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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

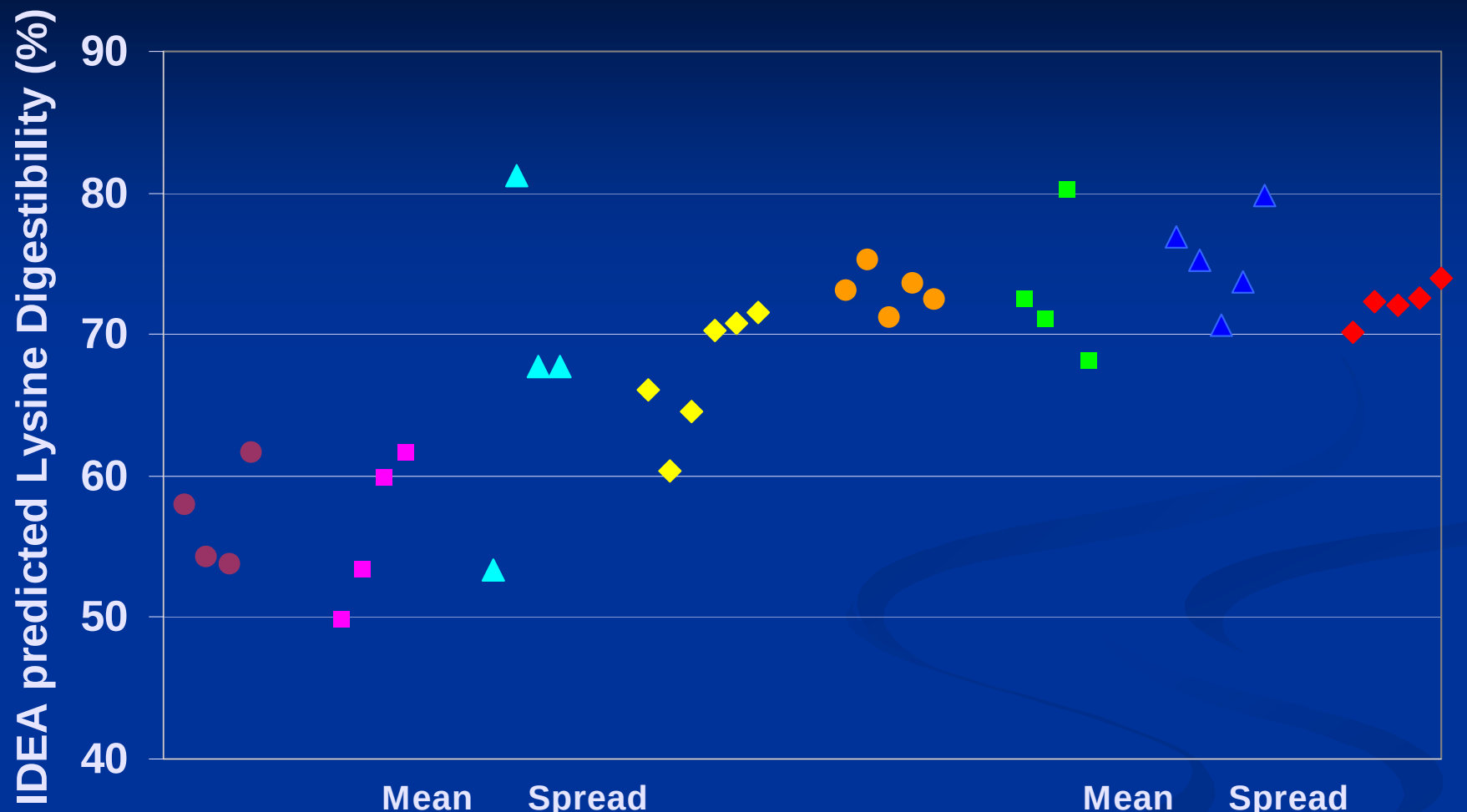
- Grain input:
  - CP% of corn 6.8 x 3 = 20.4% CP
    - 0.22 % lysine x 3 = 0.66% lysine
  - CP% of corn 8.2 x 3 = 24.6% CP
    - 0.30 % lysine x 3 = 0.90% lysine
- Processing at plant
- Drying temperature
- Solubles
  - Amount added back
  - Change nutrition profile
  - Syrup balls

