By-Product or Co-Product Distiller's Dried Grains Plus Solubles (DDGS); Poultry Feeding

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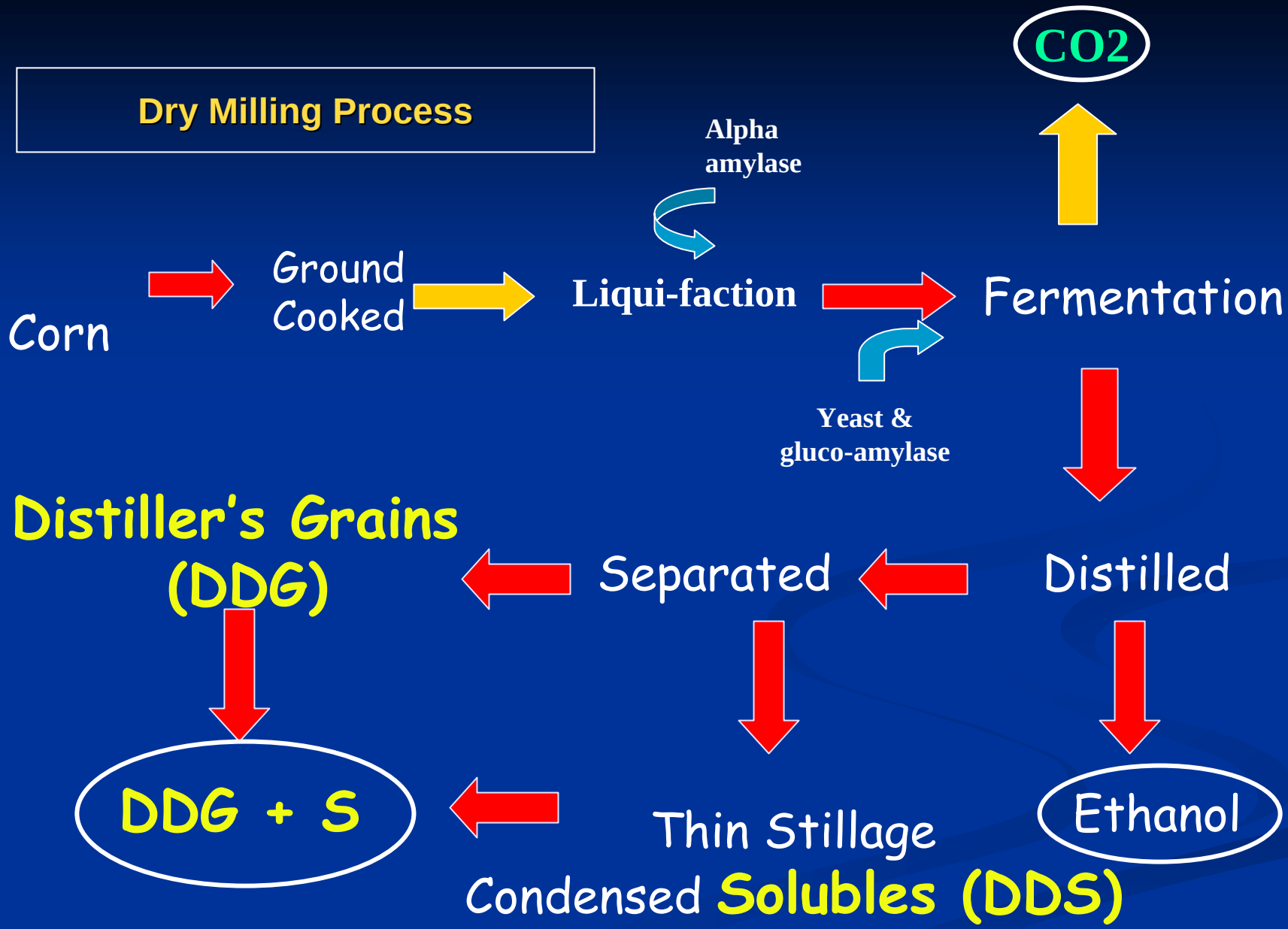
Dry Milling Process



