Starch Digestibility青贮玉米的淀粉消化率

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Taian，第五届奶牛粗饲料大会 2015年6月25日

INSERT SENSITIVITY CLASSIFICATION HERE

青贮玉米的干物质和消化率DM and Digestibility of Corn

Corn Silage Energy Pools

Grain = ~40-45% DM

玉米粒=40-45% 干物质

秸秆 = 55-60% 干物质

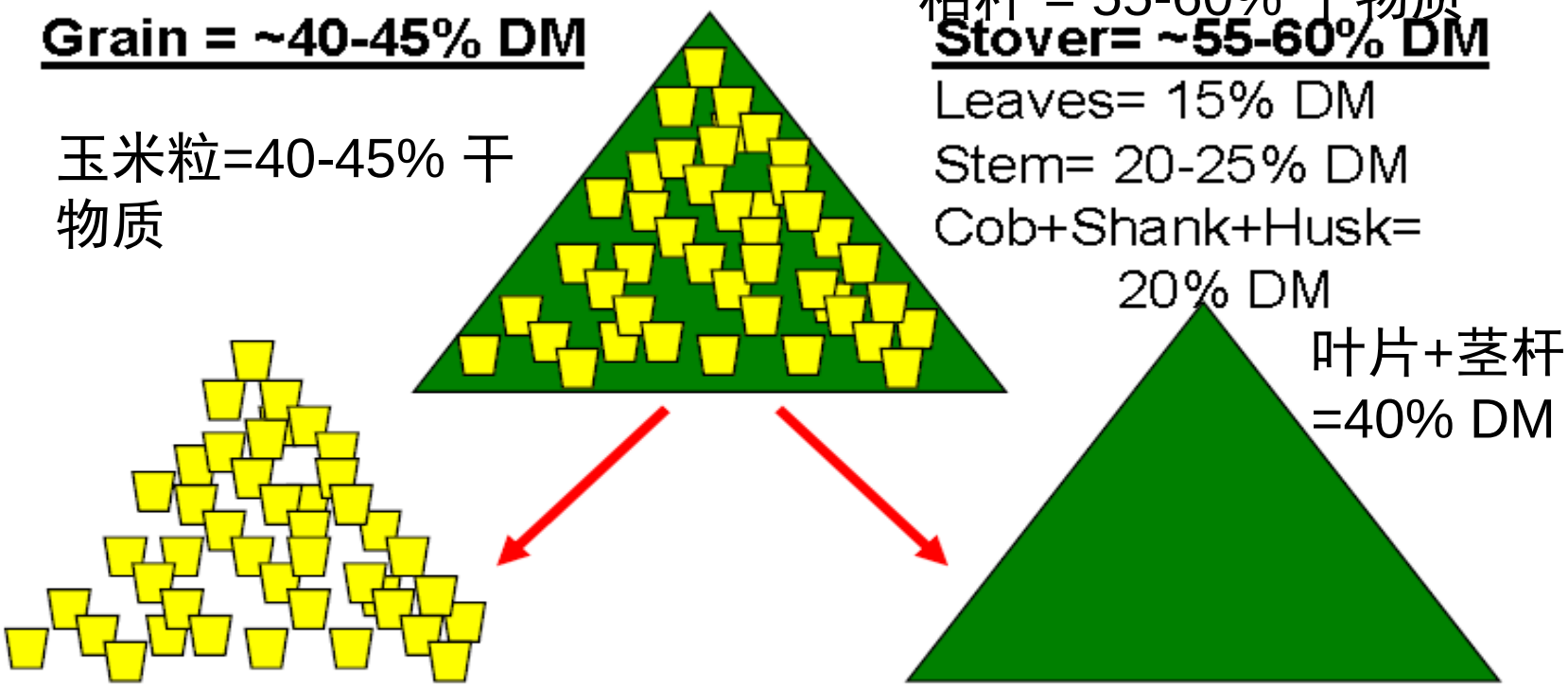
Stover= ~55-60% DM

Leaves= 15% DM

Stem= 20-25% DM

Cob+Shank+Husk= 20% DM

叶片+茎杆 =40% DM



80 to 100% digestible

- Kernel maturity
- Starch digestibility

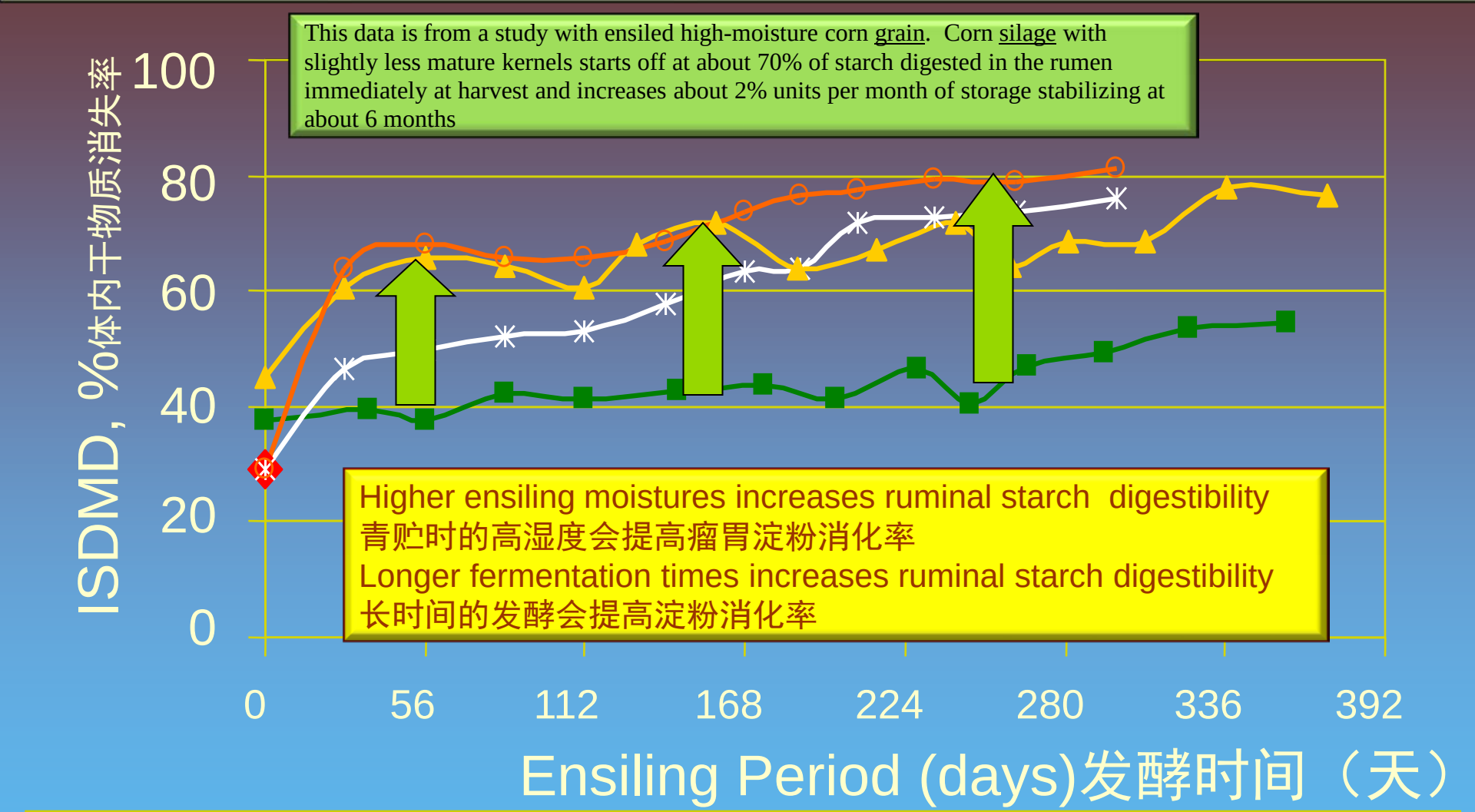
淀粉消化率（7小时）83.19% +-15.24% (52.72-98%)

