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# ETHANOL PRODUCTION: IMPLICATIONS FOR POULTRY FEEDING

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# Projected Ethanol, By-product Production and Usage for Ethanol

	2006/07	2007/08	2008/09	2009/10	2010/11
Ethanol Produced, billion gal.	4.95	6.29	7.33	8.39	9.20
Corn required, billion bu.	2.15	2.51	2.91	3.22	3.46
Ethanol by-product feeds (dry basis), million tons	14.37	17.40	20.82	23.41	25.45
Corn crop, billion bu	10.74	11.48	11.99	12.27	12.50
% Corn crop	20.01	21.86	24.27	26.24	27.68

FAPRI, 2006

**Net results – increases in ethanol, corn price, corn acreage, feed use of by-products? and decrease in corn exports?**

# Types of Distiller's By-Products From Dry-Grind Ethanol Plant

- **Wet distiller's grains**
  - Fed primarily to beef, some dairy
- **Dry distiller's grains**
  - Fed to beef and dairy
- **Wet distiller's grains with solubles**
  - Fed to beef and dairy
- **Dried distiller's grains with solubles**
  - Fed to dairy, swine, poultry, some beef
- **Modified wet cake (blend of wet and dry distiller's grains)**
  - Fed primarily to beef, some dairy
- **Condensed distiller's solubles**
  - Fed to beef and dairy
  - Ontario, Canada – swine liquid feeding system

**The poultry (and swine) sector(s) have the greatest potential for increased DDGS usage**

# Corn Distillers Dried Grains and Solubles



## Nutrient Composition of DDGS for Poultry

Component (%)	Mean	Range	CV (%)
TME (kcal/kg)	2,863	2607-3054	3.6
Lysine	0.73	0.59-0.89	11.6
Lysine Dig.	72	59-84	11.2
Methionine	0.49	0.41-0.60	9.7
Methionine Dig.	88	85-92	1.9
Threonine	0.98	0.85-1.14	6.0
Threonine Dig.	76	69-83	4.8
Fat	10	4-16	4.8
Ca	0.03	0.02-0.04	38.4
P	0.73	0.62-0.77	5.3
Na	0.24	0.05-0.45	32.8



# Practical Issues with DDGS Use in Poultry Diets

- **Availability**
  - Price!!
- **Product Consistency – Predictable**
  - **Nutrient variability**
    - Moisture, Crude protein, Sodium, Fat, etc.
  - **Nutrient digestibility (esp. for lysine)**
  - **Reliance on one Supplier?**
- **Logistics and Handling – Flow-ability**
  - **Pellet quality**
  - **Particle Size**
- **Mycotoxins**
- **High fiber limits its maximum inclusion level**

# Increasing Costs

- **Increasing price of corn**
  - Increased price of DDGS
  - Currently DDGS is priced at about 110% of corn
  - To be economical for poultry DDGS needs to be priced at approx. 80% of corn
- **Increasing price of energy**
  - Corn is the main energy source in poultry diets
- **Increasing feed costs**
  - Estimated 18% increase in poultry feed costs
- **Increase in food costs?**

# DDGS – Product variability/consistency

- **Grain input:**
  - CP% of corn  $6.8 \times 3 = 20.4\%$  CP
    - $0.22\%$  lysine  $\times 3 = 0.66\%$  lysine
  - CP% of corn  $8.2 \times 3 = 24.6\%$  CP
    - $0.30\%$  lysine  $\times 3 = 0.90\%$  lysine
- **Processing at plant**
- **Drying temperature**
- **Solubles**
  - Amount added back
  - Change nutrition profile
  - Syrup balls