Source: H. D. Tilstra

Corn Distillers Dried Grains Plus Solubles

“New Generation DDGS”

High Quality Corn Distiller's Dried Grains with Solubles is a Highly Acceptable Feed Ingredient for Use in Monogastric (Swine and Poultry) Diets

Nutrient Composition of DDGS

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	45-84	11.2
Fat	14	3-16	4.8
Ca	0.03	0.02-0.04	38.4
P	0.73	0.62-0.77	5.3
P availability	65	62-102	--
Na	0.24	0.05-0.49	32.8

Practical issues with DDGS Use in Poultry (Swine – monogastric) Diets

- Product Consistency/ Nutrient Variability
- Nutrient quality (nutrient specifications)
  - Protein composition – Amino acid balance
    - Formulating diets for digestible AA
- Handling – Logistics - Flowability
- Pellet quality
- Mycotoxins
- High fiber limits its maximum inclusion level
- Pigment
- Moisture levels

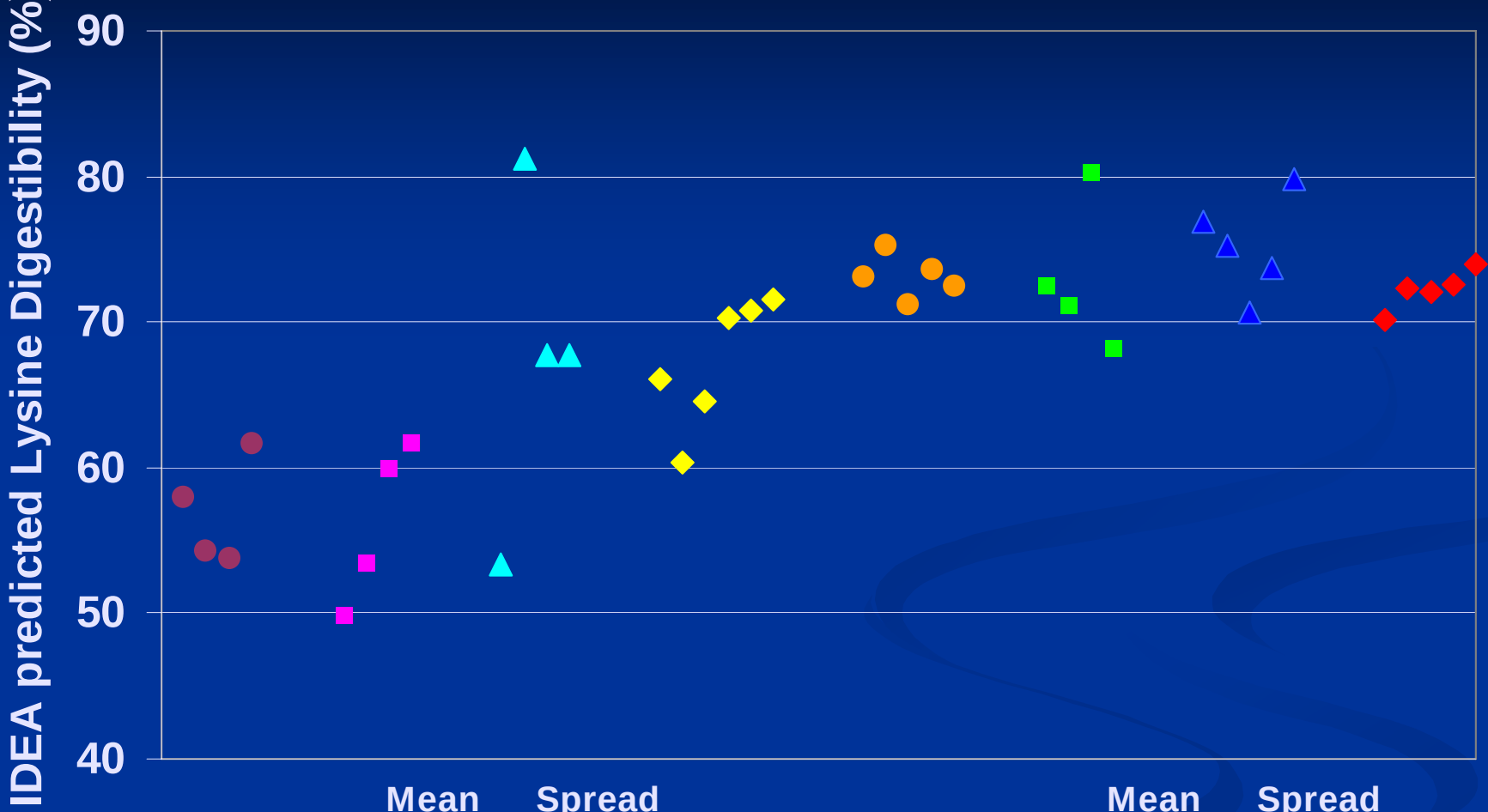
DDGS – Product variability/consistency

- 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/Overprocessing (High drying temps)
  - Effect on Lysine Availability
    - Decrease in lysine availability due to overheating – Mailard reaction

DDGS – Product variability/consistency

- Drying temperature/Overprocessing (High drying temps)
  - Effect on Phosphorus Availability
    - Increase in P availability with heating
    - Inverse relationship between lysine and P availability
- Solubles
  - Amount added back
  - Change nutrition profile
  - Syrup balls

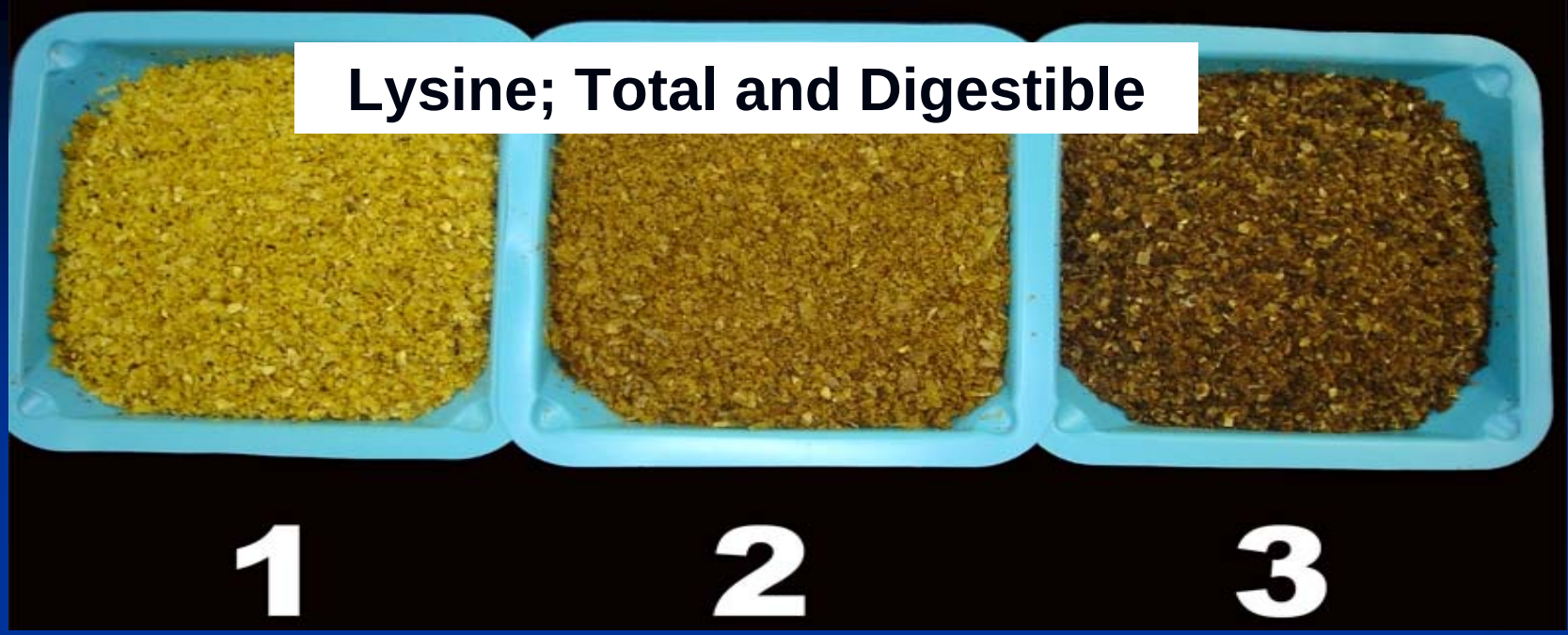
DDGS Product Variation Between Supplier/Plant



