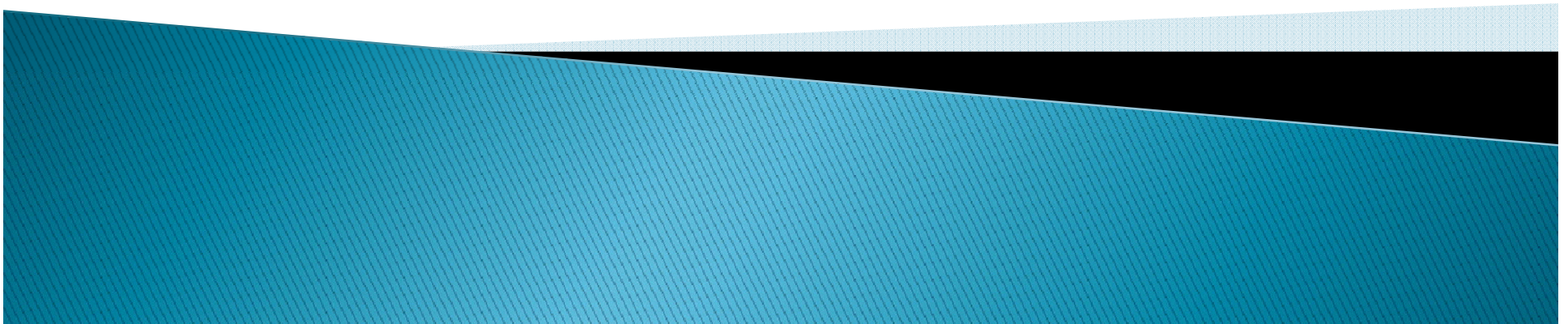# Nutrient Variability in DDGS and Procurement Considerations for Obtaining More Precise Nutrient Values for Use in Feed Formulation

Dr. Jerry Shurson
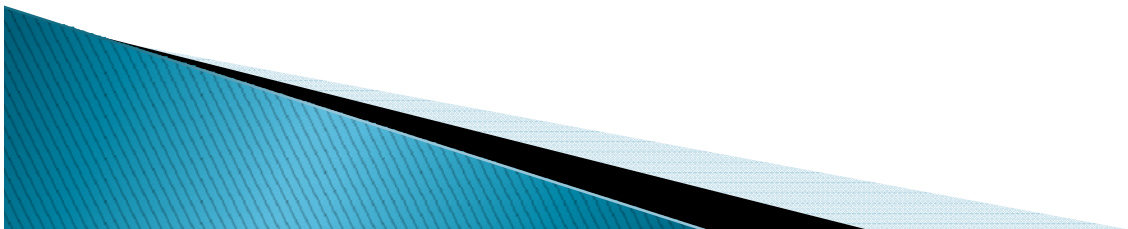
Department of Animal Science

University of Minnesota

DDGS – The Opportunity

- DDGS is an economical source of nutrients
 - Energy
  - Amino acids
  - Phosphorus

- DDGS is not one ingredient
  - Plant to plant variation
  - Within plant variation
  - New fractionated corn co-products being called DDGS

- Most pork producers do not effectively capture the value of DDGS

Current U.S. Pork Industry Dietary DDGS Inclusion Rates and Estimated Usage

- 70- 80% of MN pork producers are using DDGS in their swine diets

- Grower–finisher diets ~ 80–85%
  - 10 – 40% of the diet
  - Save $3 to $10/ton for each 10% DDGS added to the diet
  - Save $3 to $9/market hog for each 10% added to the diet

- Sow diets ~ 10–15%
  - Gestation – 10 – 90% of the diet
  - Lactation – 10 – 30% of the diet