40 to 55% digestible

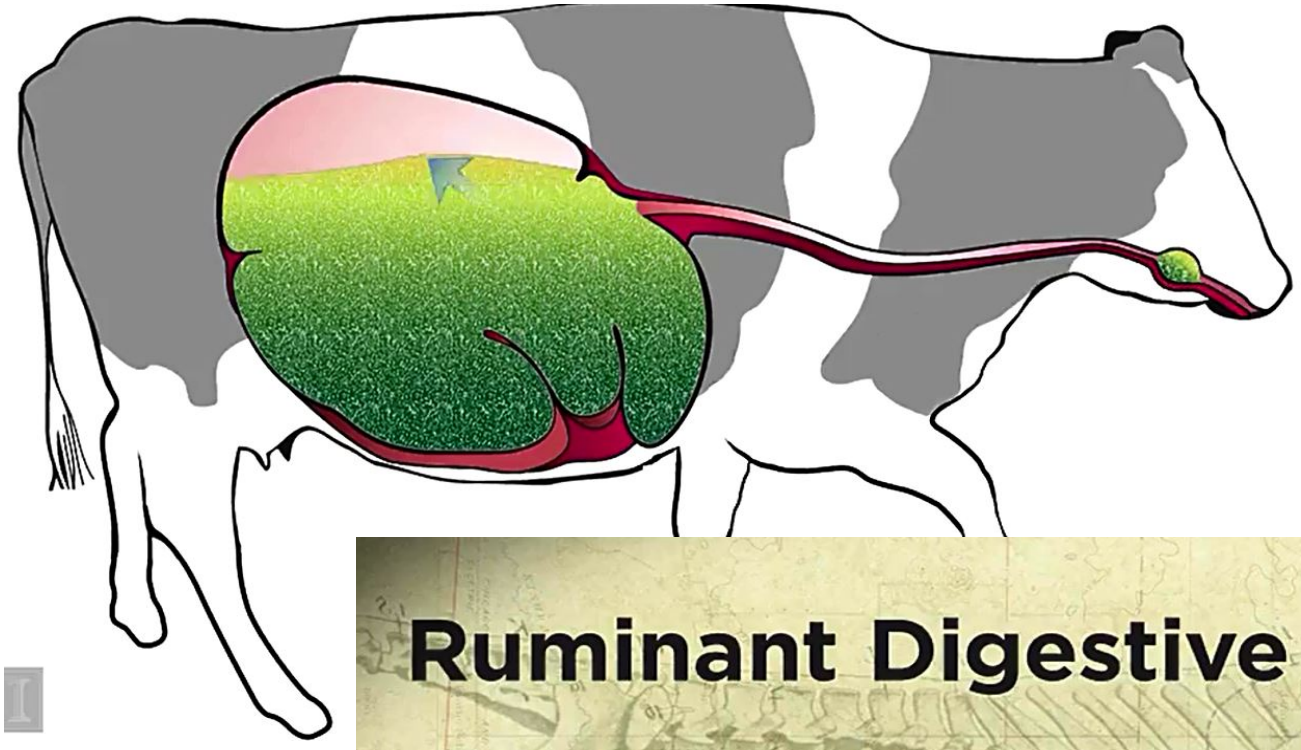
- Cell wall digestibility

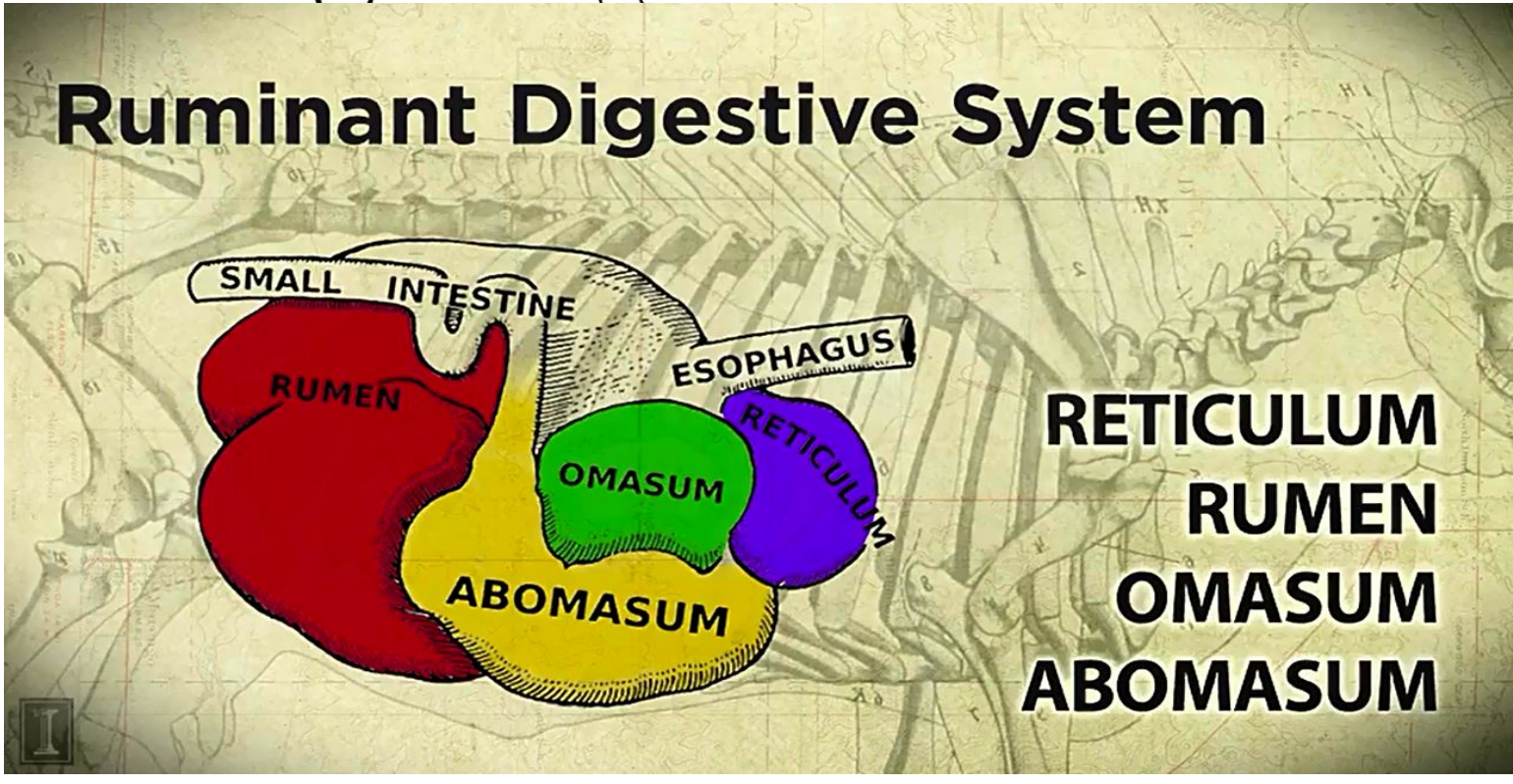
中洗纤维消化率47.68% +-5.24% （37.21-58.15）

Unlike Fermented Wheat or Barley, Fermented Corn (as silage or fermented maize grain) Drifts Upwards in Ruminal Starch Digestibility Over Time in Storage
与青贮小麦和燕麦不同，青贮玉米的瘤胃淀粉消化率随贮藏时间的延长而上升



Source: J.R. Benton, G.E. Erickson, and T.J. Klopfenstein U. of NE, Lincoln. Abstract # 936 2004 ASAS/ADSA Sessions, St. Louis, MO




Ruminant Digestive System
SMALL INTESTINE
ESOPHAGUS
RUMEN
RETICULUM
OMASUM
ABOMASUM
RETICULUM
RUMEN
OMASUM
ABOMASUM

2011 康奈尔大学推荐的奶牛饲养配方标准 (2011.5)

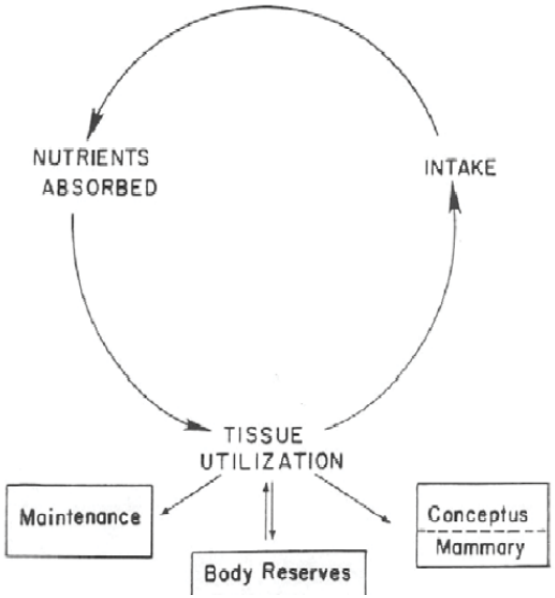
	单位	远干奶牛	近干奶牛	新产奶牛	高产奶牛
干物质采食量DMI	kg	13-14	'12-13	19+	**23+**
泌乳净能NE_L	兆卡/Kg	1.30-1.39	1.40-1.45	1.72-1.76	**1.69-1.76**
代谢能平衡	% 需求量	110%-120%	110-120%	80-90%	**100-110%**
碳水化合物					
有效纤维peNDF	% DM干物质	30-40	28-35	24-26	**23-25**
淀粉，最大值	% DM干物质	16	19	27	**30**
糖	% DM干物质	<3	<3	5	**5**
蛋白Protein					
粗蛋白	% DM	<16	<15	<18	**<18**
源于瘤胃细菌的代谢氮白	% of MP		>50	>40	**>40**
脂肪Fat					
总脂肪，最优	% DM	3.5	3.5	4	**5**
微量元素					
钙Ca	% DM	0.5-0.7	0.9-1.1	0.8-1.0	**0.8-1.0**
磷P	% DM	0.3-0.36	0.3-0.36	0.35-0.4	**0.35-0.4**

http://www.ansci.cornell.edu/

Tom Overton, Ph.D.

Larry Chase, Ph.D.

