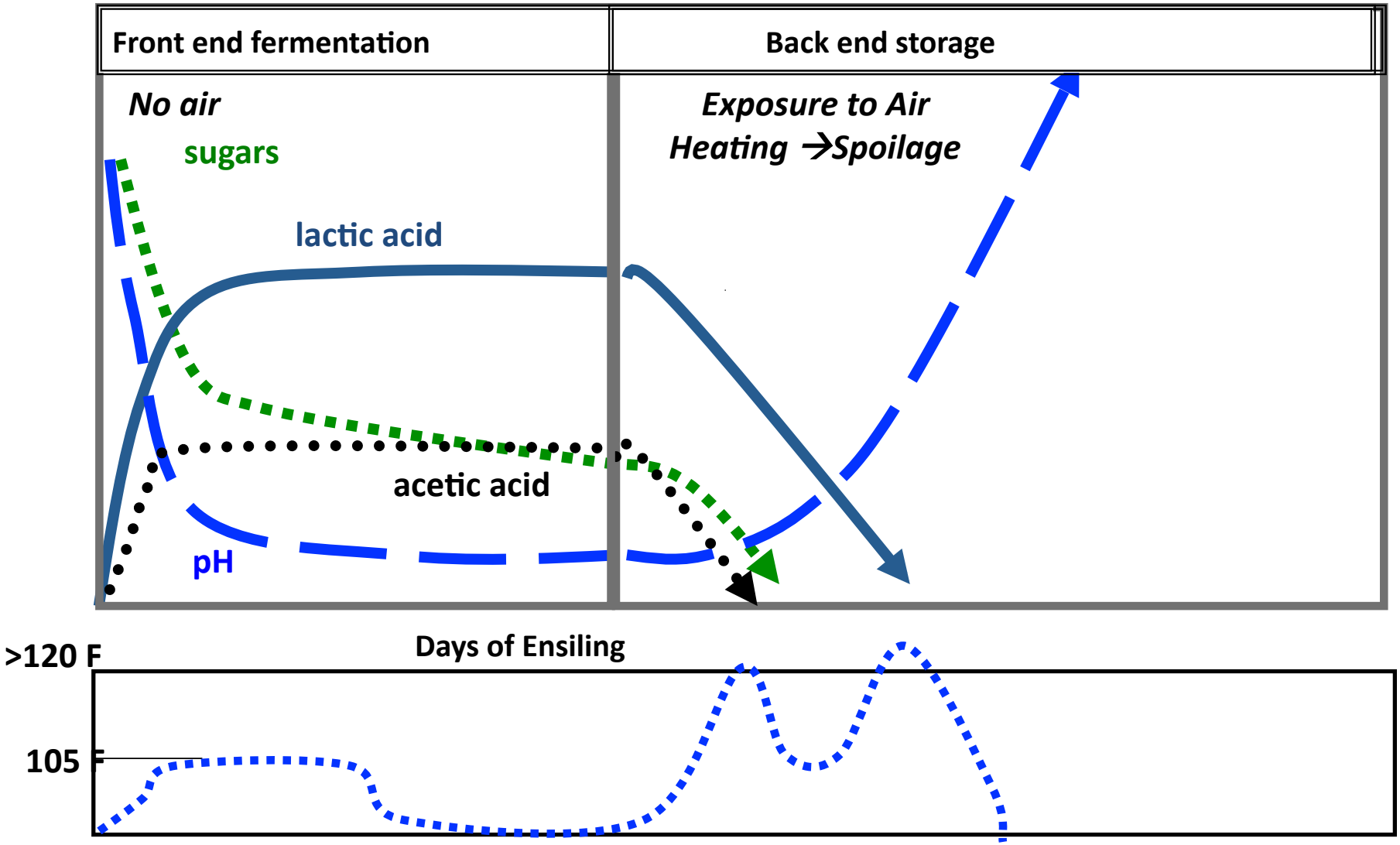
	OB plastic	Normal plastic
DM, %	32.30	27.40
pH	3.99	5.89
Lactic acid, %	2.05	0.87
Acetic Acid, %	3.72	2.58

Borreani et al. (2007)

Issues With Keeping the Quality of Corn Silage

- Keeping silage from aerobic spoilage during storage and feedout

Ideal Fermentation but Poor Storage Conditions



The "Domino Effect" of Air on Aerobic Spoilage

- Silage is exposed to air
  - Lactate Assimilating Yeasts 'wake up' and degrade lactic acid
    - Numbers of yeasts increase
      - Highly degradable nutrients are destroyed
        - Heat is produced
          - pH increases
            - Molds/bacteria 'wake up' causing further spoilage
              - More heating
                - Massive spoilage

What' wrong with this picture?

