

# DISTILLERS GRAINS in Cattle Diets

F. E. W. Workshop  
St Louis, MO  
June 28, 2007

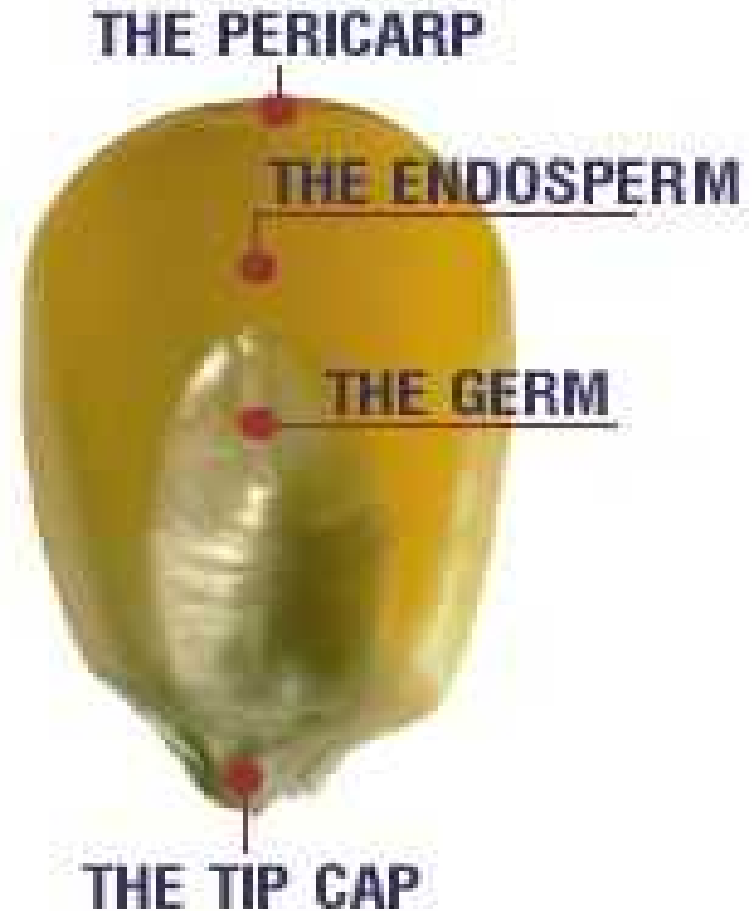
Al Miron PhD, PAS  
Land O' Lakes Purina Feeds

# Objectives

- Look at production of distillers grains in the United States
- Evaluate the use of distillers grains in cattle diets
- Look at factors limiting use in cattle diets