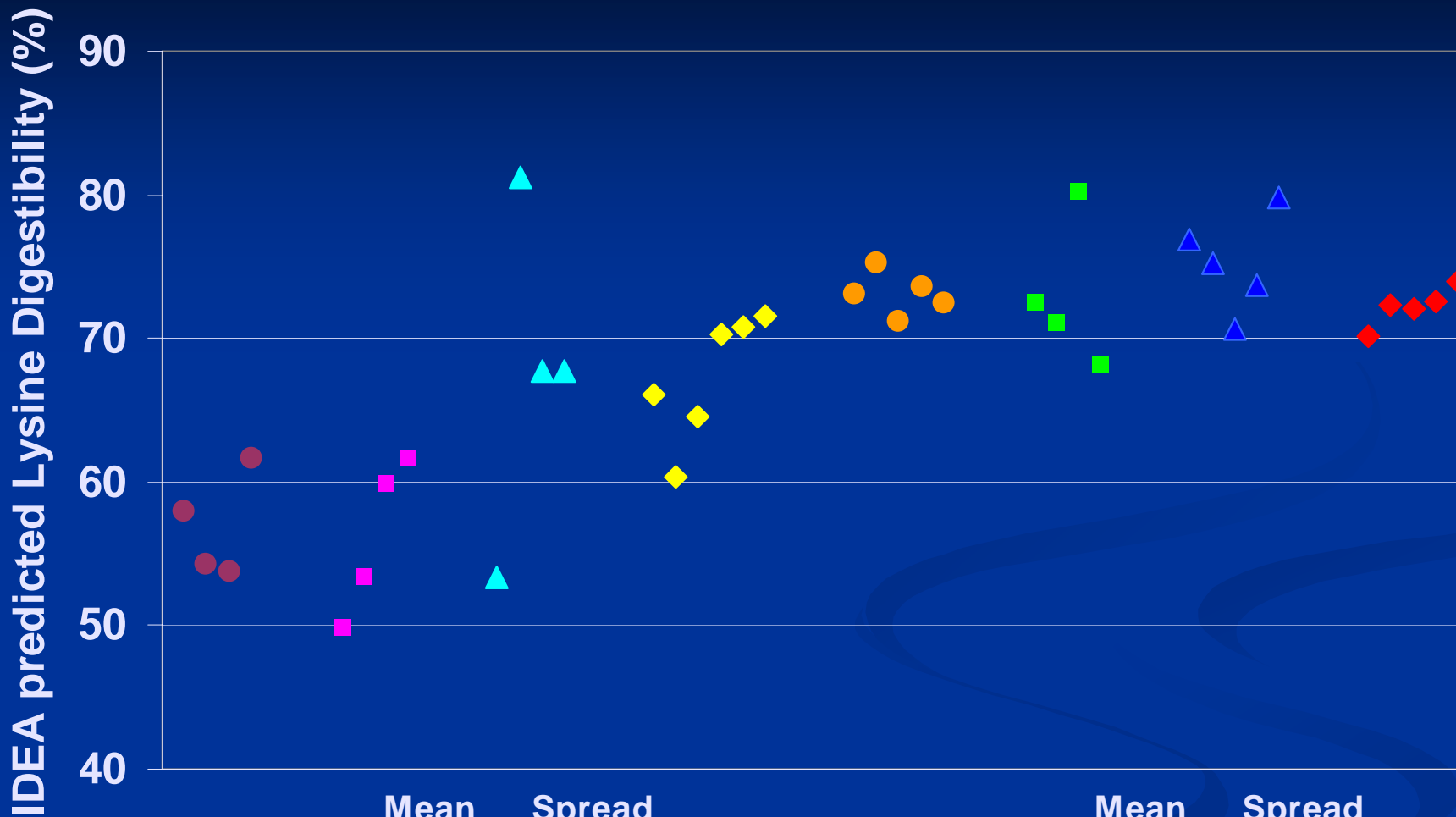


## **Nutrient composition of distiller's dried grains and distiller's solubles**

	<b>Distillers dried grains</b>	<b>Distillers Solubles</b>
<b>Crude Protein, %</b>	<b>34</b>	<b>19</b>
<b>Lysine, %</b>	<b>1.05</b>	<b>0.68</b>
<b>Methionine, %</b>	<b>0.66</b>	<b>0.27</b>
<b>Threonine, %</b>	<b>1.27</b>	<b>0.70</b>
<b>Crude Fiber, %</b>	<b>10</b>	<b>3</b>
<b>Fat, %</b>	<b>8</b>	<b>16</b>
<b>Total P, %</b>	<b>0.54</b>	<b>1.30</b>