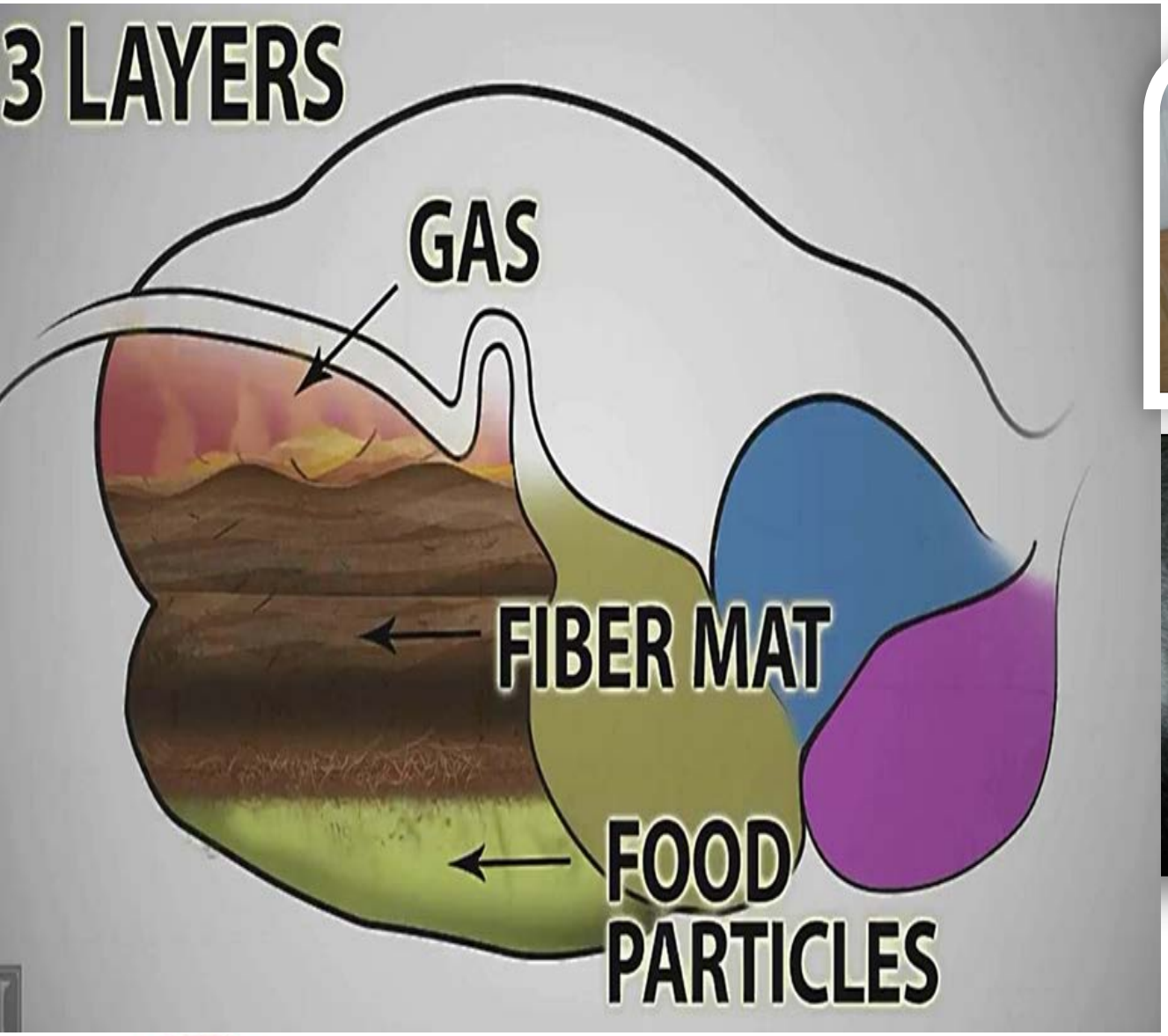
Cycle of Life



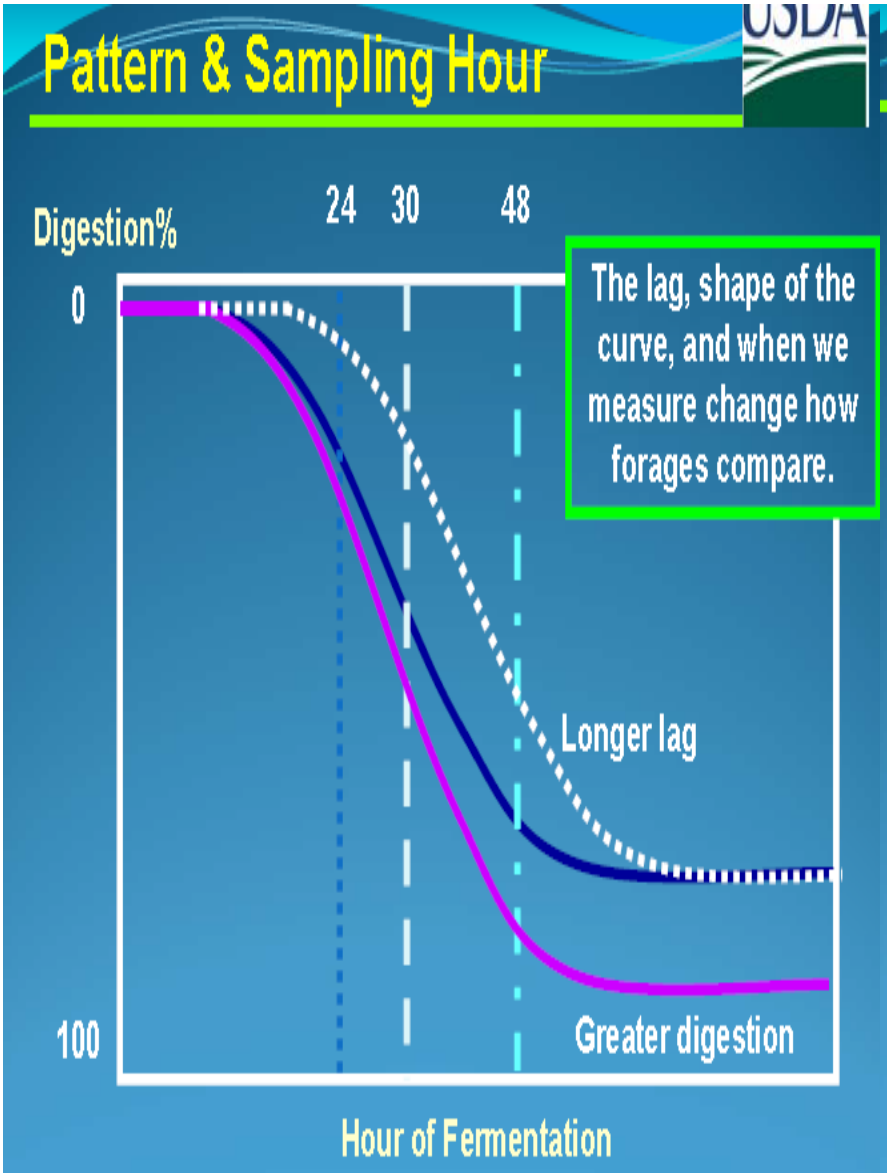
Starch Concentration

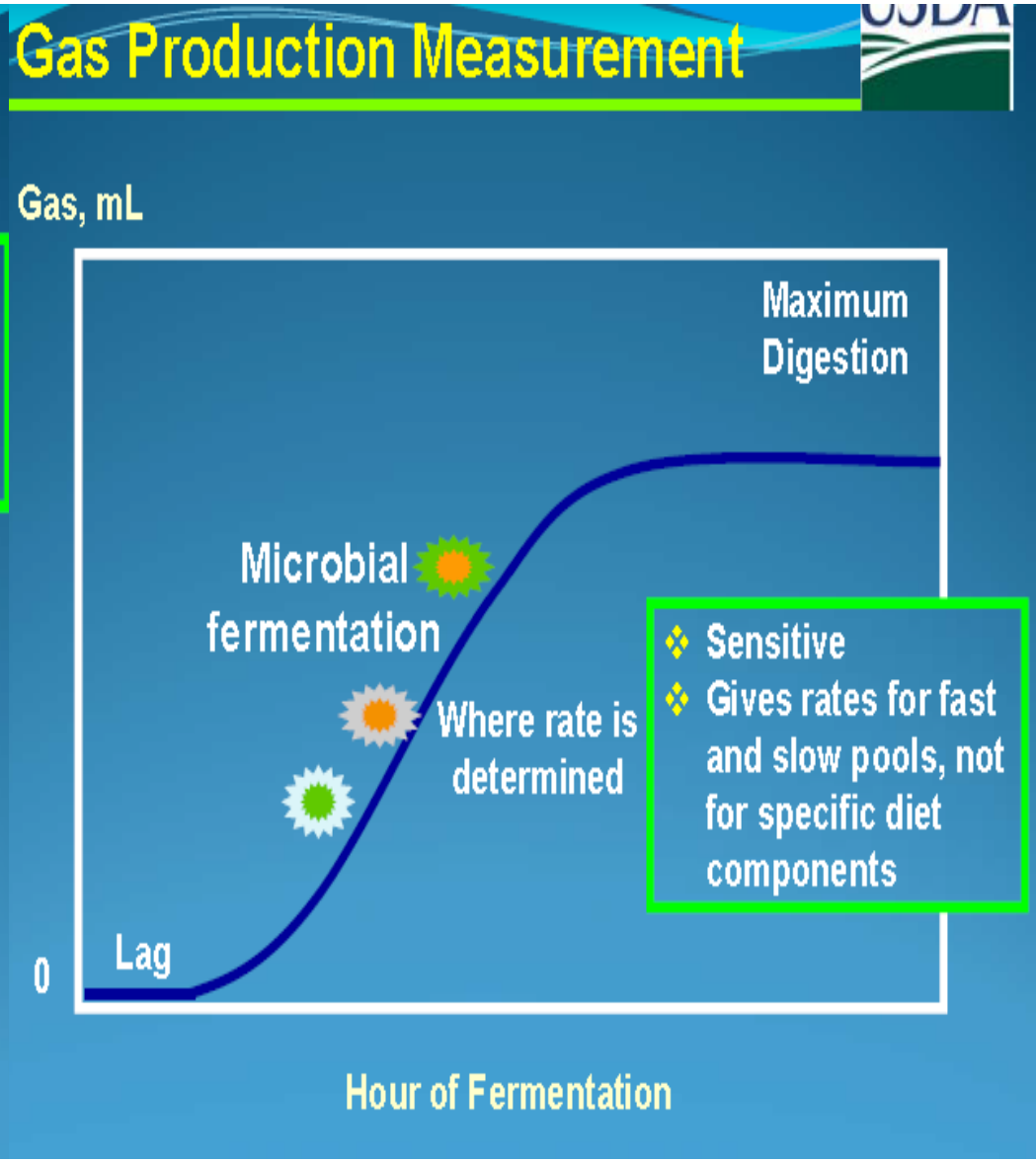
Legumes 2-5%	Beet Pulp 0%
Grasses 1-3%	Brewers Grains 4-10%
Corn Silage 25-35%	Corn Gluten Feed 20-30%
Corn 70-75%	Corn Gluten Meal 15%
Oats 40-45%	Cottonseed 1%
Barley 55-65%	Distillers Grains 3-5%
Wheat 60-70%	Soyhulls 5%