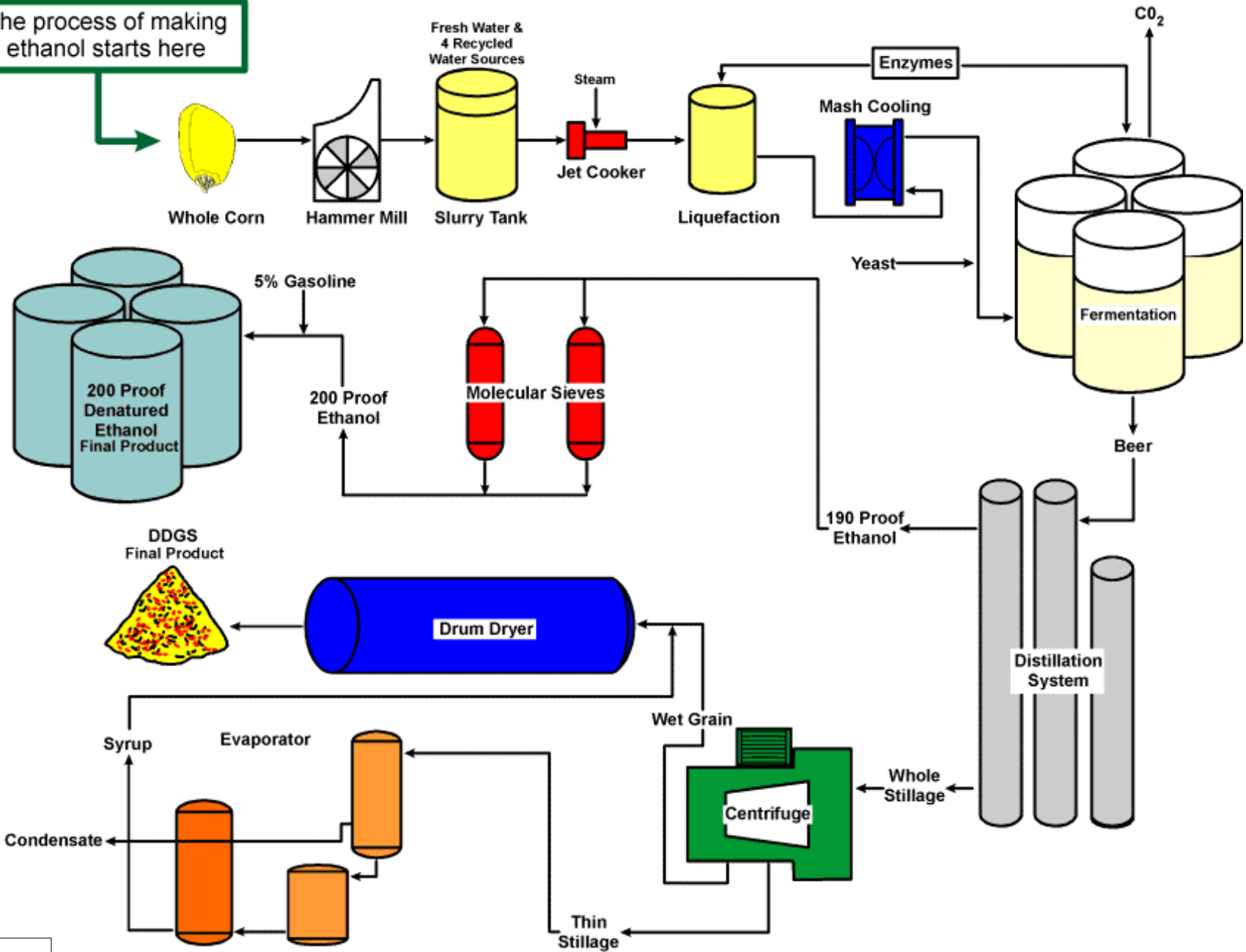
# Components of Yellow Dent Corn

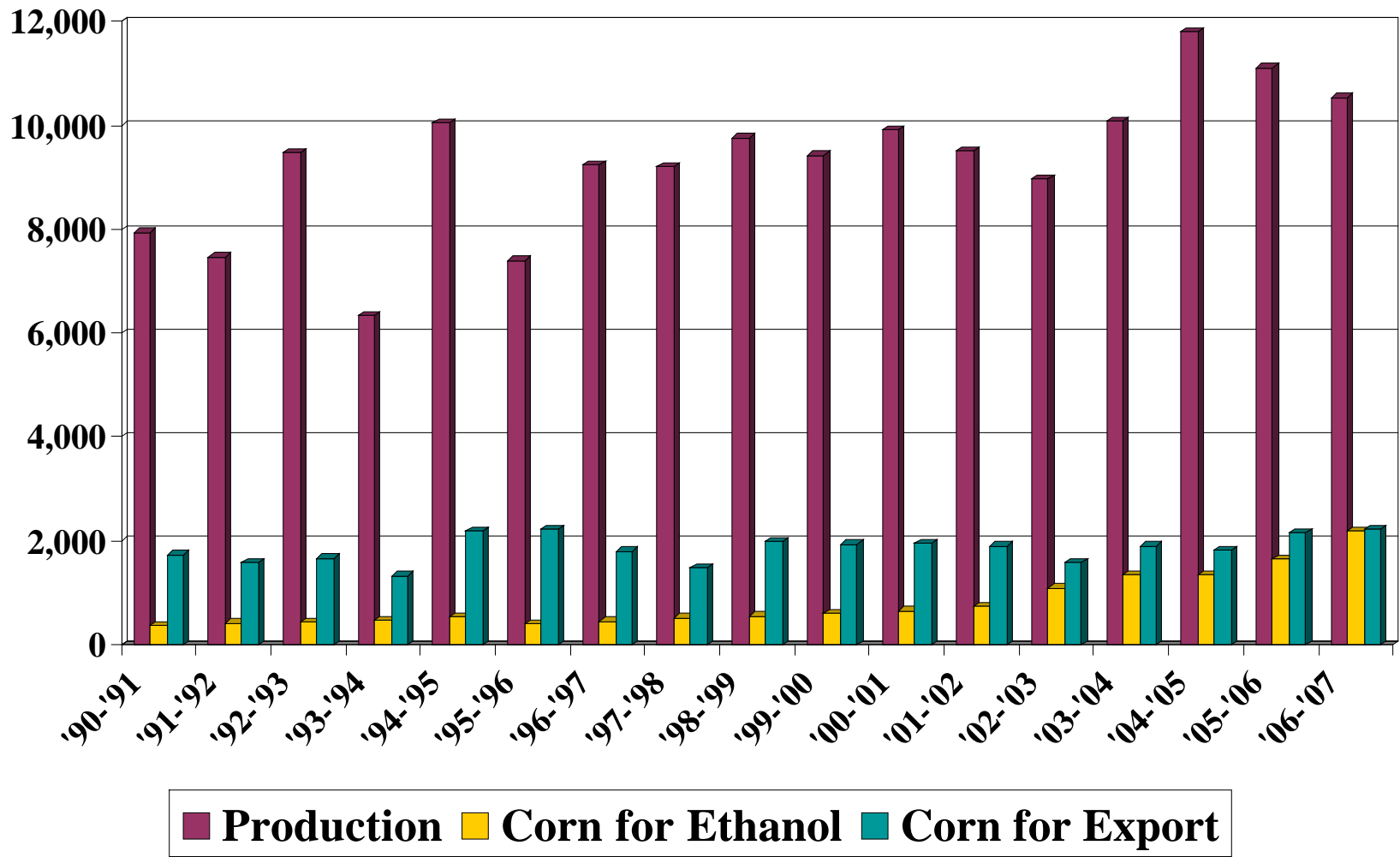
<b>Starch</b>	<b>72.6 %</b>
<b>Corn Oil</b>	<b>4.3 %</b>
<b>Protein</b>	<b>9.8 %</b>
<b>NDF</b>	<b>9.0 %</b>
<b>Minerals</b>	<b>1.6 %</b>