**\*Values are expressed on a Dry Matter basis**

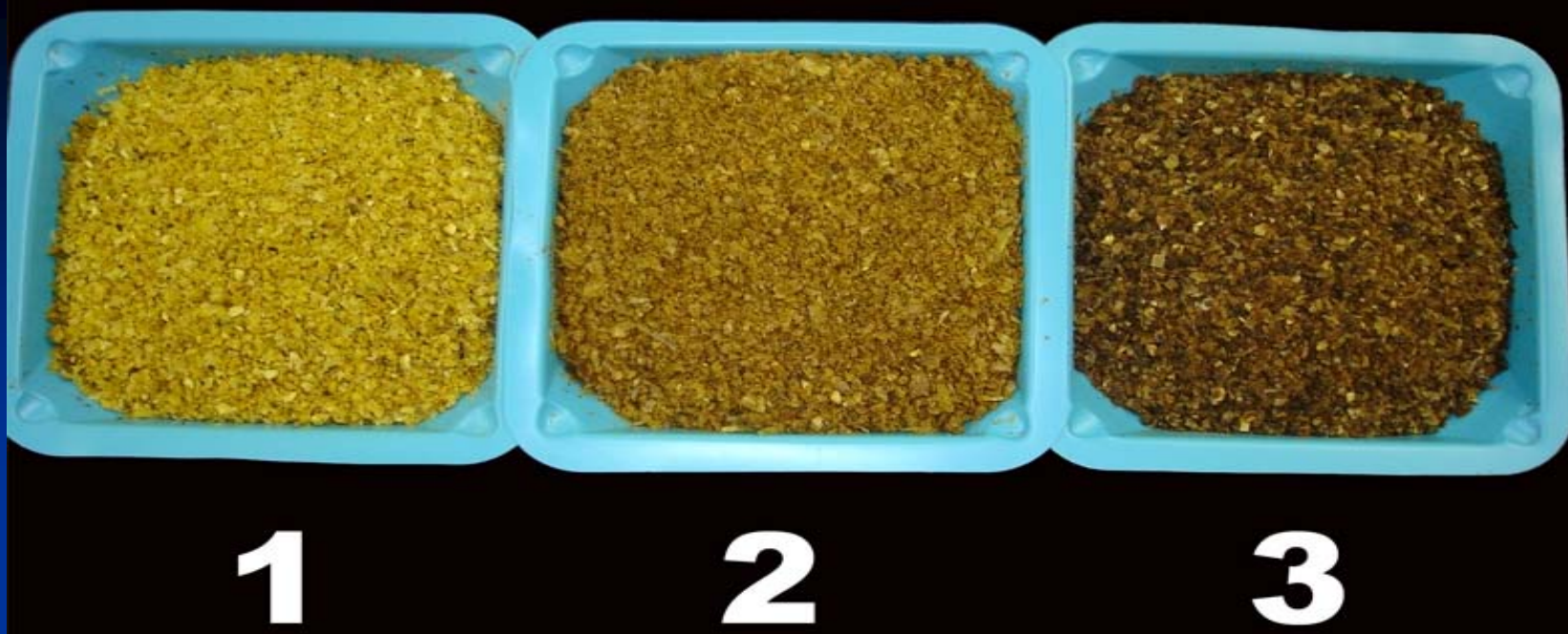
# DDGS Product Variation Between Supplier/Plant



	Mean	Spread		Mean	Spread
● Supplier 1	56.9	7.9	● Supplier 5	73.1	4.0
■ Supplier 2	56.3	11.9	■ Supplier 6	73.1	12.1
▲ Supplier 3	67.5	27.8	▲ Supplier 7	75.3	9.1
◆ Supplier 4	67.2	11.1	◆ Supplier 8	72.2	3.9

# **DDGS – Over-processing/High Drying Temps**

- **Effect on Lysine Availability**
  - Decrease in lysine availability due to overheating
- **Effect on Phosphorus Availability**
  - Increase in P availability with heating
  - Inverse relationship between lysine and P availability
- **Increase in peroxidation values – increase in rancidity?**



### Color

Spl	L* (Lightness)	b* (Yellowness)	a* (Redness)	Total Lys	Lys Dig. Co	Dig. Lys
1	60.3	25.9	5.0	0.86	76.8	0.66
2	57.7	18.3	6.2	0.82	72.1	0.59
3	50.4	7.41	5.2	0.39	45.8	0.18

Color (L\*, b\*, a\*) was measured with a Minolta Chroma Meter CR-300

## Available Phosphorus (P) in DDGS

Ingredient	% P	Avail. P %	% Phytate P	% Avail. P
Corn*	0.28	0.08	0.20	29
SBM*	0.62	0.22	0.40	35
DDGS*	0.72	0.39	0.33	54
<b>DDGS (UGA)<sup>1</sup></b>	<b>0.74</b>	<b>0.47</b>	<b>0.27</b>	<b>64 (68)</b>
DDGS (UI) (MSU)	0.73	0.60 (approx.)	0.13	<b>69-102 (82)</b> <b>76-85 (80)</b>

<sup>1</sup> Average of 9 DDGS samples varying in color and plant location.