- Late nursery diets < 5%
  - Added at 5 – 30% of the diet
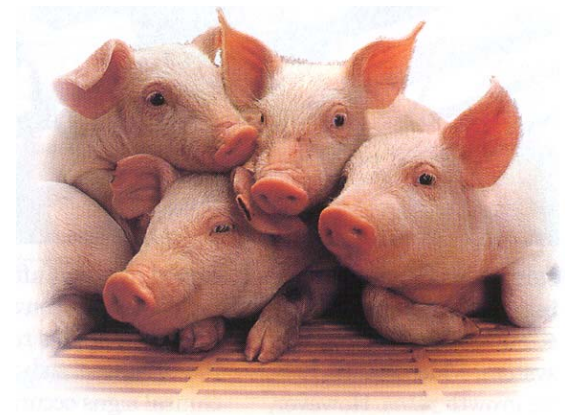
DDGS Varies in Nutrient Content and Digestibility, Color, and Particle Size Among U.S. Sources
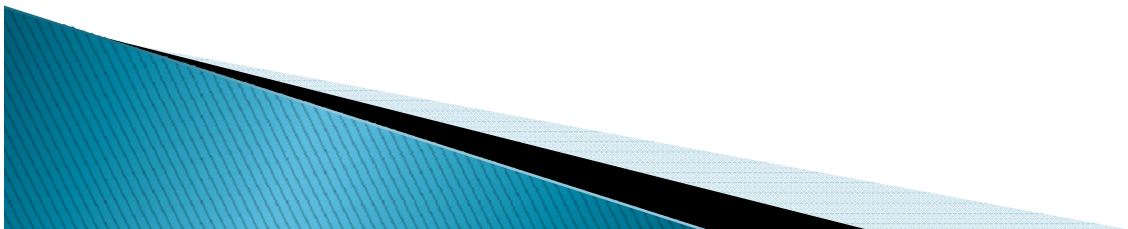
Averages, Coefficients of Variation, and Ranges of Selected Nutrients Among 32 U.S. DDGS Sources (100% Dry Matter Basis)

Nutrient	Average	Range
Dry matter, %	89.3	87.3 – 92.4
Crude protein, %	30.9 (4.7)	28.7 – 32.9
Crude fat, %	10.7 (16.4)	8.8 – 12.4
Crude fiber, %	7.2 (18.0)	5.4 – 10.4
Ash, %	6.0 (26.6)	3.0 – 9.8
Swine ME, kcal/kg	3810 (3.5)	3504 – 4048
Lysine, %	0.90 (11.4)	0.61 – 1.06
Phosphorus, %	0.75 (19.4)	0.42 – 0.99

Variation in Digestible Amino Acids in 34 Sources of Corn DDGS (%)
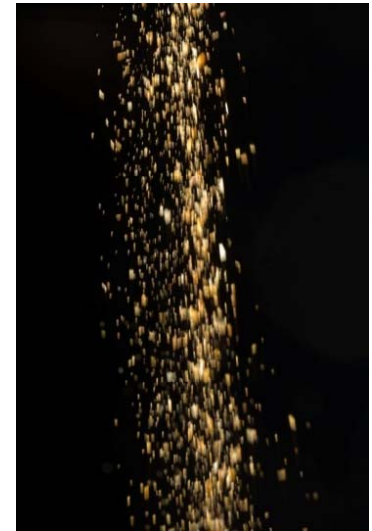
Amino Acid	Max	Min	CV
Lys	0.77	0.33	18.4
Met	0.66	0.40	12.6
Thr	0.96	0.68	10.2
Trp	0.21	0.10	15.8

Urriola et al. (2007)