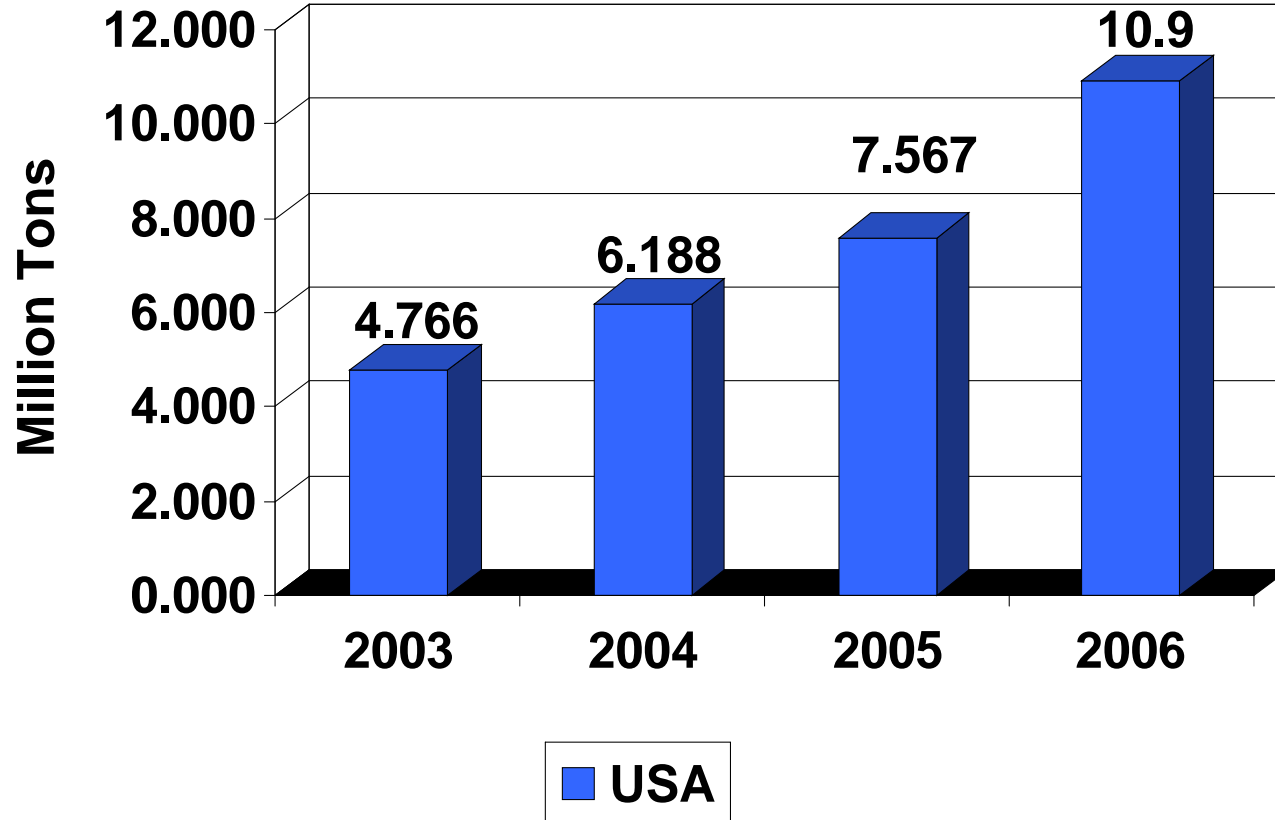
# Dry Grind, Fuel Process

The process of making ethanol starts here





# USA DDGS Production



# Market Opportunities in USA<sup>1</sup>

Species	Feed <sup>a</sup>	% Incl <sup>b</sup>	DDG/S <sup>a</sup>
G/F Pig	34.4	10	3.4
Fin. Cattle	37.9	5	1.9
Dairy	31.5	10	3.2
Broilers	43.4	5	2.2
Layers	13.5	10	1.4
Turkeys	13.2	10	1.3
Total			13.4