瘤胃体外模拟发酵测试法，Fenmentrics

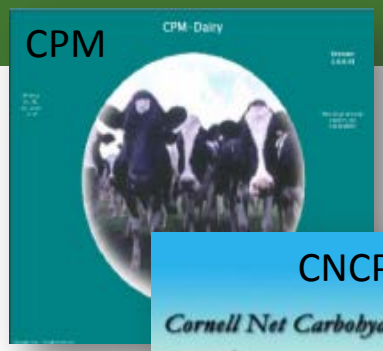


消化率测定和微生物发酵产气





CPM



CNCPS V6.1

Cornell Net Carbohydrate & Protein System v.6.1

NDS v3

B_1 and B_3 Digestion Rates (K_d) are critical to estimating intake, production and tendency for acidosis B_1和B_3消化率(K_d) 对于估量采食，生产和酸中毒都非常重要

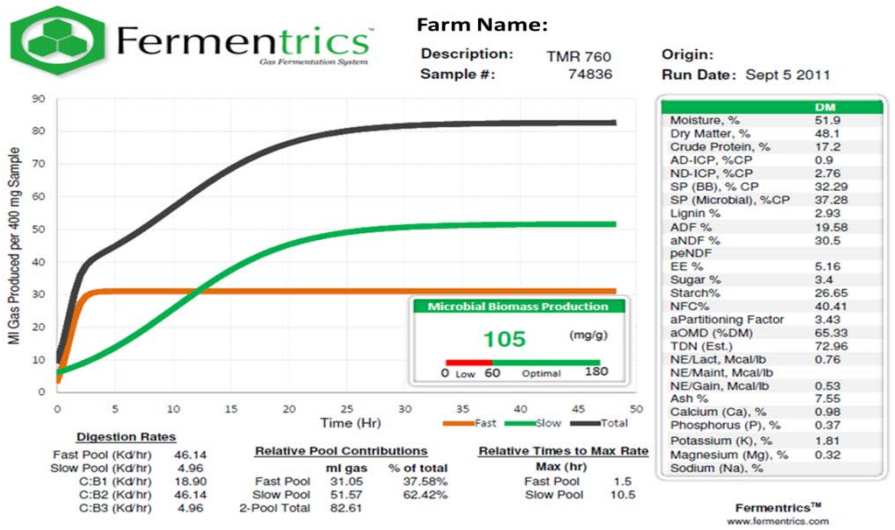


Table 1. Composition and digestion of carbohydrate fractions in CPM-Dairy

CPM Dairy v3	Composition	Digestion Rumen (%/h)	Digestion Intestine (%)
A_1	Silage Acids	1-2	100
A_2	Sugars	100-300	100
B_1	Starch	10-40	75
B_2	Soluble Available Fiber Pectins	40-60	75
	β Glucans		
B_3	Insoluble Available Fiber Cellulose Hemicellulose	2-15	20
C	Unavailable Fiber Lignin Fiber associated with lignin	0	0

Fast pool

Slow pool

Fast Kd's

Slow Kd's

粗饲料的正确取样

Forage Sampling

- Collect a representative sample
  - Hay
    - 20 to 25 cores per lot of hay
  - Silage
    - Avoid spoiled material
    - 10 to 12 locations
  - TMR
    - Sample within 20 minutes of feeding
    - Fill 5 gallon bucket with grab samples from entire length of feed area
    - Sub-sample from bucket
  - Pasture
    - 25 to 30 locations
    - Grab sample of what cows are eating

这种质量的玉米青贮看上去会产更多奶吗？

Does this analysis look like this corn silage should produce milk?

RESULTS:			
	Moisture	65.53%	
	Dry Matter	34.47%	
	pH	3.96	
		DRY BASIS:	
	Crude Protein	7.51%	
	A D F	22.62%	
	aN D F	35.86%	(w/ Na2SO3)
	Lignin (Sulfuric Acid)	3.05%	
	Lignin % of NDF	8.51%	
	NDFD 48 (1mm)	60.15%	
	IVTDMD 48	85.71%	
	AD-ICP % of CP	5.86%	
	AD-ICP % of DM	0.44%	
	ND-ICP % of CP	6.00%	(w/o Na2SO3)
	ND-ICP % of DM	0.45%	(w/o Na2SO3)
	Protein Sol. % of CP	44.34%	
	Starch	37.95%	
	Fat	3.22%	
	Ash	3.62%	
	Calcium	0.22%	1.00 g/lb
	Phosphorus	0.21%	0.95 g/lb

是的，它会
但是营养学家会说因为这种玉米青贮奶牛产奶量下降

Yes, it does
But the nutritionist claimed cows were down in milk because of this corn silage

MILK 2006 SPECIAL REPORT

CALCS:					
	T.D.N.1X - MLK06 NonProc	73.89%		25.47%	
	N.E.L.3X - MLK06 Proc	0.75	Mcal/lb	0.26	Mcal/lb
	N.E.L.3X - MLK06 NonProc	0.73	Mcal/lb	0.25	Mcal/lb
	N.E.- G. - MLK06	0.49	Mcal/lb	0.17	Mcal/lb
	N.E.- M. - MLK06	0.77	Mcal/lb	0.27	Mcal/lb
	Milk per ton - MLK06	3508 lbs/ton CS DM			

不进行籽粒破碎，日粮中淀粉消化率低

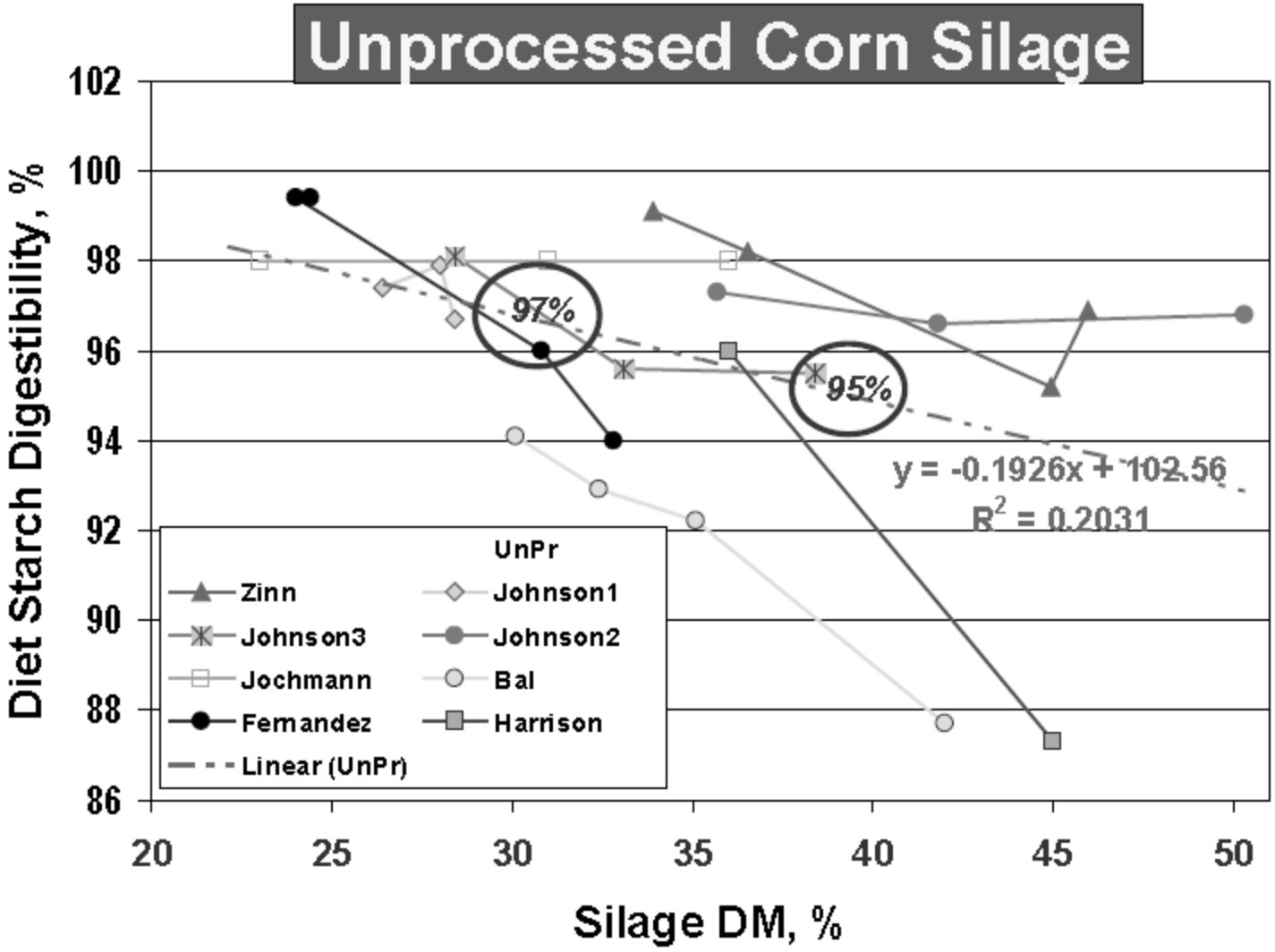


Figure 6. Diet starch digestibility from trials where cattle were fed unprocessed corn silage.