Standardized Ileal Lysine Digestibility Coefficients Among 10 "Golden" Corn DDGS Sources
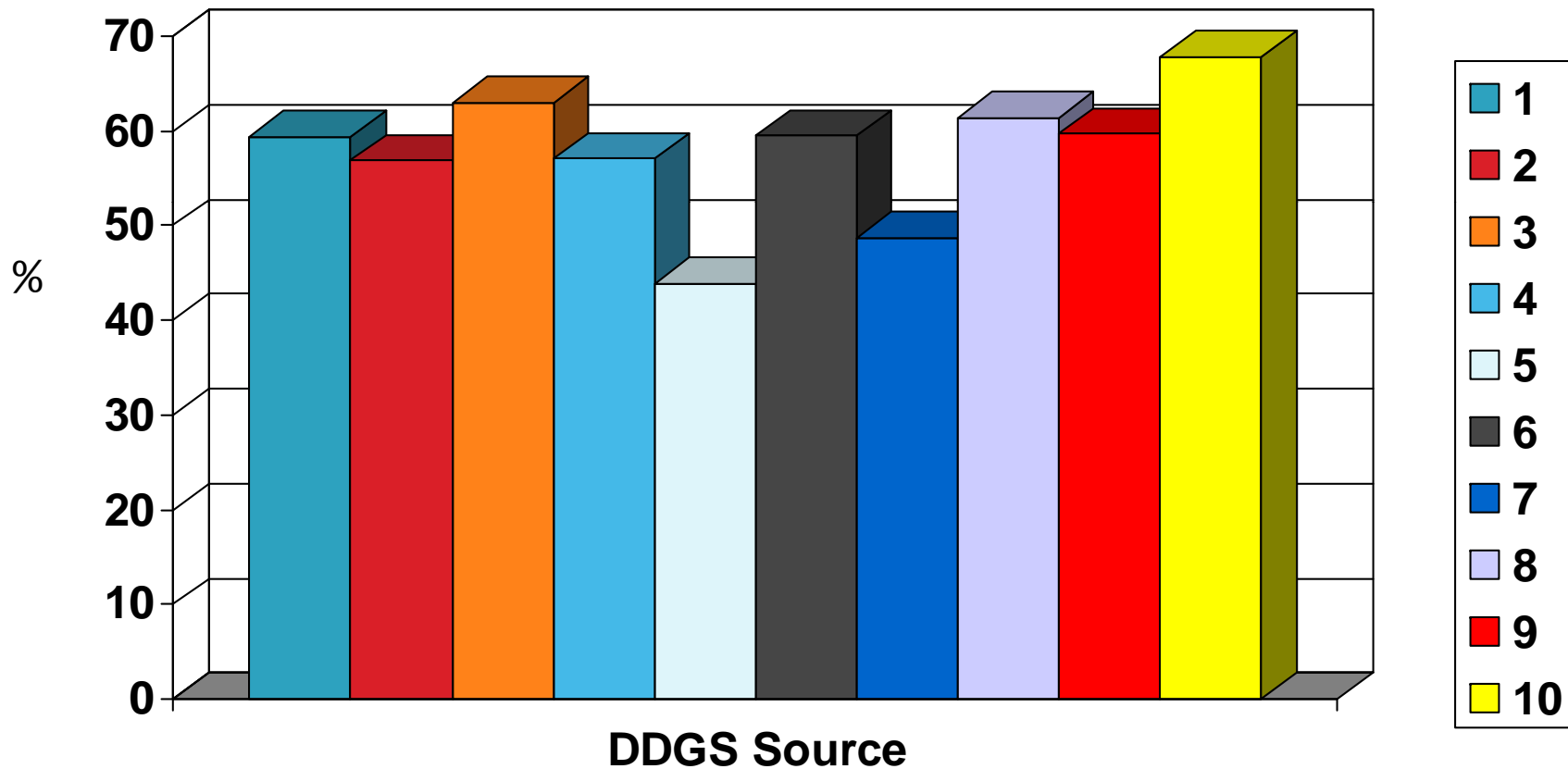
Stein et al. (2005)

Effect of Acid Detergent Insoluble Nitrogen (ADIN) and Color Score on Growth Performance of Pigs fed Three Blended Sources of DDGS

| Source	Hunter Lab Color[3]			ADIN%	ADG g[2]	ADFI, g[2]	F/G[2]
	L*	a*	b*				
A	29.0	6.5	12.7	27.1	218	1,103	5.05
E	31.1	6.1	13.1	36.9			
G	38.8	6.8	16.5	16.0	291	1,312	4.52
I	41.8	6.5	18.8	26.4			
B	53.2	4.7	21.8	8.8	390	1,416	3.61
D	51.7	7.1	24.1	12.0			

[1] Modifed form Cromwell *et al.,* 1993.
[2] Difference among diets (P < 0.01)
[3] L=lightness 0=black; 100=white; The higher the a* and b* values, the greater degree of redness and yellowness, respectively.