\* NRC (1994) values for poultry

# Sodium (%) Composition of DDGS

Sample	Sodium	
1	0.09	
2	0.12	
3	0.29	
4	0.11	Avg. 1-7 = 0.13%
5	0.12	
6	0.11	
7	0.09	
8 <sup>1</sup>	0.42	
9 <sup>1</sup>	0.44	
10 <sup>1</sup>	0.39	Avg. 8-12 = 0.42%
11 <sup>1</sup>	0.43	
12 <sup>1</sup>	0.43	
<b>Average ± SD</b>	<b>0.25 ± 0.15</b>	
<b>NRC (1994)</b>	<b>0.48</b>	
<b>Projected</b>	<b>0.06</b>	

<sup>1</sup> Samples obtained from same plant at different time periods



# DDGS

## Handling/Flowability/Pellet Quality

- DDGS setting up in rail cars, trucks, barges – still a problem
  - Effect of supplier
  - Currently no flow agents have been found that correct the flow or handling problems of DDGS, Some help
- Increasing DDGS use in diets– negative effect on pellet quality
- Bin space at feed mills?

# **DDGS use in Poultry Diets**

# What DDGS Replaces in Poultry Diets

- **Corn**

- 7.5% CP, 3,390 kcal/kg (1,540 kcal/lb), 0.24% lys

- **Soybean meal**

- 48% CP, 2,458 kcal/kg (1,115kcal/lb), 3.02% Lys

- **Phosphorus**

- Reduce P supplementation

- **Meat and Bone meal (Poultry By-product meal)**

# Other Changes in Poultry Diets with the Inclusion of DDGS

**Increases in:**

- **Fat**
- **Lysine**
- **Limestone**

# Nutrient Composition (as-fed)

## DDGS

	Corn	(new generation)	SBM
TME, kcal/kg (Poultry)	3,390	2,800	2,458
Crude Protein, %	7.5	27 (23 to 29)	47.8
Lysine, %	0.24 (81% avail.)	0.80 (75% avail.) (range 0.65 to 1.09)	3.02 (91% avail.)
Methionine, %	0.18 (91% avail.)	0.51 (85% avail.)	0.70 (92% avail.)
Crude Fiber, %	1.9	8.5	3.0
Fat, %	3.5	9.0 (3 to 12)	1.0
Total P, %	0.25	0.89	0.65
Avail. P, %	0.09 (36% avail.)	0.55 (62% avail.)	0.21 (32% avail.)

Dry Matter = average 88%, range 83 to 91%

## Metabolizable Energy (ME) Distribution of Corn and DDGS for Poultry

	Corn	DDGS	Energy Loss
Kcal/lb	3395	2820	17%
Kcal/lb	3395	931 (2820x0.33)*	73%

- Only one third (1/3) of the original corn is recovered as DDGS.
- The metabolizable energy value of DDGS is multiplied by 0.33 to reflect the amount of energy from a unit of corn that is retained in the resulting quantity of DDGS



# DDGS in Poultry Diets

- **Broilers (industry averages 2 to 8%)**
  - 6 - 9% inclusions rates during starter period
  - 12 - 15% inclusions rates during the grower and finisher periods
- **Laying Hens (chickens)**
  - 10% inclusions rates during peak production
  - 15% inclusions rates after approx. 36 wks of age – after peak production
- **Turkeys**
  - 5% inclusions rates during starter period
  - 15% inclusions rates during the grower and finisher periods

Higher levels may be used if diets are formulated on a digestible amino acid basis and are adjusted for energy

# Potential use of DDGS in Poultry Diets

- **Top Three Broiler/Layer/Turkey Companies**
  - If using 5% (10%) DDGS in all Poultry diets
  - **1.5 (3) millions tons** of DDGS per year
- **If all Poultry** (Broilers, layers, and turkey's) **were fed DDGS**
  - 5% = approx. **3.1 million** tons of DDGS per year
  - 10% = approx. **6.2 million** tons of DDGS per year

\* Conservative estimates

# New DDGS Products – Fractionation

- High Protein DDGS, Corn Germ and Bran (as-fed basis)