<sup>1</sup> Feed Mgmt Mag '03

<sup>a</sup> Tons x 1,000,000

<sup>b</sup> Reasonable or  
Conservative

Source: Poet

# Corn Condensed Distillers Solubles

- May be sold as a ingredient in liquid form
- Dry matter basis 22 - 29% protein, 9 - 20% fat and 4% fiber. Typical dry matter 25 - 35%
- Excellent source of vitamins and minerals, especially phosphorous and potassium
- Can be dried to 5% moisture
- Highly palatable
- May be high in sulfur (1.0 to 1.5% of DM)
- Usually added to distillers grain and then dried

# CDS IN FINISHING RATIONS

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		4%	8%
	Control	CDS	CDS
Initial Wt	850	846	852
ADG	3.46	3.57	3.24
DMI	21.0 <sup>a</sup>	20.6 <sup>a</sup>	19.3 <sup>b</sup>
F/G	6.08	5.78	5.99

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a,b (P<.05)

126-d trial; all rations with 10% corn silage, 5% hay.

ISU Trenkle, 2002 Beef Res. Rpt.

# DDGS Nutrient Profile Comparison

**Wet Grains fraction compared to Solubles fraction\***

<b>Nutrient</b>	<b>Grains Fraction</b>	<b>Solubles Fraction</b>
Dry Matter, %	<b>34.3</b>	27.7
Crude protein, %	<b>33.8</b>	19.5
Crude fat, %	7.7	<b>17.4</b>
Crude fiber, %	<b>9.1</b>	1.4
Ash, %	3.0	<b>8.4</b>
Calcium, %	0.04	0.09
Phosphorus, %	0.56	<b>1.30</b>

\*Goihl, Knott, and Shurson: Random samples from 6 Minnesota ethanol plants taken over a three week period and tested at Iowa Testing Laboratories, Eagle Grove, Iowa. Mean values reported.

# Distillers Dried Grains With Solubles or DDGS

- Starch is removed from grain in alcohol production
- Nutrients remaining are about 3X that of the incoming grain
- Contains recycled microbial products
- Yeast provide increased vitamins, particularly B-complex group
- May come from corn or other grains

# Distillers Dried Grains with Solubles

- Typically analyzes 27-30% protein, 10-14% fat and 9% fiber
- Provide ruminants an excellent source of bypass protein
- Often sold in the wet or modified wet form
- Successfully used in rations for beef, sheep, dairy, poultry, swine, aquaculture and pet food

# Protein Value of Distillers Grains

- 27-30% of DM
  - More than old “book values”*
  - Good source of Ruminally Undegradable Protein (~55% RUP/UIP)

Protein quality:

*Fairly good quality (color/heat damaged)*

*Lysine may be limiting*



# Energy Value of Corn & Co-products

	NE <sub>g</sub> Mcal/100 lb.
Corn	68.2
Flaked Corn	73.6
Distillers Gr. W. Sol.	68.2
Distillers Sol. Dehy.	68.2
Distillers Gr. Wet	70.5
Corn Gluten Feed	59.1

1996 Beef NRC

# Energy Value of DDGS

- Decreased slightly with drying.
- May vary with source plant
- Will vary with fat content
- Will vary with inclusion rate
- Is dependent upon associative effects of feedstuffs
- Calculated to be 104 to 108% that of corn

# Energy Value of Distillers Grain

DG Level %	<u>0</u>	<u>10</u>	<u>20</u>	<u>30</u>	<u>40</u>	<u>50</u>
Steers, n	48	48	48	48	48	48
Days on Feed	126	126	126	126	126	126
Initial BW, lb	774	772	772	772	774	772
Final BW, lb	1234	1285	1291	1313	1313	1267
DMI, lb/day	24.0	24.6	25.1	26.0	24.4	23.3
ADG, lb/day	3.65	4.07	4.11	4.31	4.27	3.92
Feed:Gain lb/lb	6.52	6.06	6.10	5.78	5.68	5.92
Energy Value, %		178	138	144	137	121