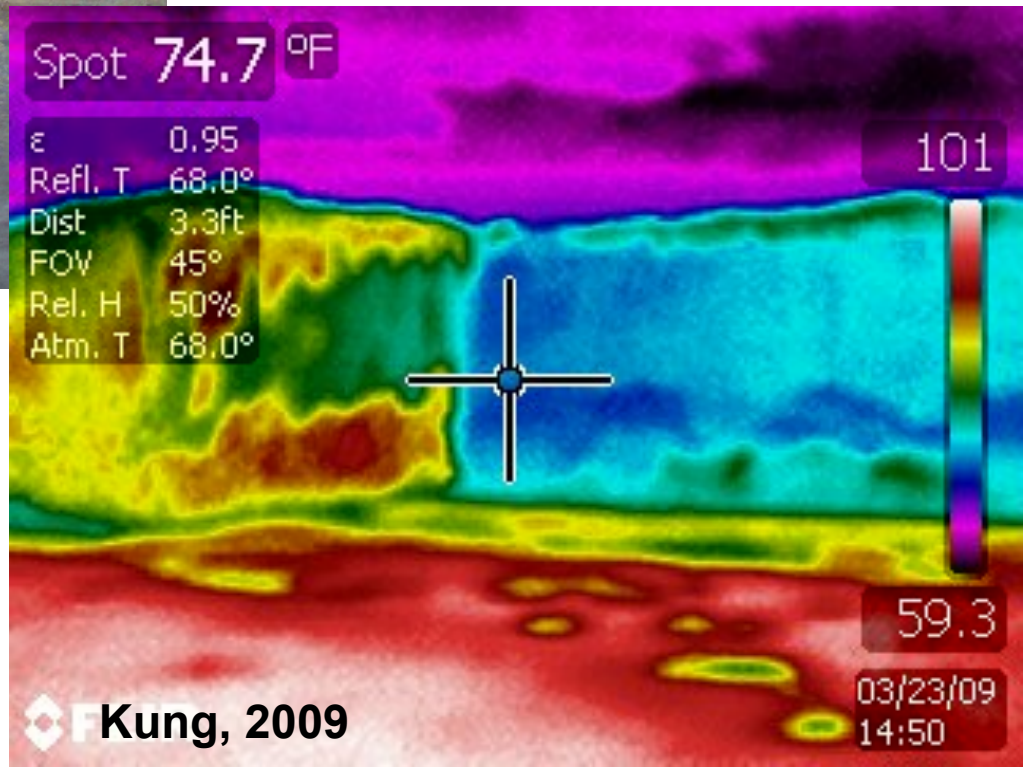
Keep the Air Out at the Edges and Seams

Kung, 2008

WoW!


Gravel bags and tires
to weigh down the plastic
Kung, 2007


Kung, 2009


Spot 74.7 °F
ε 0.95
Refl. T 68.0°
Dist 3.3ft
FOV 45°
Rel. H 50%
Atm. T 68.0°
101
59.3
03/23/09
14:50
Kung, 2009


Check bags regularly for holes and patch
Clean area with alcohol before using tape
(bags have beeswax)
06.30.2004

Vent bags 2-3 days

Place vents high on bags

Open vent a few minutes if bag continues to gas

Kung, 2008

Challenges Specific to Baleage (These are Silos Too!!)

- Relatively longer wilting (50% moisture is optimum) times decreases fermentable sugar content. This may result in:
  - clostridial fermentation
  - rain damage

- Small mass is affected by environmental conditions
  - silage mass is not in a steady state condition

Challenges Specific to Baleage

- High ratio of plastic area:forage mass increases probability of aerobic challenges

- Relatively low moisture results in a slow and limited fermentation
  - bad bugs have more time to compete
  - stabilizing silage more difficult with low acid content

Face Management

-Remove a minimum ??? inch/d
-Remove more in hot weather and for drier and poorly packed silages
-Keep face clean, minimize face damage
-Knock down only enough silage to feed

Face Shavers Must Be Used Properly!!!

Keep Plastic Down at the Feeding Face

What Additive Can I Use to Minimize Spoilage Yeasts and Improve the Aerobic Stability of Silages?