带籽粒破碎青贮收割机，35-38%干物质收获淀粉消化率依然高达98%

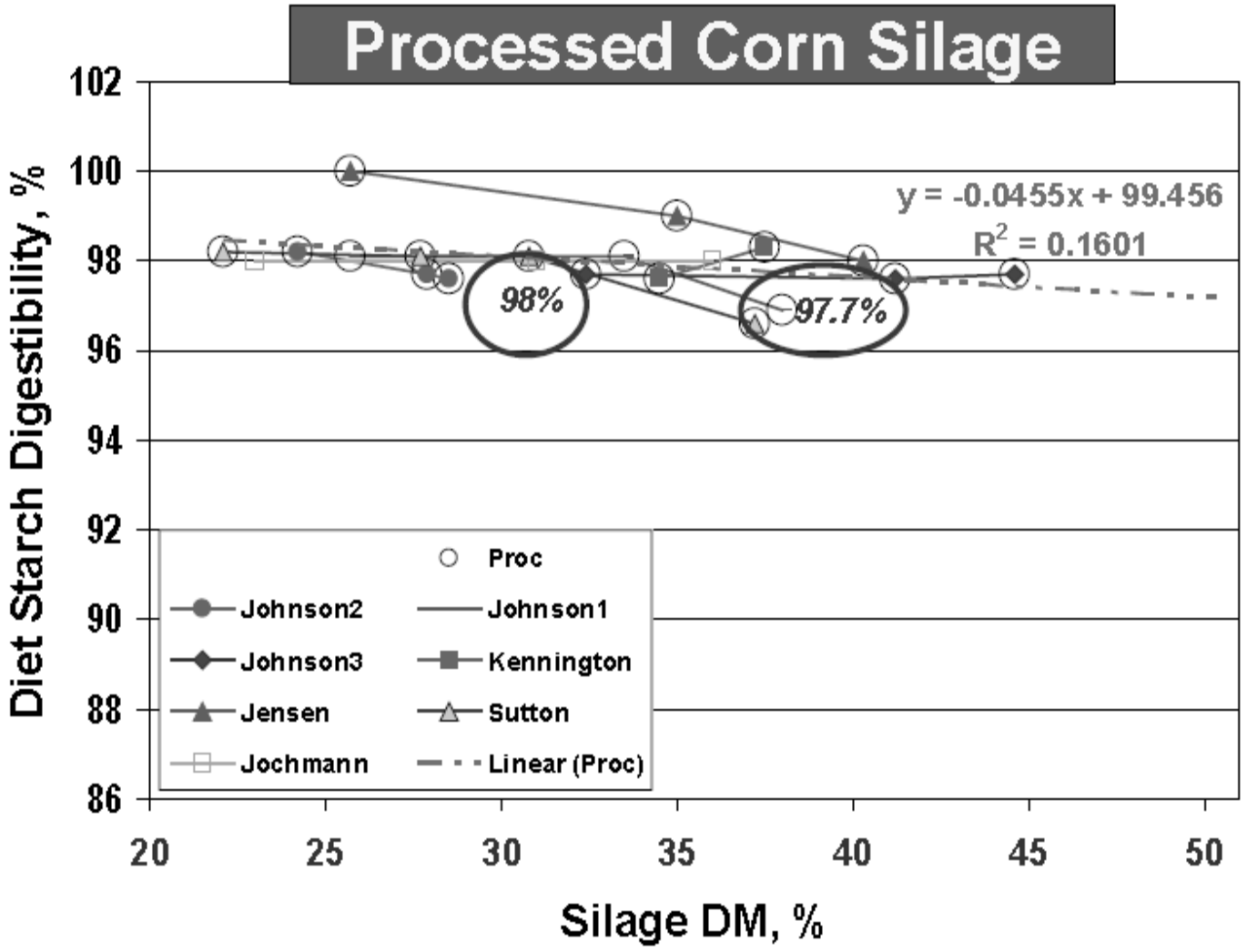
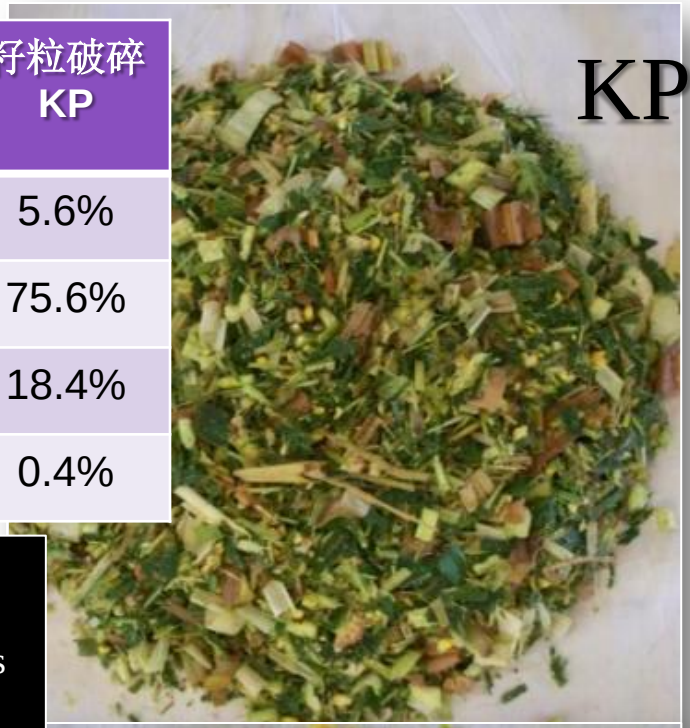


Figure 7. Dietary starch digestion from trials where cattle were fed processed corn silage.

Shredlage

筛目 Screen (mm)	揉丝青贮 Shredlage	籽粒破碎 KP
19	**31.5%**	5.6%
8	41.5%	75.6%
1.18	26.2%	18.4%
Pan	0.8%	0.4%

* Penn State data from silo bags
* No sorting differences in refusals



KP

加工评分75+/-3.3
Processing score 75 +/- 3.3

加工评分 60+/-3.9
Processing score 60 +/- 3.9

青贮玉米籽粒破碎优化的进展

Corn Silage Processing
(CVAS Data, 2006 to 2013)

Crop Year	Number	Average	Percent Optimum	Percent Poor
2006	97	52.8	8.2	43.3
2007	272	52.3	9.2	37.9
2008	250	54.6	5.2	34.8
2009	244	51.1	6.1	48.0
2010	373	51.4	5.9	43.4
2011	726	55.5	12.3	33.1
2012	871	60.8	14.8	19.9
2013	2658	64.6	36.0	12.9

籽粒破碎指南 Kernel Damage Guidelines

(per Dr. Dave Mertens USDA/ARS)

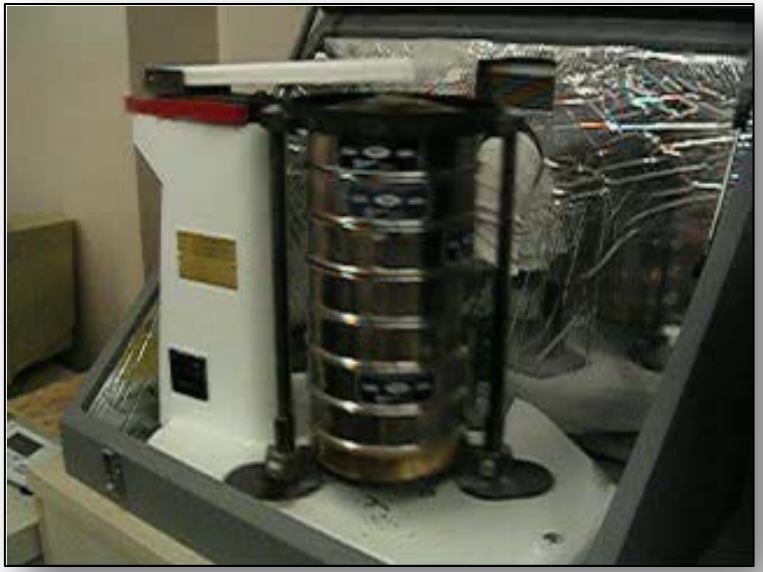
- 超过 70% = 最佳 Over 70% = optimal
- 50-70 = 平均 50-70 = Average
- 未破碎部分应**低于50%** **Less than 50% under processed**

Laboratory Ro-Tap Lab Method to Quantify Kernel Damage

Lab method jointly developed by DuPont Pioneer, US Dairy Forage Research Center and Dairyland Labs (Arcadia, WI)