Adapted from Vander Pol et al Nebraska 2006 Beef Cattle Report

# WDGS IN FINISHING RATIIONS

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	Control	20% WDGS	40% WDGS
Initial Wt	938	940	948
ADG	3.03	3.36	3.00
DMI	19.7	19.2	17.6
F/G	6.50	5.75	5.89

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113-d trial; all rations with 12% alfalfa.  
ISU Trenkle,

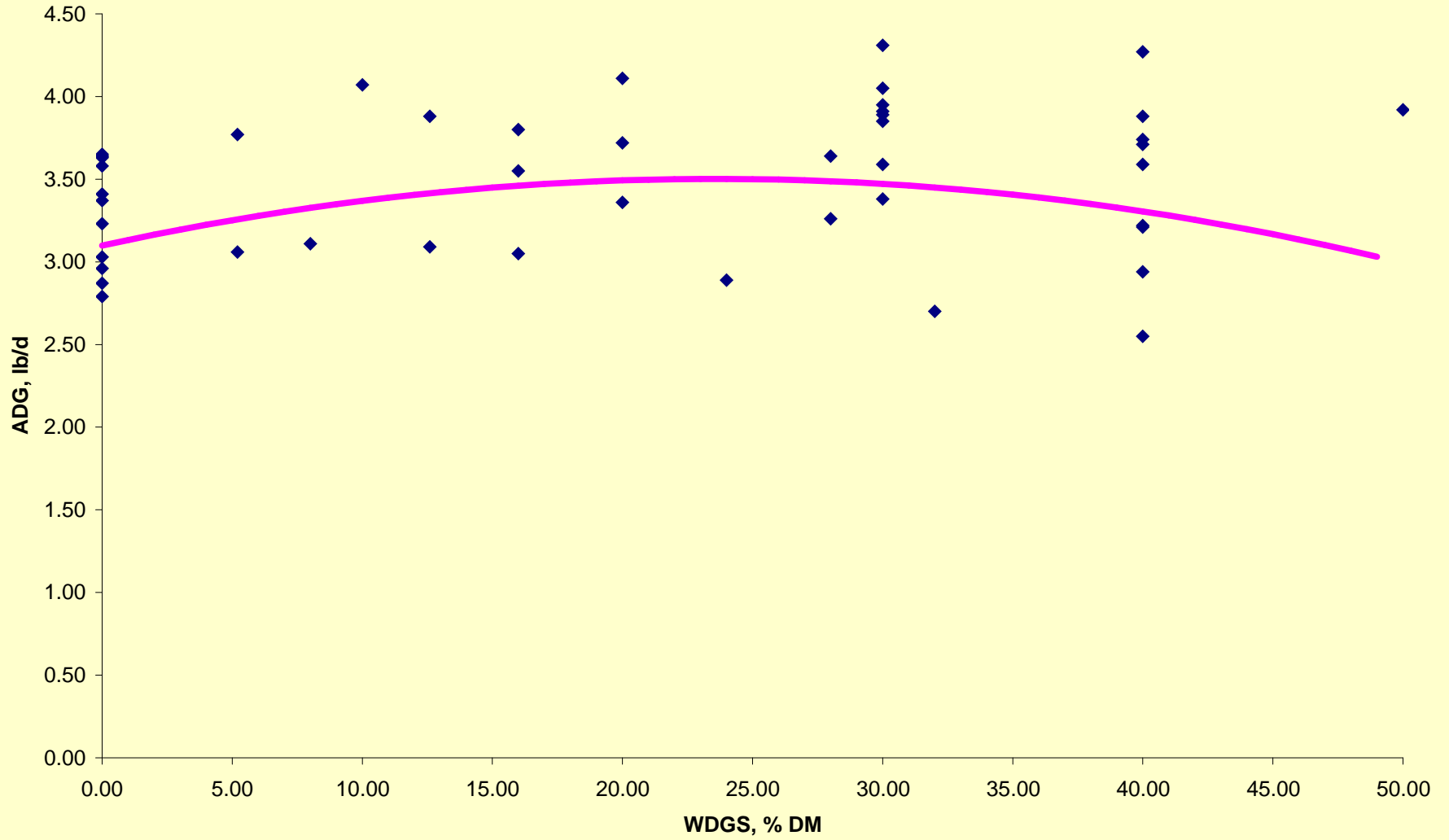
## Composition of diets fed to finishing steers