	DDGS (conventional)	DDGS High protein	Corn Germ Dehydrated
TME kcal/kg (Poultry)	2860	2695	2965
Crude Protein, %	27.0	43.0	15.6
Lysine, % (% CP)	0.79 (3.0)	1.03 (2.4)	0.82 (5.3)
Crude Fat, %	9.7	3.0	17.8
Crude Fiber, %	6.1	6.91	5.1
Phosphorus, %	0.79	0.37	1.40

- Problems with new HP - DDGS Product:

- Lower Fat
- Lower Phosphorus
- No Change (or decrease) in Lysine as % Crude Protein (poor AA balance)

# The usage of DDGS will depend on whether it will cost into the ration when the formulas are optimized

- Competition from other ingredients
  - Price of these ingredients
  - Energy value is the driver of the value of DDGS
- Consistency
- Nutrient value
  - Current Analytical Information
  - Amino acid digestibility - Lysine digestibility will influence the value of DDGS
- Logistics

**Bio-Diesel?**  
**Effects on Energy Cost  
for Poultry Production?**

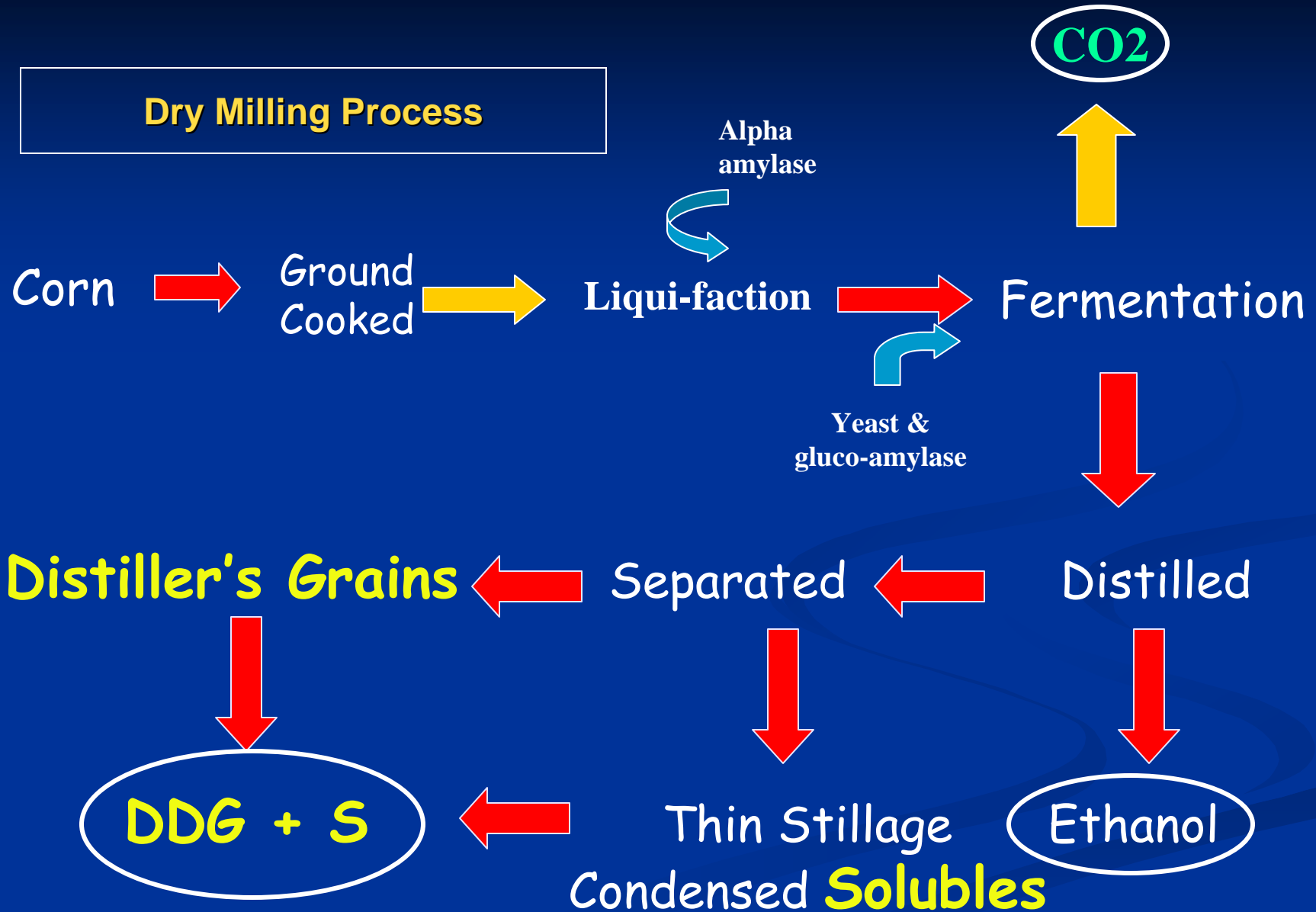
**“The Higher Grain Prices will  
be Passed along to the  
Consumer Who Will Pay  
Higher Prices for Protein and  
other Grain Dependent  
Products”**