数量化玉米籽粒压碎度的实验室方法 (Ro-Tap Lab)

该方法是由杜邦先锋，美国农业部奶牛牧草研究中心和Dairyland 实验室联合研发的



- Quantifies % of starch in damaged vs. undamaged kernels

  精确测量破碎和未破碎籽粒的淀粉含量（%）

- Available commercially from many forage testing labs

  许多牧草检测实验室提供商业化

Starch is less ruminally available in kernels on or above the 4.75mm sieve (retains ¼ kernel pieces and greater)当压碎的籽粒≥4.75mm筛上部分（≥1/4颗籽粒），籽粒中的淀粉不易

4.75mm screen

Starch more ruminally available in kernels below the 4.75mm sieve

当压碎后的籽粒<4.75mm时，籽粒中的淀粉更易于在瘤胃中被利用

Sieve (mm)	
19	coarse
13	coarse
9.5	coarse
6.7	coarse
4.75	coarse
3.35	medium
2.36	medium
1.18	medium
0.6	fine
pan	fine

Guidelines for Interpreting Lab Processing Scores:
实验室报告评分指南解读

- **Less than 50% = Under processed** <50% =破碎做得
- **50%-70% = Average (but prefer >65%)** 一般（最好>65
- **Greater than 70% = Optimum (but difficult to obtain)**

>70%= 最佳（但很难达到）

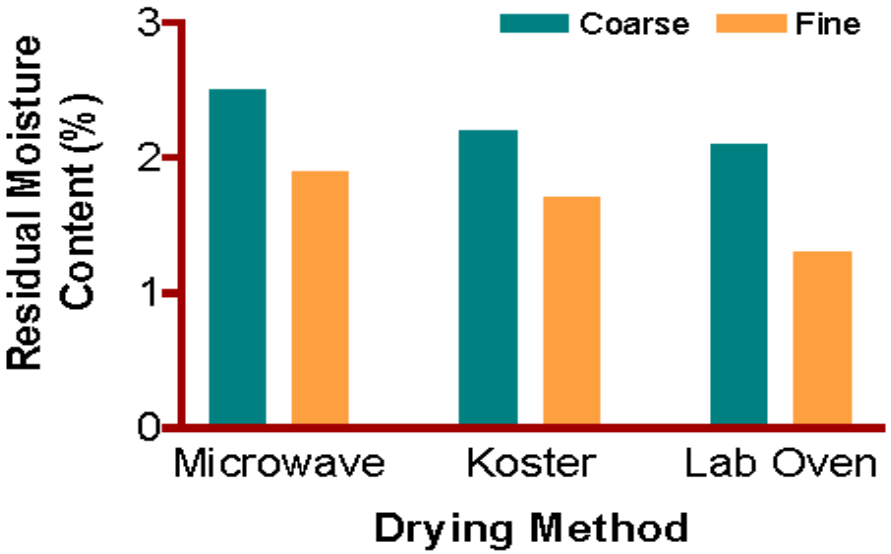
谷粒加工 Kernel Processing

先锋感到有义务帮助做好籽粒破碎，惟有如此，先锋的良种才能实现其最大化价值

We feel an obligation to help customers get this accomplished successfully so Pioneer hybrids deliver their maximum value

全株玉米植株水分的测定

- 微波炉测定法
- 100g新鲜粉碎样品放入纸托盘(蛋糕店有)
- 最高档烘4分钟，测量重量
- 再放入用最高档烘1分钟，取出称重
- 重复进行(即1分种烘、测)
- 直至重量不变
- 最后重量/100g即为干物质含量
- 用磁盘需减去盘的重量



- 现场快速测水分仪器Wile 26 (3200元）
- Wile 253盘形探头 （1000元)
- 统一购买可优惠30-40%，另满50台每台再-50元；满100台，每台-100元

芬兰芬牧公司中国总代理：特雷首邦（北京）贸易有限公司 6334 5789
□+13910063332

全株玉米水分的测定

- Koster 干燥器 Drier， 100克粉碎样品 30分钟
- 注意仪器所测得的样品水分与绝干样品之间还有2-4%的滞留水分含量差异。
- 实验室烘箱 55度隔夜，

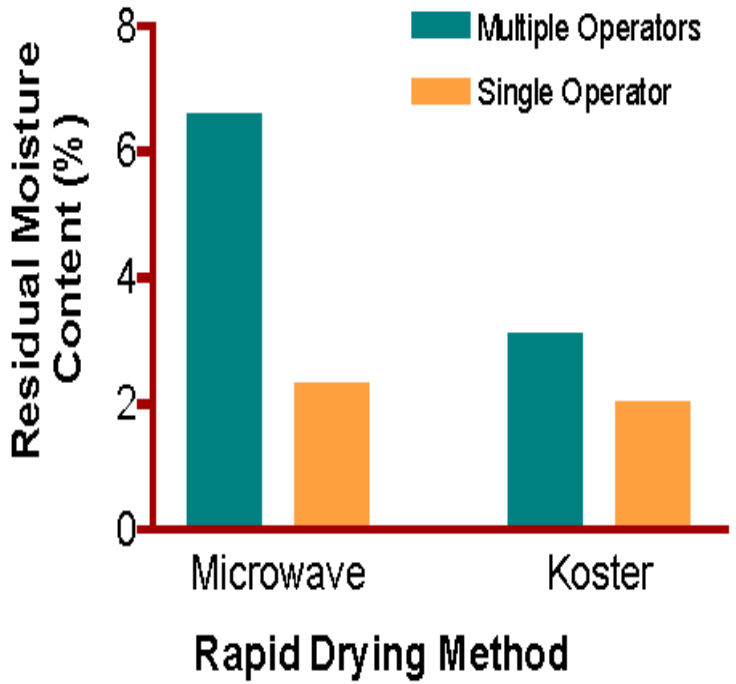


Figure 1. Effect of rapid drying method and number of operators on residual moisture content of corn silage samples.

产后产前奶牛日粮配方营养成分典型关键值

Postfresh Ration Summary

Item	Mean	Min	Max
DMI	37.8	28.7	44.3
ME, Mcal/d	46.6	33.8	56.4
ME Bal, Mcal	-13.5	-21.3	0.8
MP, g/d	1,890	1,355	2,356
MP Bal, g	-488	-818	-47
g MP/kg DM	110	102	128
CP, %	17.6	16.7	19.3
NDF, %	33.2	28.7	38.0
Starch, %	23.5	19.5	29.5
Met, g/d	41.6	32.3	56.2
Lys, g/d	128.4	91.0	159.9

Prefresh Ration Summary

Item	Mean	Min	Max
DMI, lbs (SD)	28.5 (4.7)	21.4	35.2
ME, Mcal/d	30.0	18.2	42.8
ME Bal, Mcal	5.4	-5.2	17.8
MP, g/d	1,187	657	1,687
MP Bal, g	64	-287	455
g MP/kg DM	93	73	118
CP, %	14.6	12.6	17.5
NDF, %	41.7	32.7	52.6
Starch, %	19.0	8.7	25.3
Met, g/d	27.1	15.9	39.4
Lys, g/d	84.1	48.7	116.4

2014年威斯康辛大学实验配方 UW Trial

	揉丝青贮	籽粒破碎	籽粒破碎加干草
主要成分 % DM			
BMR揉丝青贮玉米	45		
BMR KP 青贮玉米		45	35
干草			10
苜蓿青贮	10	10	10
玉米粉	14.2	14.2	17.7
干玉米麸皮	11.1	11.1	9.6
豆粕，压榨	5	5	4.2
豆粕，油浸	8.8	8.8	7.7
配方养分 % DM			
NDF	32	32	32
粗饲料NDF	24	24	24
蛋白	17	17	17
淀粉	25	25	25
脂肪	5	5	5

Item	SHRD	KP	KPH
Major Ingredients, % of DM			
BMR KP Corn Silage	---	45.0	35.0
BMR Shredlage®	45.0	---	---
Alfalfa Silage	10.0	10.0	10.0
Chopped Dry Hay	---	---	10.0
Dry Ground Shelled Corn	14.2	14.2	17.7
Soybean Meal, expeller	5.0	5.0	4.2
Soybean Meal, solvent	8.8	8.8	7.7
Corn Gluten Feed, dried	11.1	11.1	9.6
Key Nutrient Targets, % of DM			
CP	17	17	17
EE	5	5	5
NDF	32	32	32
Forage NDF	24	24	24
Starch	25	25	25

美国科学院(NRC)荷斯坦奶牛蛋白推荐饲喂标准

NRC (2001) protein recommendations for Holsteins

Category	Production	MP, g/d	CP, %	RDP, %	RUP, %
Lactating cows	90 DIM, 45 kg/d MY, 3% TP, 27 kg/d DMI	2,950 (about 11% of DMI)	16.0	9.8 (61%)	6.2 (39%)
Fresh cows	11 DIM, 35 kg/d MY, 3% TP, 15.6 kg/d DMI	2,160	19.5	10.5	9.0
1st lactation heifers	270 d pregnant, 10.6 kg/d DMI, 960 g/d ADG	1,030	15.0 (13.5-15.0)	10.2	4.9
Dry cows: far-off	240 d pregnant, 14.4 kg/d DMI	870	9.9	7.7	2.2
Dry cows: close-up	270-279 d pregnant, 13.7-10.1 kg/d DMI	900-810	10.8-12.4	8.7-9.6	2.1-2.8