Item	Control	20% DDGS	40% DDGS	20% WDGS	40% WDGS
<b>Ingredients composition, % diet DM</b>					
Alfalfa hay	10.0	10.0	10.0	10.0	10.0
DDGS	-	20.0	40.0	-	-
WDGS	-	-	-	20.0	40.0
Cracked corn	73.5	64.0	43.6	64.0	43.6
Soybean meal	10.5	-	-	-	-
Wet molasses	4.0	4.0	4.0	-	-
Dry molasses	-	-	-	4.0	4.0
Limestone	-	-	0.4	-	0.4
Mineral Supplement	2.0	2.0	2.0	2.0	2.0
<b>Nutrient composition</b>					
Dry matter, %	86.2	86.6	86.9	67.3	54.7
Crude protein, % DM	14.6	14.5	18.7	14.7	19.1

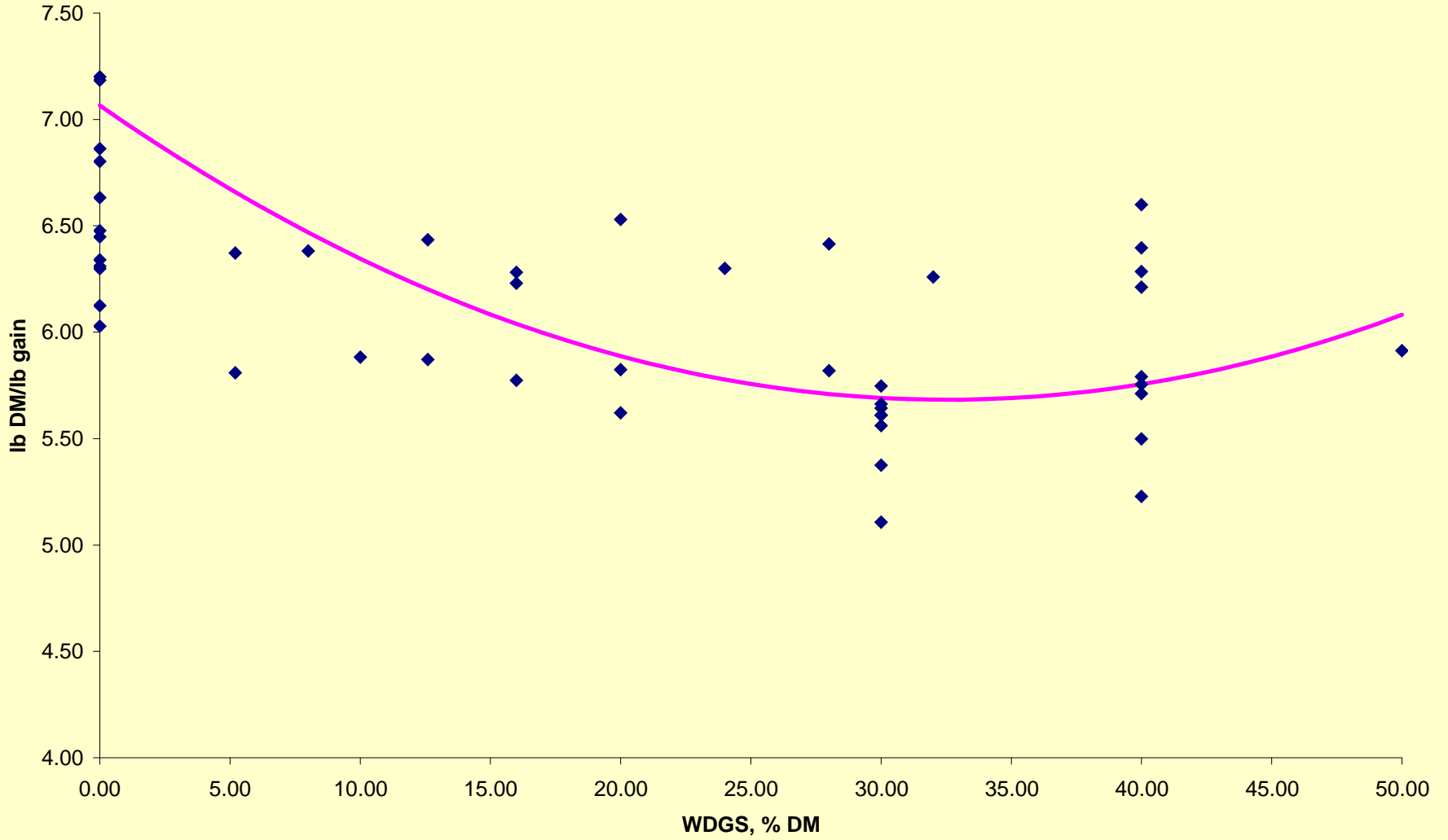
## **Intake and performance of finishing steers fed dry or wet distiller's grains with solubles**