Relationship Between Lightness of Color (L*) and Digestible Lysine Content of DDGS
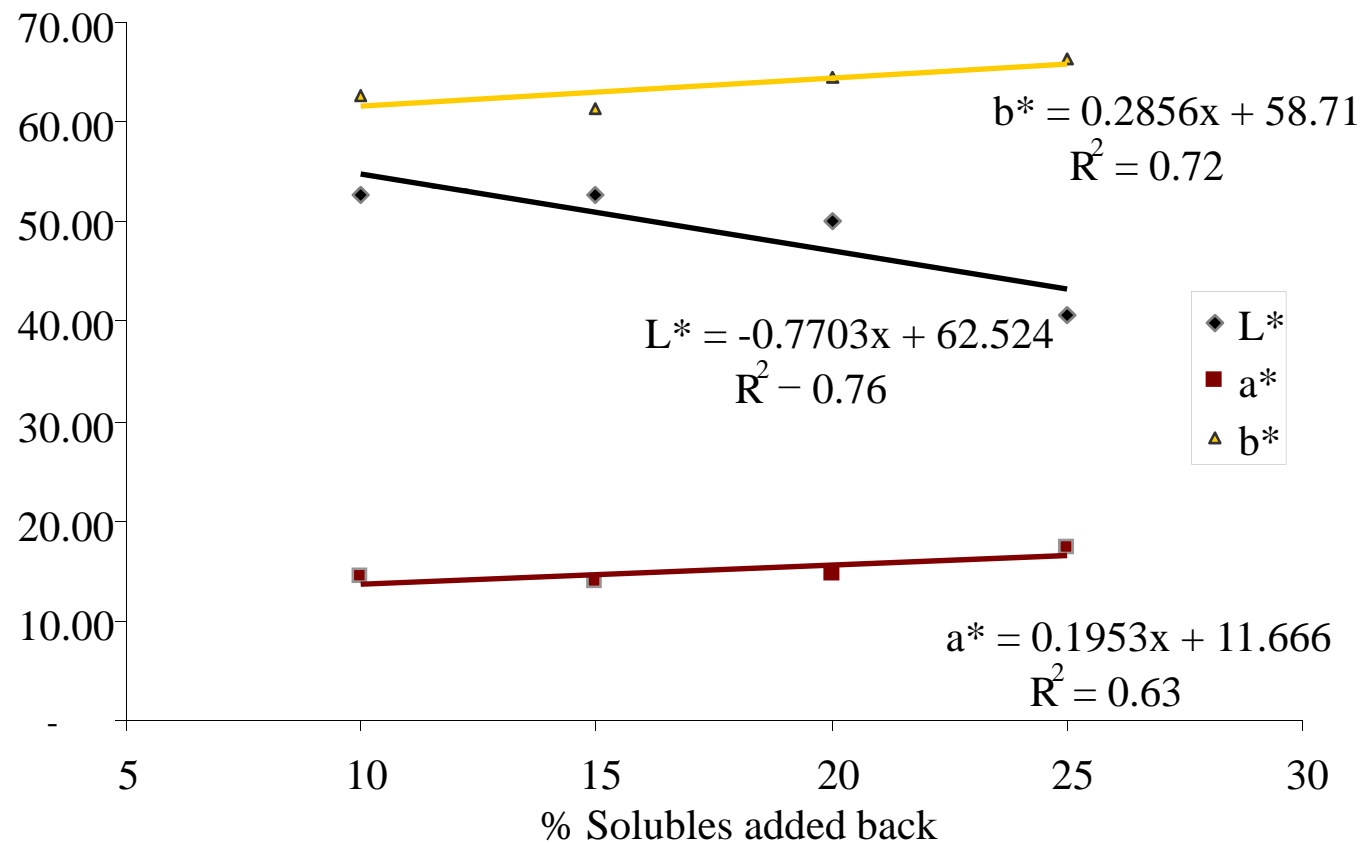
Dlys = 0.02(L*) - 0.25
$R^2 = 0.48$