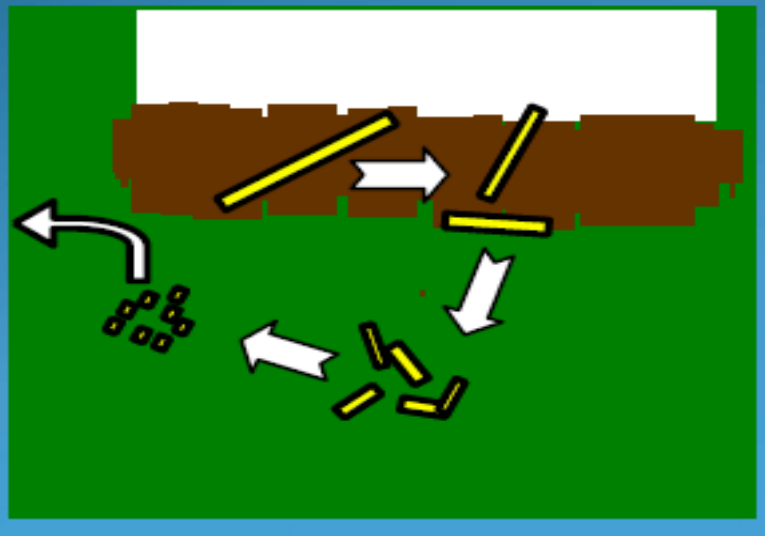
纽约州7个牧场高产奶牛的日粮配方

Item	D	A	B	F	L	J	H
Cows奶牛头数	920	1550	108	100	45	45	60
Milk, 产奶量 kg	53	40	40	39	39	36	27
MUN,mg/dl尿素氮	8	11	12	9	8-9	8-9	9
日粮蛋白CP, %	**15.9**	**15.9**	**15.5**	**16**	**15.6**	**15.6**	**16.5**
微生物蛋白MP g/cow	3306	2625	2720	3016	2419	2305	1991
赖蛋比 Lys:Meth	2.5:1	3.4:1	3.18:1	3.5:1	3.3:1	3.3:1	3.16:1
中洗纤维NDF, %	30.9	28.9	30.8	31.5	29.3	29.3	30.5
非纤维糖水化合物NFC,%	41.5	43.4	41.9	38.1	44.4	41.3	40
淀粉Starch, %	**28.7**	**28.5**	**27.1**	**24**	**29.5**	**28.6**	**26.3**
糖Sugar, %	5.4	3.5	3.1	3.3	4.1	3.7	7
脂肪Fat, %	5.1	4.3	3.8	5.2	4	5.1	5.4
日粮粗饲料比例 Forage % of ration DM	60	57	60.4	57	59	59	50
粗饲料中青贮玉米比例	**68**	**80**	**72**	**47**	**38**	**56**	**0**

Forage: What We Need It To Do

- Composition
- Physical form
- Digestibility

Min. Forage NDF	Min. Dietary NDF	Max. Dietary NFC
19	25	44
18	27	42
17	29	40
16	31	38
15	33	36



- NDF from Forage as 0.9 to 1% of body weight (Mertens)
- 75% NDF from forage

Dairy NRC, 2001

高饲料摄入提高牛奶产量…
采食量主要受以下影响：

Feed intake drives milk production….
and intake is primarily influenced by:

1) 饲料纤维浓度 （中性洗涤纤维 – 量）

Forage fiber concentrations (NDF-**quantity**)

2) **饲料中性洗涤纤维消化特性**

Forage NDF digestion characteristics

- 易破碎性 fragility
- 填饱效果filling-effect
- **消化率 （中性洗涤纤维消化率）**
  digestibility (NDFD)

3) 日粮发酵程度 （特别是淀粉）

Diet fermentability (particularly starch)

4) 脂肪数量/类型 Type/amount of fat

Source: Mike Allen, March, 2011. Western Dairy Management Conference presentation

全混合日粮配方中的关键值（一般状况和理想状况）

Assuming a normal, conservative baseline TMR has the following nutrient specs:

- ❑ 30 to 32 % 中洗NDF
- ❑ 25% 淀粉starch
- ❑ 17.3 to 17.5 % 蛋白 CP

At *maximum* topdress, where should the nutrient specs of the total ration be?

- ✓ 不低于Minimum 30% NDF
- ✓ 淀粉最高Starch maximum of 27%
- ✓ 蛋白最高Crude protein at maximum 18.5%
- ✓ 粗饲料比例超过53% Forage percent over 53%

国内某牧场的青贮样品营养值与美国的差距

干物质 DM	酸性洗涤纤维 ADF	中性洗涤纤维NDF	淀粉Starch	糖分sugar	粗脂肪 Crude fat	全株消化率 Digestibility	pH	乳酸lactic acid (%挥发性脂肪酸FM)	乙酸acetic acid (% FM)	丁酸butyric acid (% FM)	氨态氮(%总可消化养分)
TM	ADF	NDF	Stärke	Sugar	XL	Elos	pH	MS FM	ES FM	BS FM	NH3N %TN
29.9	23.6	48.8	21.4	2.8	2.7	68.9	3.9	1.3	0.6	0.0	9.7
32.0	22.3	47.8	21.2	2.4	2.5	68.8	4.0	1.1	0.5	0.0	12.3
30.5	23.4	49.1	20.2	3.3	2.5	68.1	3.9	1.1	0.5	0.0	11.7
27.7	24.1	47.8	17.6	3.5	2.5	68.4	3.8	1.5	0.6	0.1	14.6
28.0	24.1	47.8	17.2	3.3	2.5	68.1	3.9	1.4	0.6	0.1	14.7

	平均值	标准差
干物质	35.4	8.3
NDF	41.1	7.0
NDFd(30H)	54	4.6
NDFd(24H)	47.7	5.2
ADF	24	5.0
淀粉	31.1	10.2
糖分	4	2.6

2012 Corn Silage Summary Statistics, 31412 样品 from Dairyland Lab – Arcadia, Wisconsin

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Table 3. Correlation estimates of several feed datasets

	n[1]	CP/NDF	Lignin/NDF	Starch/NDF
Corn silage	103,1191	0.20	0.76	-0.88
Alfalfa silage	12,597	-0.72	0.53	0.02
Grass hay	15,146	-0.64	0.71	-0.02
Dried distillers grains	2,740	0.05	0.27	0.23
Corn gluten feed dry	347	0.13	-0.08	-0.35
Wet brewers grains		-0.40	0.22	-0.26

[1]Number of samples in dataset.

	干物质 (%)	粗蛋白 (%)	粗脂肪 (%)	粗纤维 (%)	消化能 (MJ/kg)	综合净能 (MJ/kg)
全株玉米	22.7%	7.0%	2.6%	30.4%	9.90	4.40
秸秆青贮	25.0%	5.6%	1.2%	35.6%	6.78	2.44
玉米粒	88.4%	9.7%	4.4%	2.3%	16.36	9.12

中国的奶牛饲料原料营养标准

北美人怎么利用玉米青贮饲养奶牛

How North Americans Manage Corn Silage in Dairy Diets

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Global Nutritional Sciences Mana
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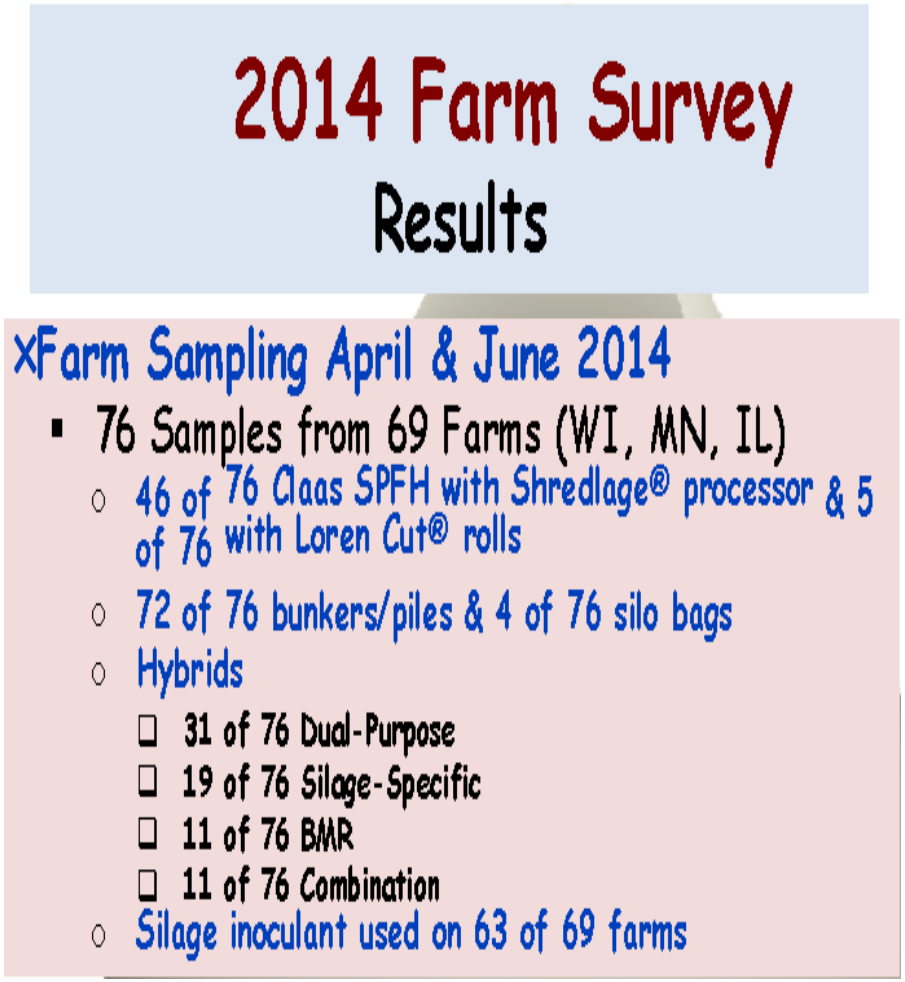
美国奶牛场2014年青贮状况调查