	<b>Control</b>	<b>20% DDGS</b>	<b>40% DDGS</b>	<b>20% WDGS</b>	<b>40% WDGS</b>
<b>Initial weight, lb</b>	<b>755</b>	<b>756</b>	<b>760</b>	<b>751</b>	<b>755</b>
<b>Final weight, lb</b>	<b>1255</b>	<b>1268</b>	<b>1282</b>	<b>1264</b>	<b>1278</b>
<b>Dry matter intake, lb/d</b>	<b>21.82</b>	<b>23.15</b>	<b>23.42</b>	<b>22.37</b>	<b>20.82</b>
<b>Average daily gain, lb/d</b>	<b>3.63</b>	<b>3.65</b>	<b>3.72</b>	<b>3.72</b>	<b>3.74</b>
<b>Feed to gain ratio</b>	<b>6.02</b>	<b>6.36</b>	<b>6.30</b>	<b>6.03</b>	<b>5.57</b>
<b>Hot carcass weight, lb</b>	<b>768</b>	<b>773</b>	<b>779</b>	<b>774</b>	<b>775</b>

**ADG Response  
(750-lb 15% 45% DIP)**



**FTG Response**  
**(750-lb 15% 45% DIP)**



# Observations Made By DiCostanzo

- Optimum WDGS inclusion for:
  - ADG = 24%
  - FTG = 32%
- WDGS diets at 24% inclusion
  - CP at 15%
  - DIP between 40% and 43%
- WDGS diets at 32% inclusion
  - CP at 16%
  - DIP between 40% and 43%

# Benefits of Distillers Grains in Beef Diets

- Most basal diets fed to beef animals are deficient in protein
- Distillers grains are generally an economical source of supplemental protein
- Distillers grains are especially high in UIP
- Do we need to supplement with DIP for effective utilization of distillers grains?

# Benefits of Distillers Grains in Beef Diets

- Distillers grains are palatable
- Most trials show no change to slight increases in feed intake
- Intake response may be due to:
  1. More adequately meeting protein needs
  2. Improvements in rumen health
  3. Microbial metabolites
  4. Ration conditioning

# Benefits of Distillers Grains in Beef Diets

- Typical beef ration would require supplementation with about 1 pound of soy.

	Cents per day
1 lb. soybean meal..	10.0
0.144 lb. urea and 0.856 lb. corn..	8.8
1.78 lb. DDGS minus .78 lb. corn..	5.3
Savings	3.5 to 4.7

# Benefits of Distillers Grains in Beef Diets

- Rumen Health:

Distillers grains are high in energy but low in starch. When used at ~15% in the diet we can reduce starch levels in the diet by about 7%. This can help to stabilize rumen pH and decrease acidosis.

# Concerns for the use of distillers grains in beef diets

## Effect on carcass quality

- Summary of 21 individual trials in 6 states showed:
  1. Marbling increases 3.7 units with 12% distillers grain in the diet
  2. Marbling declines below control with 23% or more distillers grain in the diet

From Reinhardt et al Midwest Animal Science 2007

# Concerns for the use of distillers grains in beef rations

- Consider shrink, spoilage concerns and transportation costs of wet products
- Protein quality may be of concern. Especially the Lysine content of UIP
- Avoid products excessively damaged by drying
- Phosphorus may be of concern
- Sulfur may be high. Know the sulfur content
- Consider fat level in the diet (5 to 7% best)
- Product variation may be of concern
- Work with reputable suppliers that provide a quality product free of mycotoxins

# Formulating Beef Rations With Distillers Grains

- Know the nutrient content of the distillers grain being fed (protein, fat, P and S)
- Use a reasonable energy value and roughage level (5-10%)
- Make sure adequate calcium is provided
- Generally 15% distillers grains will meet protein needs and keep phosphorus, sulfur and fat at a manageable levels.
- 40% usually a safe maximum level

# Sulfur Induced Polio

- Maximum suggested sulfur level is 0.4% of ration dry matter
- Considerable variation in animal tolerance
- Performance may be reduced at even lower levels of intake
- Total sulfur intake should include water sources

# Sulfur Induced Polio

- Normal sulfur levels in the diet are 0.15 to 0.20% or one part sulfur to 11 or 12 of N
- Feed intake and performance may be reduced when sulfur exceeds 1 part for every 9 parts nitrogen (about 0.25 to 0.3%)
- Most common sources of excess sulfur include: excess protein, plants that accumulate sulfur, co-product feeds with added sulfur or water sources

# Sulfur in Water

- Sulfur in water is usually expressed as  $\text{SO}_4$  and in ppm
- $\text{SO}_4$  is 35% sulfur
- An estimate of water intake is 3X feed intake (this will be higher in summer)
- If  $\text{SO}_4$  is about  $\frac{1}{3}$  S and water intake is 3X feed then  $\frac{1}{3} \times 3 = 1$
- Therefore take water sulfate in ppm and move the decimal 4 places to the left and add this to the % sulfur in the feed to get total ration sulfur