Dlys = 0.01(L*) + 0.32
$R^2 = 0.03$

d-Lys content, %

Color parameter L*
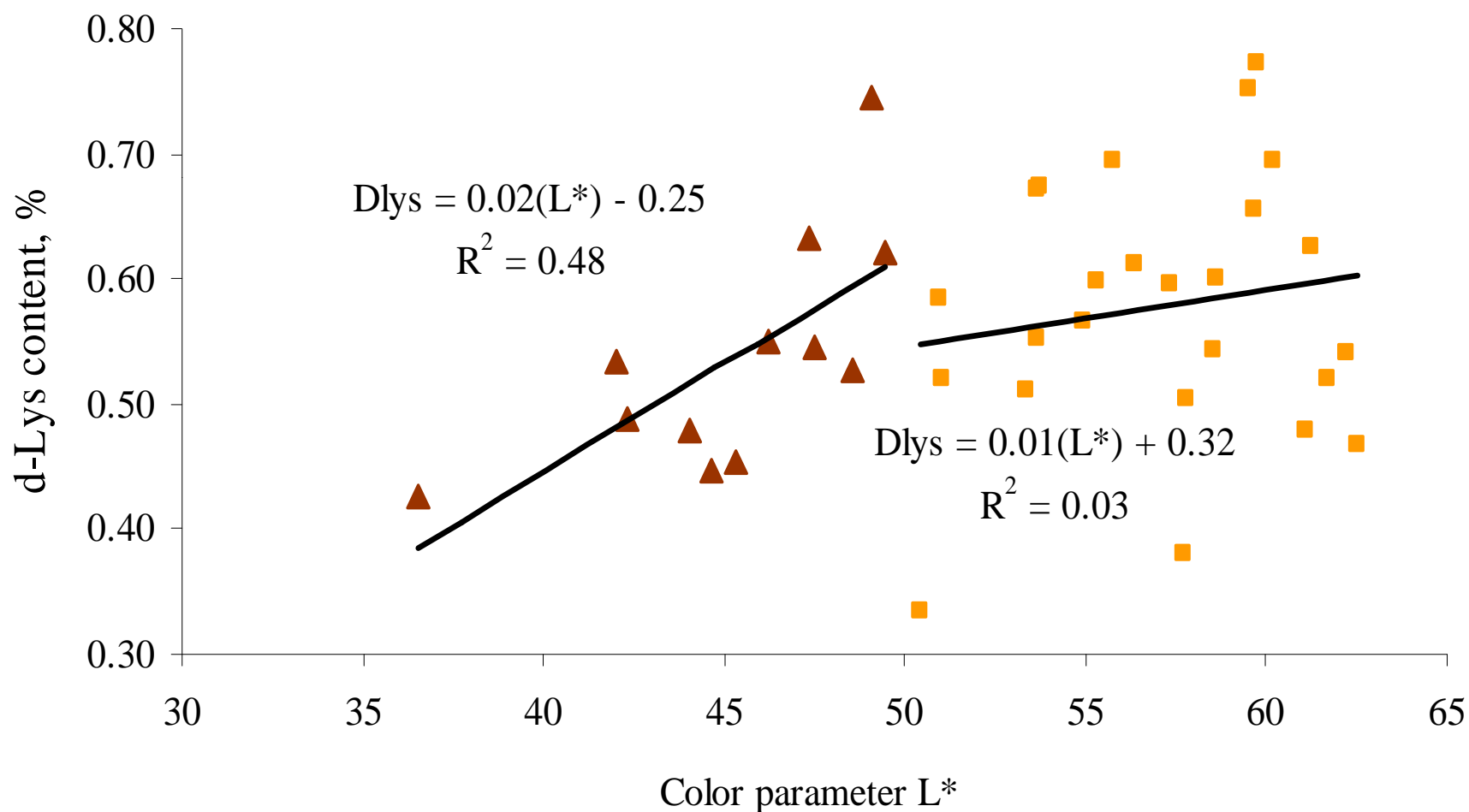
Comparison of the Nutrient Content of Corn Distiller's Grains