	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

Lysine; Total and Digestible



Spl	Color			Total Lys	Lys Dig. Co	Dig. Lys
	L* (Lightness)	b* (Yellowness)	a* (Redness)			
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

Influence of Digestible Lysine Level on the Value of DDGS ($/cwt)

$/cwt	High Digestible Lysine (79%)	Low Digestible Lysine (64%)
Corn, 3.10	4.78	4.28
Corn, 3.50	5.00	4.54
Corn, 5.30	6.02	5.70
SBM, 8.25	5.00	4.54
SBM, 8.70	5.21	4.72

Noll, 2003

New DDGS Products

- High Protein DDGS, De-Germ and De-Bran

	DDGS (new generation)	DDGS High protein	Corn Germ Dehydrated
ME kcal/kg (Poultry)	3108	2928	4387
Crude Protein, %	29.6	43.0	17.5
Lysine, % (% CP)	1.02 (3.4)	1.43 (3.2)	0.84 (4.8)
Crude Fat, %	10.8	4.3	20.2
Phosphorus, %	0.92	0.50	1.66

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

What DDGS Replaces in Poultry Diets

- **Corn**
  - 7.5% CP, 3,390 kcal/kg, 0.24% lys
- **Soybean meal**
  - 48% CP, 2,458 kcal/kg, 3.02% Lys
- **Phosphorus**
  - Reduce P supplementation
- **Meat and Bone meal**

DDGS = 29% CP, 2,800 kcal/kg, 0.70% Lys

Other Changes in Poultry Diets with the Inclusion of DDGS

Increases in:

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

Recommended Dietary Inclusion Levels for Golden Corn DDGS in Poultry Diets

- **Broilers:**
  - 6 - 9% inclusions rates during starter period
  - 12 - 15% inclusions rates during the grower/finisher periods
- **Laying Hens:**
  - 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/finisher periods

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

Maximum Recommended Dietary Inclusion Levels for Golden Corn DDGS in Swine Diets

Production Phase	Max. Dietary Inclusion Level
Weaned pigs (> 7 kg)	25%
Grow-finish	20%
Gestation	50%
Lactation	20%

Common usage is no more than 10% of the diet

Recommendations based on high quality DDGS

Jerry Shurson, 2005

Potential uses of DDGS in Poultry Diets

- Tyson
  - manufactures approximately 11 million tons of feed per year
  - If DDGS were added at 5% (10%) level to all broiler feeds there would be a possible usage of 2.2 (4.4) millions tons of DDGS per year
- Gold Kist
  - manufactures approximately 4.4 million tons of feed per year
  - If DDGS were added at 5% (10%) level to all broiler feeds there would be a possible usage of 221,000 (441,000) tons of DDGS per year

Potential uses of DDGS in Poultry Diets

- Pilgrims Pride
  - manufactures approximately 8.3 million tons of feed per year
  - If DDGS were added at 5% (10%) level to all broiler feeds there would be a possible usage of 4.2 (8.4) millions tons of DDGS per year