L. buchneri Silage Inoculants Improve Stability

Produce Moderate Amounts of Acetic Acid (similar to propionic acid)

↓

Fewer yeasts in silage
Improved aerobic stability, less heating
Less spoiled silage

Effect of Treating Corn Silage with *L. buchneri* 40788 on Microbial Populations From Farm Silages

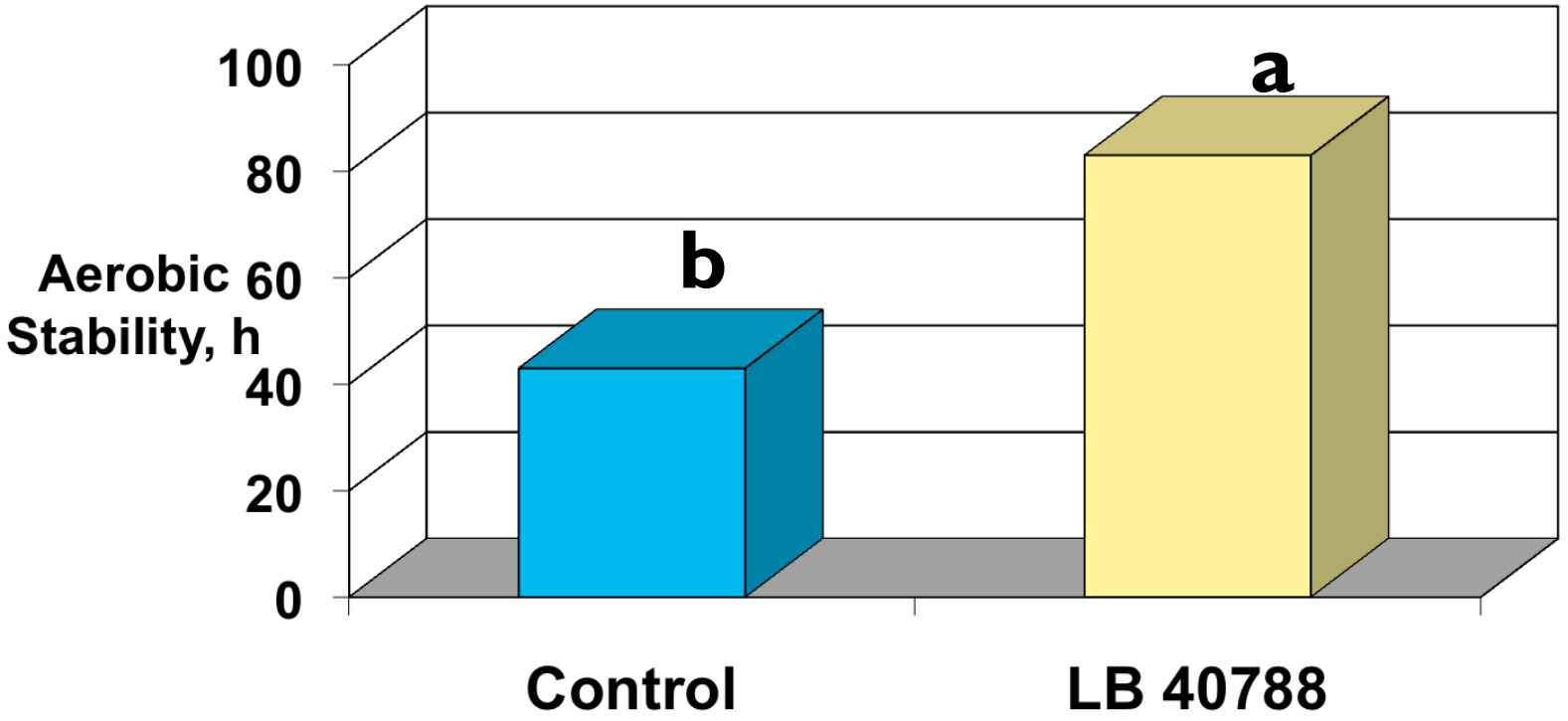
Item	Control	LB(C)
***L. buchneri*,** cfu/g equivalent (qPCR)	67,000[b]	4,800,000[a]
Spoilage yeasts, cfu/g	320,000[a]	43,000[b]

[a,b]Numbers in rows with unlike superscript differ, $P < 0.05$

Mari et al. 2009, J. Dairy Sci. 92: 1174-1176

Aerobic Stability of Corn Silages Treated with *L. buchneri* 40788 From Farm Silages

[a,b]Blocks with unlike letters differ, $P < 0.05$



Mari et al. 2009, J. Dairy Sci. 92: 1174-1176

Summary

- Proper silo management is a must to maximize the efficient use of forages
- Start with the best forage
- Follow with the best silo management techniques
- Protect your investment and maximize net farm income

Thank You!

Website: http://ag.udel.edu/anfs/faculty/Dr.Kung.htm
Email: LKSILAGE@UDEL.EDU