and Corn Condensed Distiller's Solubles
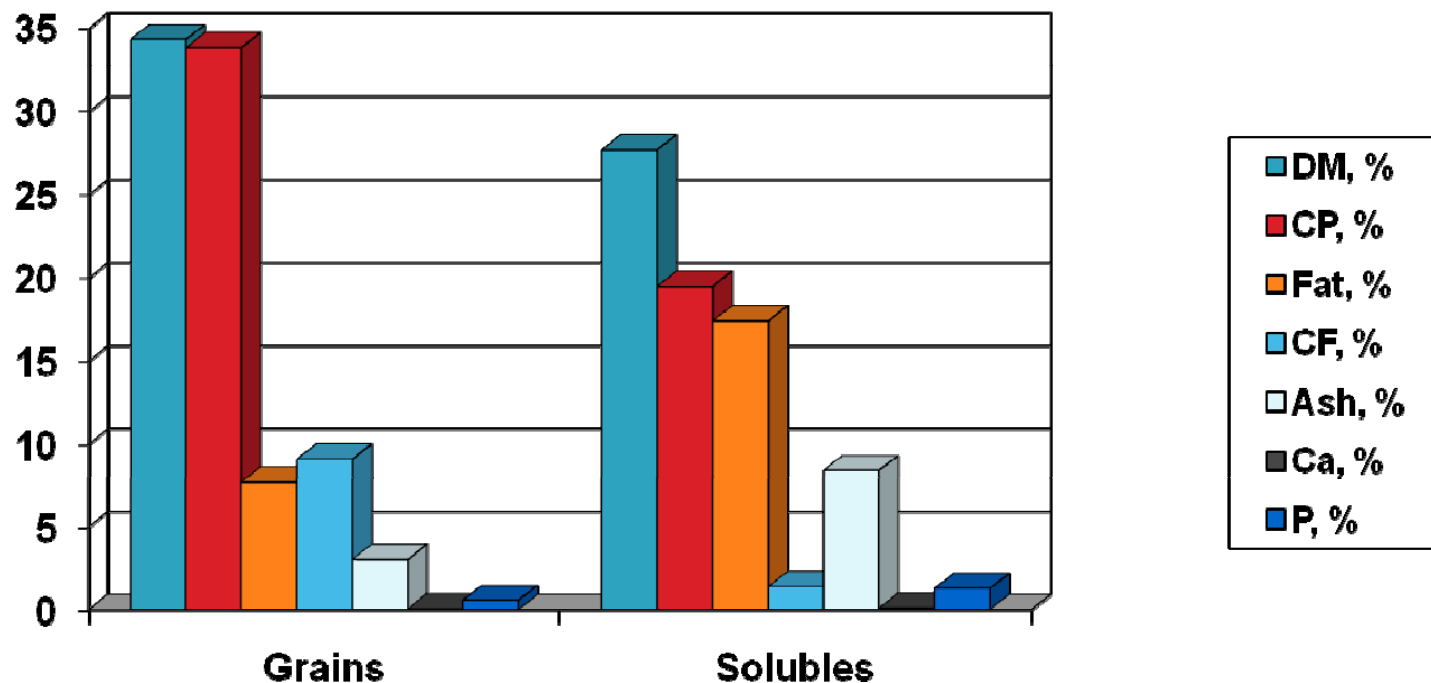
Effect of Solubles Addition to Distillers Grains on Color of DDGS (Ganesan *et al.,* 2005)