Potential uses of DDGS in Poultry Diets

- **Pilgrims Pride**
  - **manufactures approximately 8.3 million tons of feed per year**
  - **If DDGS were added at 5% (10%) level to all broiler feeds there would be a possible usage of 4.2 (8.4) millions tons of DDGS per year**
- **Total Top Three Companies**
  - **If using 5% (10%) DDGS in all broiler diets**
  - **6.62 (13.24) millions tons of DDGS per year**

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
- Consistency
- Nutrient value
- Handling

High Quality Corn Distiller's Dried Grains with Solubles is a Highly Acceptable Feed Ingredient for Use in Monogastric (Swine and Poultry) Diets

Question/Concern for the Poultry Industry:

Where will the energy come from to feed chickens if it is all going into oil production?

Keys to DDGS use in Poultry Diets

- Need Current Analytical Information
  - Adjust for energy and lysine
- Formulate diets considering amino acid digestibility (esp. lysine, cysteine, methionine)
  - Use minimums for Trp, Arg, Lys, TSAA, and Thr due to potentially limiting nature of these amino acids in DDGS
- Considering using a higher ME value than currently recommended by the NRC (1994) (1,130 kcal/lb, 2450 kcal/kg)
  - DDGS has fat content of approx. 9%
  - TME_n for DDGS 2,800 kcal/kg (1,270 kcal/lb), range of 2,495 to 3,197 kcal/kg (1,132 to 1,450 kcal/lb)

* Use high quality DDGS

Mycotoxins - DDGS

- Incidence of mycotoxin contamination of DDGS from upper Midwest ethanol plants is low
- Most ethanol plants are not testing the corn or the final DDGS product for mycotoxin
  - Poor quality corn = poor ethanol yields
  - Corn supplied from a relatively small geographic region – however the region is growing!!
  - Corn produced in upper Midwest is generally lower risk for mycotoxins

Mycotoxins - DDGS

- Questions for the supplier/plant
  - Are they testing for mycotoxins?
  - How often?
  - What products?
    - Just the corn or the DDGS product as well?
    - Most common mycotoxins in DDGS – Aflatoxin, Vomitoxin, Fumonisin, Zearalenone, and T2 Toxin
  - What test are they using?
  - Good rule:
    - Aflatoxin DDGS = 20 ppb; Corn = 5 ppb
    - Fumorison DDGS = 10 ppm; Corn = 3ppm