# EFFECT OF SULFATES IN WATER ON GROWING STEERS

	Water Sulfate Level,ppm			
	400	1700	2900	4600
<b>Initial wt, lb</b>	<b>642</b>	<b>640</b>	<b>640</b>	<b>640</b>
<b>ADG, lb</b>	<b>1.79</b>	<b>1.65</b>	<b>1.48</b>	<b>.62</b>
<b>DM Intake, lb/d</b>	<b>20.8</b>	<b>20.6</b>	<b>18.9</b>	<b>13.2</b>
<b>Gain/Feed</b>	<b>0.086</b>	<b>0.080</b>	<b>0.078</b>	<b>0.045</b>
<b>H<sub>2</sub>O Intake, gal/d</b>	<b>15.0</b>	<b>13.4</b>	<b>11.9</b>	<b>9.5</b>

# EFFECT OF SULFATES IN WATER ON HEALTH OF STEERS

	Water Sulfate Level,ppm		
	<u>400</u>	<u>3100</u>	<u>3900</u>
Water Source	Rural	Well	Dam
Morbidity, % <sup>a</sup>	0.0	25.0	15.0
Mortality, %	0.0	5.0	5.0
Polio, % <sup>b</sup>	0.0	15.0	12.5

<sup>a</sup>  $p < 0.05$

<sup>b</sup>  $p < 0.10$

Patterson SDSU

# New Generation Distillers Co-Products

- Corn germ removed prior to fermentation
- Corn oil removed from distillers grains
- Products might include:
  - Corn germ
  - Corn bran
  - High protein distillers grain
  - Corn oil

# New Generation Distillers Co-Products

- Co-Products from new generation plants have performed well in animal trials
- Nutritionists must consider nutrient content and the cost of those nutrients
- Nutritionists must be aware of factors limiting the use of co-products and formulate accordingly

# Distillers Grains Values

-ration balancing software



- Looks at a variety of ingredients and predicts best cost ingredients at best inclusion levels.
- **Very dependent on nutrient profiles entered for ingredient!**

# Benefits of Distillers Grains in Dairy Diets

- Distillers grains are palatable
- Economical source of crude protein
- Good source of RUP especially methionine
- DDGS are a good source of phosphorus
- DDGS are a good source of energy
- Energy sources from fat and digestible fiber rather than starch help to reduce acidosis

# Performance of Dairy Cows Fed SBM or DDGS

	Treatment	
	Control	20% SBM      DDGS
DM Intake, lb.	47.1	47.1
Milk, lb.	68.6	76.1
4% FCM	65.1	71.9

Significant improvement in milk and 4% FCM. No significant differences in production between three sources of distillers grains with solubles

Kleinschmit et al  
SDSU

# Performance of Dairy Cows Fed Wet Distillers Grains

	% Wet Distillers Grain DM Basis			
	<u>10%</u>	<u>20%</u>	<u>30%</u>	<u>40%</u>
DM Intake, lb.	56.5	54.1	48.4	40.5
Milk, lb.	88.2	80.7	76.8	76.6
Milk Fat, %	2.64	2.96	2.93	2.64
Milk Protein, %	3.21	3.24	3.15	3.34

Kalscheur et al  
SDSU 2004

# Performance of Dairy Cows Fed Dry or Wet DGS

	Treatment				
	Control	10% DDGS	20% DDGS	10% WDGS	20% WDGS
DM Intake, lb.	51.5	49.9	49.5	50.6	48.2
Milk, lb.	87.6	90.0	93.5	93.5	95.7
Milk Fat, %	3.23	3.16	3.28	3.55	3.40
Milk Protein, %	3.05	3.01	3.02	3.11	3.06

Ladd et al  
SDSU

# Practical Use of DDGS in Dairy Diets

- SDSU research indicates good performance to 20% of dry matter in dairy diets
- Generally used at 10% or less depending on other ration components
- Generally supplemented with products to supply lysine such as blood meal, treated soy or fish meal
- May affect milk fat content depending on other sources of fat in the ration

# Practical Use of DDGS in Dairy Diets

- Generally limit the amount of DDGS so that it provides a maximum of 0.5 to 1.0 lb of fat
- Use levels make it difficult to use wet grains on most upper mid west dairy farms
- Spoilage in wet grains may cause variations in dry matter intake
- Make sure DDGS are checked for mycotoxins
- Provides a good amount of phosphorus
- Avoid Products with excessive heat damage