$b* = 0.2856x + 58.71$
$R^2 = 0.72$

$L* = -0.7703x + 62.524$
$R^2 - 0.76$

$a* = 0.1953x + 11.666$
$R^2 = 0.63$

◆ L*
■ a*
▲ b*

% Solubles added back

Prediction of Digestible Lysine from Optical Density (400 to 700 nm)

$R^2 = 0.86$, RMSE = 0.05, PC = 14

y-axis: *In vivo* digestible lysine, % .

x-axis: *In vitro* digestible lysine, % .
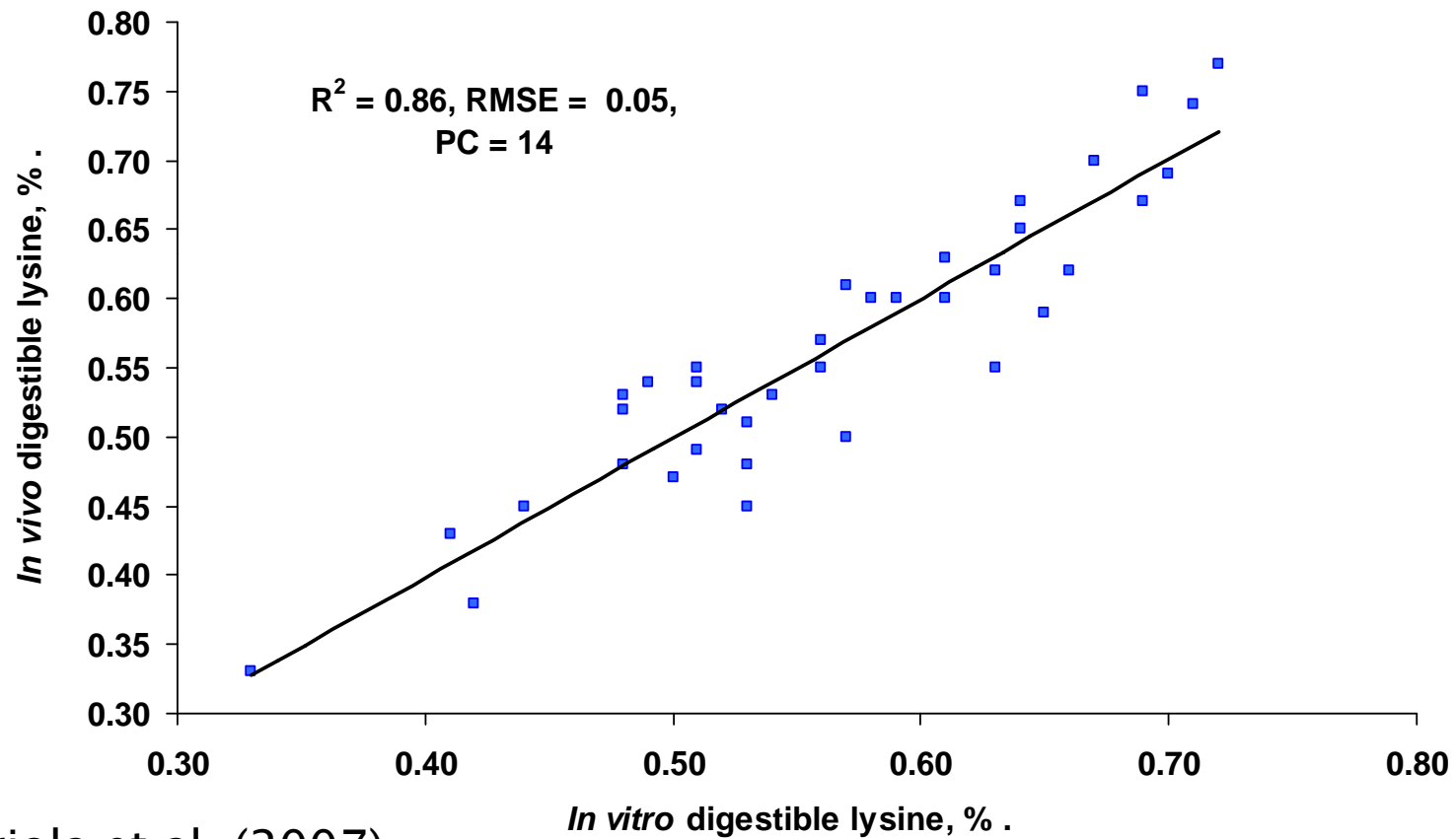
Urriola et al. (2007)

Reducing Variability

- ▸ Possible Solutions in Ethanol Plants

  - ◦ Use defined quality criteria for screening corn

  - ◦ Minimize the number of corn varieties used

  - ◦ Blend a consistent amount of solubles with grains

  - ◦ Minimize excessive drying/heating
    - • Dryer temperatures range from 260°F to 1100°F
    - • Reduces amino acid digestibility

  - ◦ Develop and implement standardized production procedures for all plants within the company

  - ◦ Communicate with customers when changing processes (e.g. fractionation)
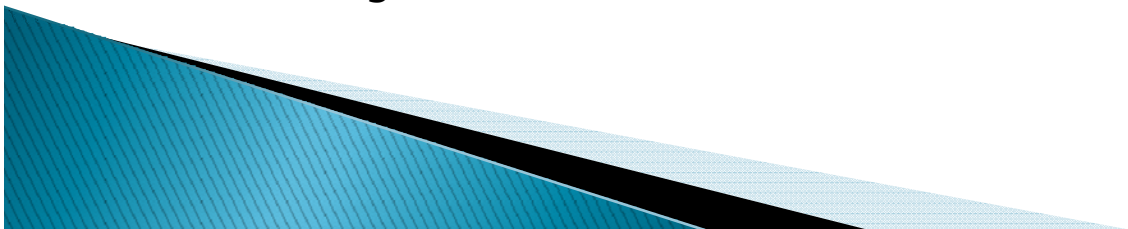
Reducing Variability