When Poor Quality DDGS Arrives

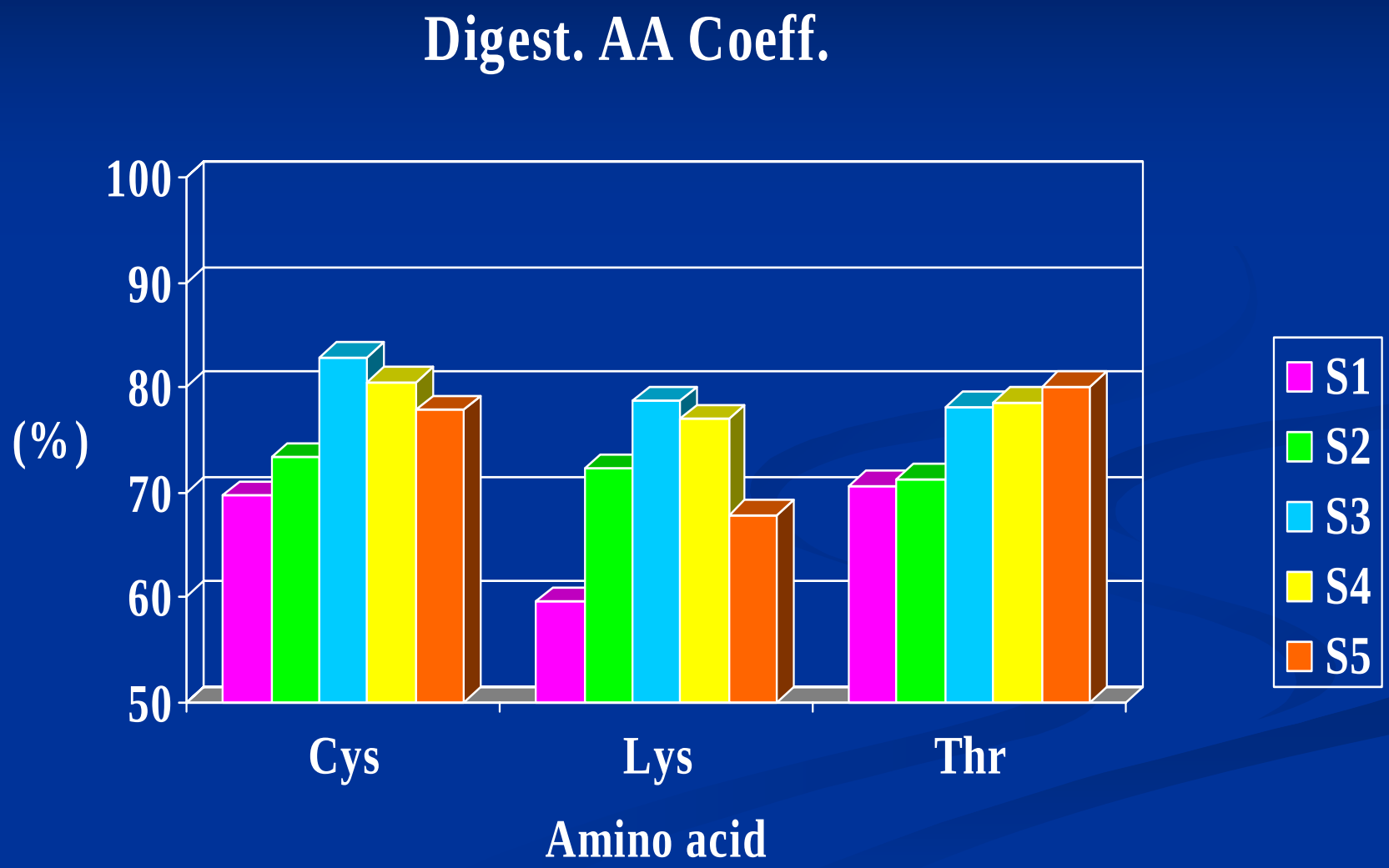
- No large effect of over-processing on TME
- Worry about lysine availability
  - Decrease in lys avail. due to overprocessing
  - Less effect on other AA – but will see a decrease in cys dig.
  - Supplement with synthetic lysine
    - Effect cost!!!
- Mycotoxins
  - Don’t feed it to breeders or young chicks

Phosphorus Availability of DDGS

	Bioavailability Coefficient (%)	Total P Content (%)	Bioavailable P Content (%)
DDGS – control spl	69	0.72	0.49
Low Digestible Lys DDGS (64.2% dig. coeff.)	102	0.74	0.75
Low Digestible Lys DDGS (61.2% dig. coeff.)	82	0.72	0.59
High Digestible Lys DDGS (78.8% dig. coeff.)	75	0.73	0.55

Martinez Amezcua et al. 2004

Comparison of Amino Acid Digestibility Coefficients of DDGS Among Ethanol Plants



Noll and Parsons

Average Total and True Amino Acid Digestibility[1] of DDGS (As –fed basis)

Amino acid	Total Concentration (%)	AA Dig. Coeff. (DC)
Lys	0.71	70 (65)[2]
Met	0.54	87 (84)
Cys	0.56	74 (77)
Thr	0.96	75 (72)
Trp	0.20	83
Arg	1.09	84 (63)
Ile	0.97	83 (84)
Leu	3.05	89 (89)

[1]Average of eight DDGS samples fed to 16 cecectomized roosters.