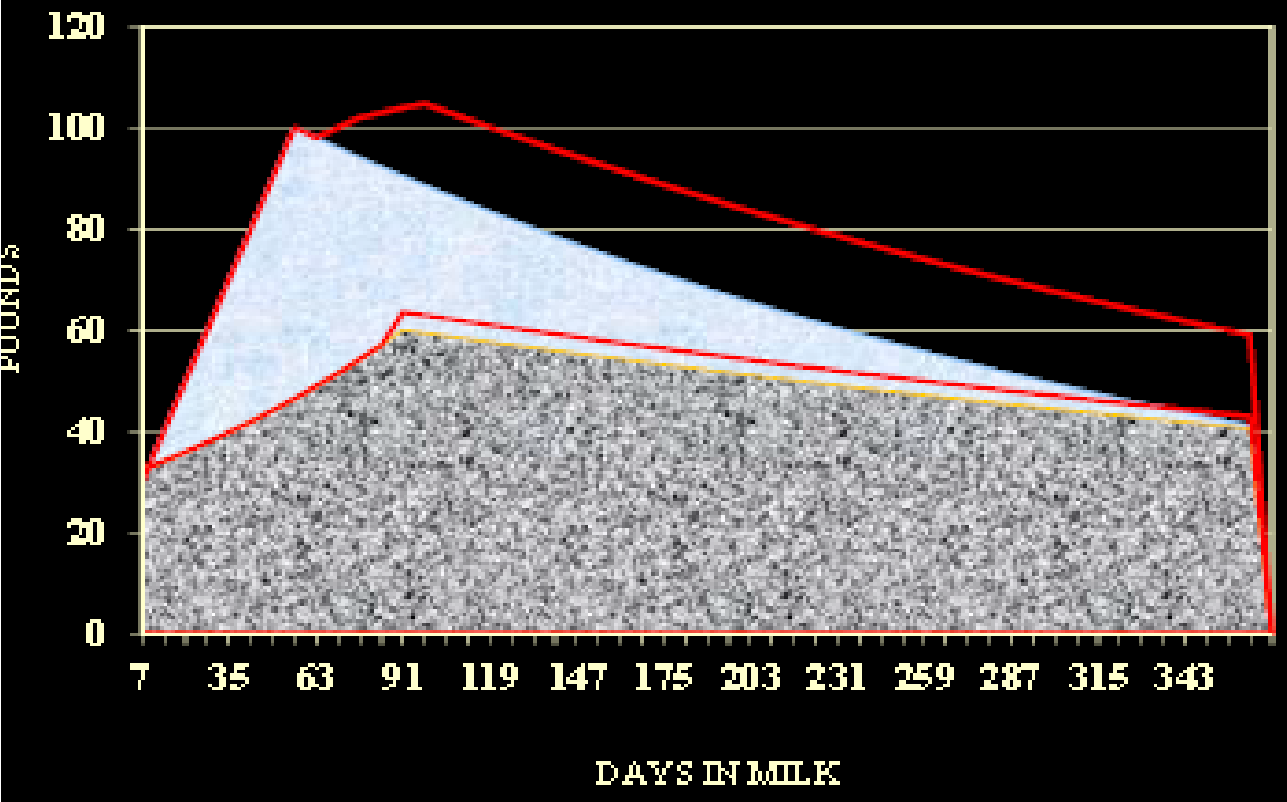


三个州69个牧场76个样品

- **46/76 使用了籽粒揉碎**，5/76使用籽粒破碎压辊
- **72/76 使用青贮窖/青贮堆**，4/76使用袋装青贮
- 品种：
  - **31/76使用粮饲通用**
  - 19/76使用青贮专用
  - 11/76使用BMR褐色叶中脉品种
  - 11/76使用混合品种
- **63/69使用了青贮接种剂**

奶牛饲喂效率的提高——料奶比

Production Enhancers



29.8 KG

- MILK =65.5
  - MILK = 79.8
    36.2 KG
- DMI = 48.3 21.9 KG
  - DMI = 50.5
    22.9 KG
- EC-DME = 1.36
  - EC-DME = 1.58

奶牛饲料添加剂的使用

Hutjens Priority

1. Rumen impact
   - 1a Rumensin
   - 1b Yeast and yeast culture
   - 1c Sodium bicarb/S-carb
2. Silage inoculants
3. Organic trace minerals (Zn, Se, & Cu)
4. Biotin

U.S. Feed Additive Use

(2013 Hoard's Market Survey)

	2006	2014
Buffers	41	40
Yeast/yeast culture	28	27
Rumensin	15	21
Niacin	9	11
Probiotics	11	13
Mycotoxin binders	11	22
Anionic products	3	6
Feed bunk stabilizer	na	3
Don't use	11	10

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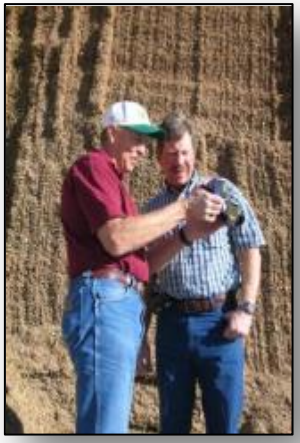
What Else is New with Corn Silage? XM1166, 阻氧膜和青贮堆

- **A strong trend towards more drive-over piles**

- **New technologies** like ***L. buchneri* inoculants**, **oxygen-barrier film** and **facers** make piles a viable, flexible method of preserving silage.

- IR camera technology proves the benefits of these management practices.



先锋先牧1166乳酸发酵添加剂投入1元，回报7元

通过乳酸菌酶活动作用可以实现高于作物收获时的营养价值

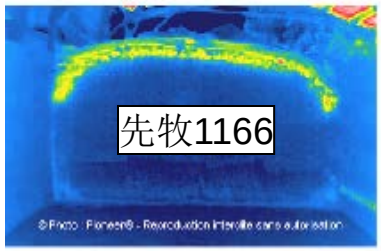
3

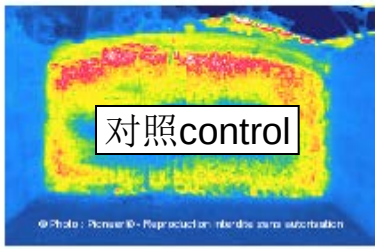
通过乳酸菌添加剂保存饲料最初的营养价值

1

2

通过特定乳酸菌菌种大幅减少开窖饲喂损失





先锋品牌

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美国先锋良种
青贮行业领导者

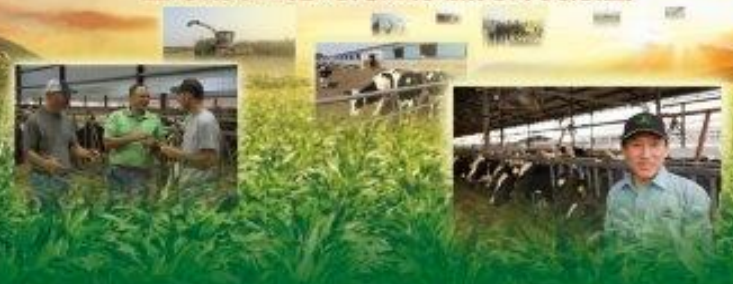
独创动物营养中心、30年研发经验

丰富种质资源

美国39%的农户首选先锋玉米种子

北美市场28%的农户使用先锋苜蓿种子

全球奶农1亿吨青贮添加先锋乳酸菌



更多内容请访问先锋中国网站 www.pioneer.com/china

美国先锋国际良种公司
电话：010-85571642 010-85571620
400 8151 335（河北、河南、山东、山西、陕西等区域）
400 8150 188（黑龙江、吉林、辽宁、内蒙、甘肃等区域）
网址：www.pioneer.com/china

（以上数据来自先锋良种）

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优质玉米种及苜蓿种
源自先锋良种

玉米种子

河南省：先玉808
河北省：先玉688
山东省：先玉688、先玉045
安徽省：先玉688
山西省：先玉987、先玉508
陕西省：先玉987
天津市：先玉1411

黑龙江：38P05(早熟)
吉林省：先玉335
辽宁省：先玉027
内蒙古：先玉335、先玉696、先玉698
宁夏：先玉335
新疆：先玉335
甘肃：先玉335

苜蓿种子

先牧54V09（抗冻星）
先牧55V48（高产王）
先牧55V12（不倒翁）
先牧56S82（多一茬）
先牧59N59（速生王）

青贮乳酸菌

先牧1166（XM1166）

- 先锋良种，源自美国，始于1926年
- 享誉全球的玉米种业公司
- 精选全球60%玉米种质资源
- 全球奶农1亿吨青贮添加先锋乳酸菌

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（以上数据来自先锋良种）

谢谢聆听，合作创新
用先锋世界经验服务中国奶农！
Thank you……

史枢卿

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