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

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

*Values are expressed on a Dry Matter basis

DDGS Product Variation Between Supplier/Plant

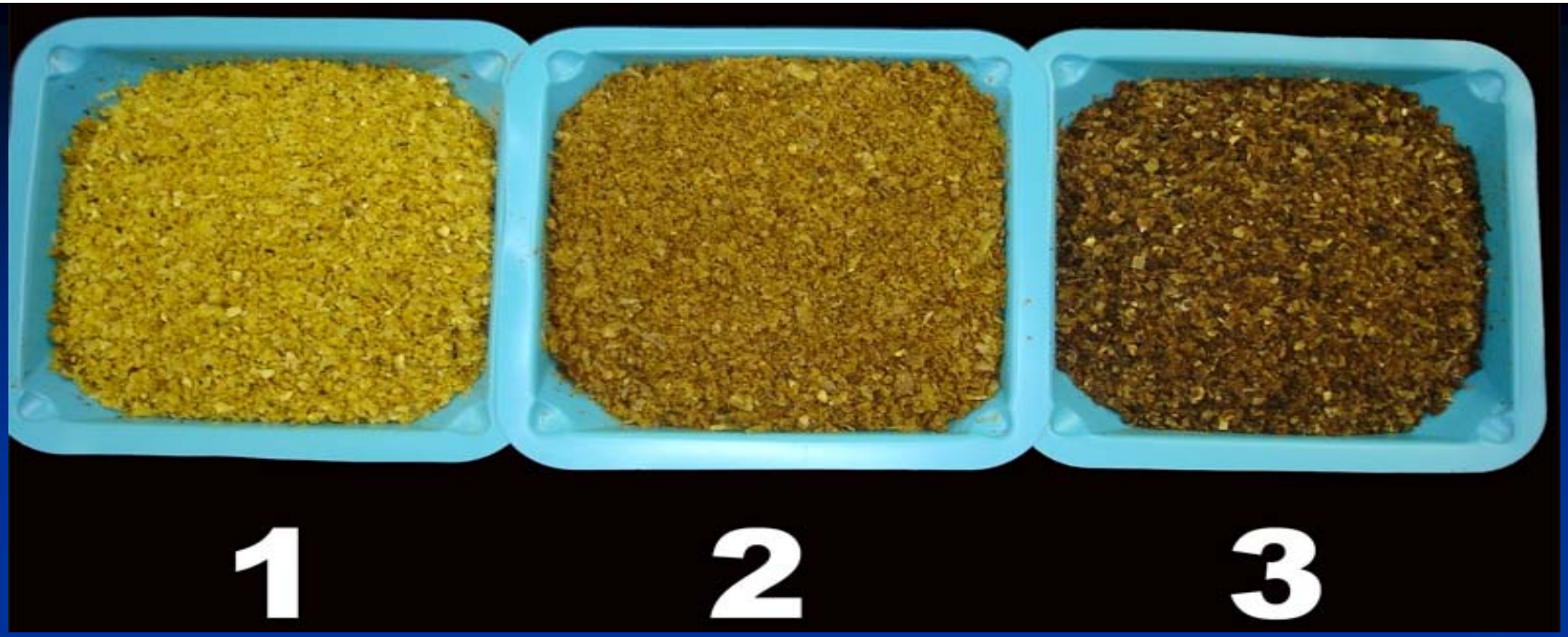


	Mean	Spread
Supplier 1	56.9	7.9
Supplier 2	56.3	11.9
Supplier 3	67.5	27.8
Supplier 4	67.2	11.1

	Mean	Spread
Supplier 5	73.1	4.0
Supplier 6	73.1	12.1
Supplier 7	75.3	9.1
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?