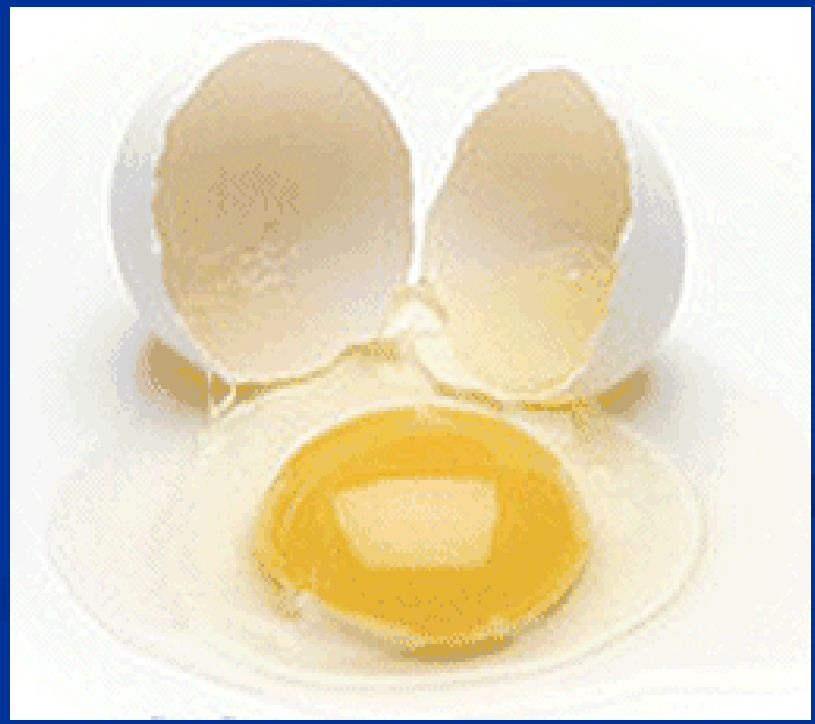
[2] In parentheses is the True amino acid digestibility coefficients from NRC (1994)

Low and High Total and True Amino Acid Digestibility Coefficients of DDGS

Amino Acid	Low		High	
	Total AA	AA DC	Total AA	AA DC
Lys	0.39	46	0.86	78
Met	0.46	83	0.61	91
Cys	0.50	63	0.62	88
Thr	0.85	64	1.05	83
Trp	0.13	76	0.28	89
Arg	0.75	73	1.25	91
Ile	0.90	81	1.03	93
Leu	2.84	85	3.21	92

DDGS Pigmentation

- Xanthophyll (pigments) very fragile
- Heat Sensitive – oxidation
- Light color DDGS may be a good source of pigmentation
  - 40 mg/kg
  - May have some value



- Corn 15-25 mg/kg
- Corn Gluten Meal 130-200 mg/kg
- DDGS 25-45 mg/kg

DDGS - Handling

- DDGS setting up in rail cars, trucks, barges – still a problem
  - DDGS will set up more than once
- Currently no flow agents have been found that correct the flow or handling problems of DDGS
  - Some help – may reduce the unloading time from 24 hrs to 12 hrs
- Cold fermentation – BPX improves handling characteristics – significant improvement

Summary

- Improved logistics – getting supply to demand areas
- Consistency between suppliers/plants is affecting product image
- Handling/flow can be an issue and is accepting product usage
- Quality ingredient with a bright future

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

Problems with New DDGS Products

- Lower Fat Content
- Lower Phosphorus Content
- No change in lysine concentration as percent crude protein
  - Poor amino acid balance (the AA balance is not improved)

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
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.)
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.)

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

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)	0.74	0.47	0.27	64 (68)
DDGS (UI) (MSU)	0.73	0.60 (approx.)	0.13	69-102 (82) 76-85 (80)

* NRC (1994) values for poultry

Amino Acid Profile (as a % of crude protein) Corn, DDGS, and Soybean meal

	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