**Dry Milling Process**



Source: H. D. Tilstra

# Potential uses of DDGS in Broiler Diets\*

- **Total Top Three Broiler Companies**

(Tyson, Pilgrims Pride, Gold Kist)

- If using 5% (10%) DDGS in all broiler diets
- **1.2 (2.4)** millions tons of DDGS per year

- **If all Broilers were fed DDGS**

- 5% = approx. **2.3** millions tons of DDGS per year
- 10% = approx. **4.6** millions tons of DDGS per year

\* Reasonable/conservative estimates

# Potential uses of DDGS in Layer Diets\*

- **Total Top Three Layer Companies**  
(Cal-Maine Food Inc, Rose Acres, Moark LLC)
  - If using 5% (10%) DDGS in all layer diets
  - **83,300** (166,600) tons of DDGS per year
- **If all Layers were fed DDGS**
  - 5% = approx. **379,000** tons of DDGS per year
  - 10% = approx. **758,000** tons of DDGS per year

\* Conservative estimates

# Potential uses of DDGS in Turkey Diets

- **Total Top Three Turkey Companies**  
(Jeannie-O Turkey, Cargill, ConAgra Foods)
  - If using 5% (10%) DDGS in all Turkey diets
  - **191,000** (382,000) tons of DDGS per year
- **If all Turkeys were fed DDGS**
  - 5% = approx. **445,000** tons of DDGS per year
  - 10% = approx. **890,000** tons of DDGS per year

\* Conservative estimates



# Amino Acid Profile

Feed to meet Amino Acid needs not a min. crude protein

	Corn	DDGS (New generation)	Soybean meal	Broiler (3-6 wks) Req. % CP
Crude protein, %	7.5	27	47.8	22
Lysine, % (% CP)	0.24 (3.2)	0.80 (3.0)	3.02 (6.3)	5.10
Methionine, % (% CP)	0.18 (2.4)	0.51 (1.9)	0.70 (1.5)	1.86
Cysteine, % (% CP)	0.18 (2.4)	0.50 (1.9)	0.72 (1.5)	1.86
Threonine, % (% CP)	0.29 (3.9)	0.92 (3.4)	2.0 (4.2)	3.41
Arginine, % (% CP)	0.40 (5.3)	1.10 (4.1)	3.6 (7.5)	5.36
Tryptophan, % (% CP)	0.07 (0.9)	0.20 (0.7)	0.70 (1.5)	0.82

# Dry-Milling Average Yield Per Bushel of Corn



- Ethanol 2.7 gallons
- DDGS 18 lbs
- CO<sub>2</sub> 18 lbs

# Economical Value of DDGS

- **DDGS will contribute energy, protein, and phosphorus**
  - **Lysine digestibility will influence the value of DDGS**
  - **Amino acid digestibility (Lysine) is higher than previous reported (NRC, 1994)**
    - **70% average lys digestibility**
  - **High levels of phosphorus (0.68 to 0.78) that is at least 50% bioavailable (higher than corn), may be as high as 90% bioavailable**
  - **Good energy source (higher than previously reported)**
    - **TME<sub>n</sub> 2,800 kcal/kg (1,270 kcal/lb)**

# What is DDGS?

- **Distiller's dried grains with solubles (DDGS)**
  - By-product of the dry-milling ethanol industry
- **Nutrient composition is different between dry-mill, wet-mill, and beverage alcohol by-products**
  - DDGS – Fuel ethanol
  - DDGS – whiskey distilleries
  - Corn gluten feed – wet mill
  - Corn gluten meal – wet mill
  - Brewer's dried grains – beer manufacturing
- **Nutrient content depends on the grain source used**
  - Corn DDGS – Midwest US
  - Wheat DDGS – Canada
  - Sorghum (milo) DDGS – Great Plains US
  - Barley DDGS