Spl	Color L* (Lightness)	Color b* (Yellowness)	Color 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
DDGS (UGA)[1]	0.74	0.47	0.27	64 (68)
DDGS (UI) (MSU)	0.73	0.60 (approx.)	0.13	69-102 (82) 76-85 (80)

[1] 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	Avg. 1-7 = 0.13%
4	0.11	
5	0.12	
6	0.11	
7	0.09	
8[1]	0.42	
9[1]	0.44	
10[1]	0.39	Avg. 8-12 = 0.42%
11[1]	0.43	
12[1]	0.43	
Average ± SD	0.25 ± 0.15	
NRC (1994)	0.48	
Projected	0.06	

[1] 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)

	Corn	DDGS (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

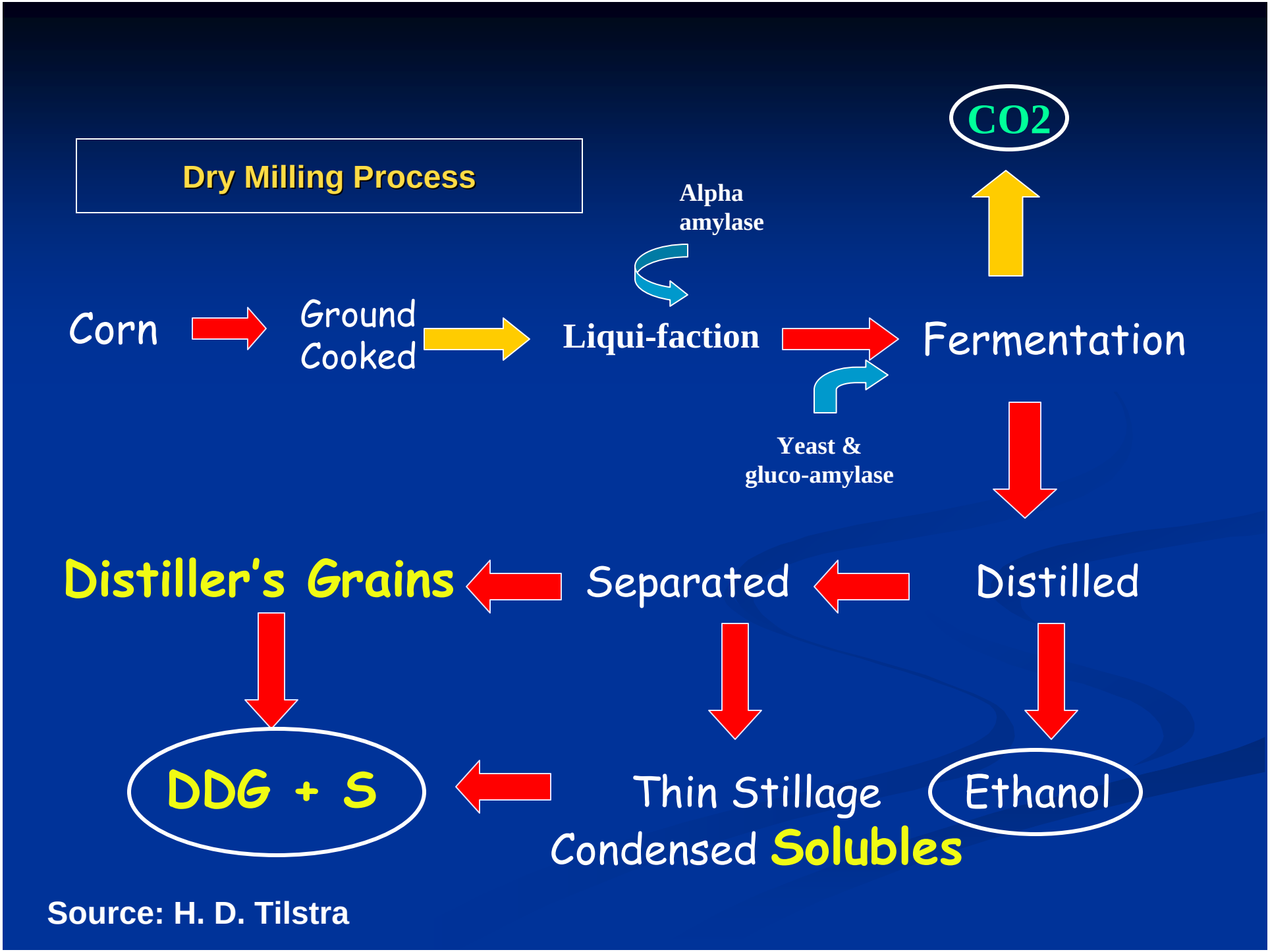
- Problems with new HP - DDGS Product:
  - Lower Fat
  - Lower Phosphorus
  - No Change (or decrease) in Lysine as % Crude Protein (poor AA balance)

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”



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_2 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_n 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