- Possible Solutions in Feed/Pork Production
  - Identify and purchase from a single ethanol plant
    - Difficult to do when purchasing through brokers
  - Source DDGS from a few, but similar plants
  - Ask for current nutrient profiles from the DDGS source
    - May, or may not, get them
    - May need to determine on your own
      - Added cost
 - Develop regular communications with DDGS marketer/plant
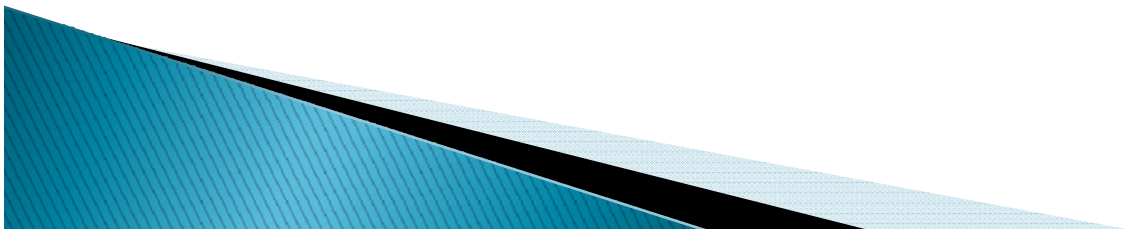
Reducing Variability

▸ Possible Solutions in Feed/Pork Production

◦ Use of *in vitro* tools and prediction equations to estimate total and digestible nutrient content of DDGS

◦ Examples:

• Cargill – Reveal®

• Value Added Science and Technology – Illuminate®

• Benefits

• Obtain better value

• No more purchasing on a DM, CP, and fat basis

• Differentiate value among sources

• Use more precise nutrient loading values in feed formulation

• More predictable pig performance, often at lower feed cost
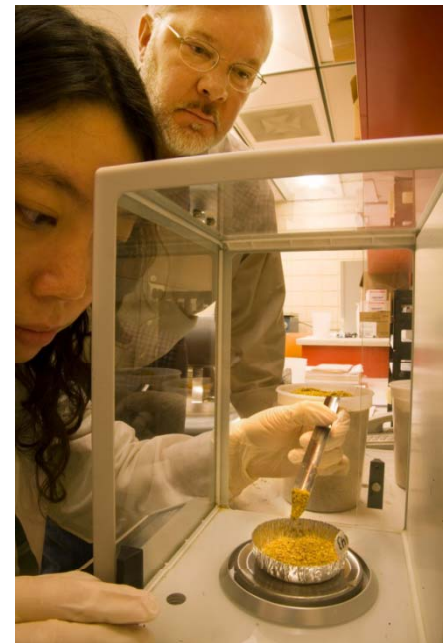
Illuminate Laboratory Results

	A	B	C	D	E
DM	87.9	90.1	86.5	91.7	90.0
CP	28.2	26.7	27.7	26.7	25.1
Fat	11.4	9.9	11.5	10.6	11.2
Starch	7.3	8.1	7.2	8.3	4.6
ADF	11.4	10.8	12.5	10.6	8.6
Ash	4.5	3.3	4.4	3.9	4.4
Phosphorus	0.90	0.66	0.82	0.75	0.76
Lysine	0.88	0.83	0.86	0.89	0.78
IDEA Lys	0.65	0.63	0.63	0.68	0.69
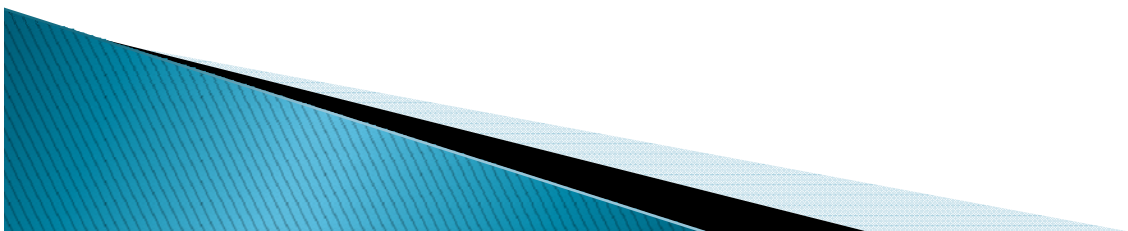
Illuminate Nutrient Loadings

	A	B	C	D	E
ME	3070	3460	2970	3410	3540
Dig. Lys	0.54	0.52	0.54	0.61	0.54
Dig. Met	0.50	0.47	0.49	0.48	0.46
Dig. Thr	0.70	0.68	0.70	0.72	0.68
Dig. Trp	0.16	0.15	0.16	0.16	0.14
Avail. Phos	0.67	0.50	0.62	0.56	0.64
Relative Value	$175	$204	$165	$208	$215