Quality Characteristics and Nutritional Profiles of DDGS

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DDGS Varies in Nutrient Content and Digestibility, Color, and Particle Size Among U.S. Sources

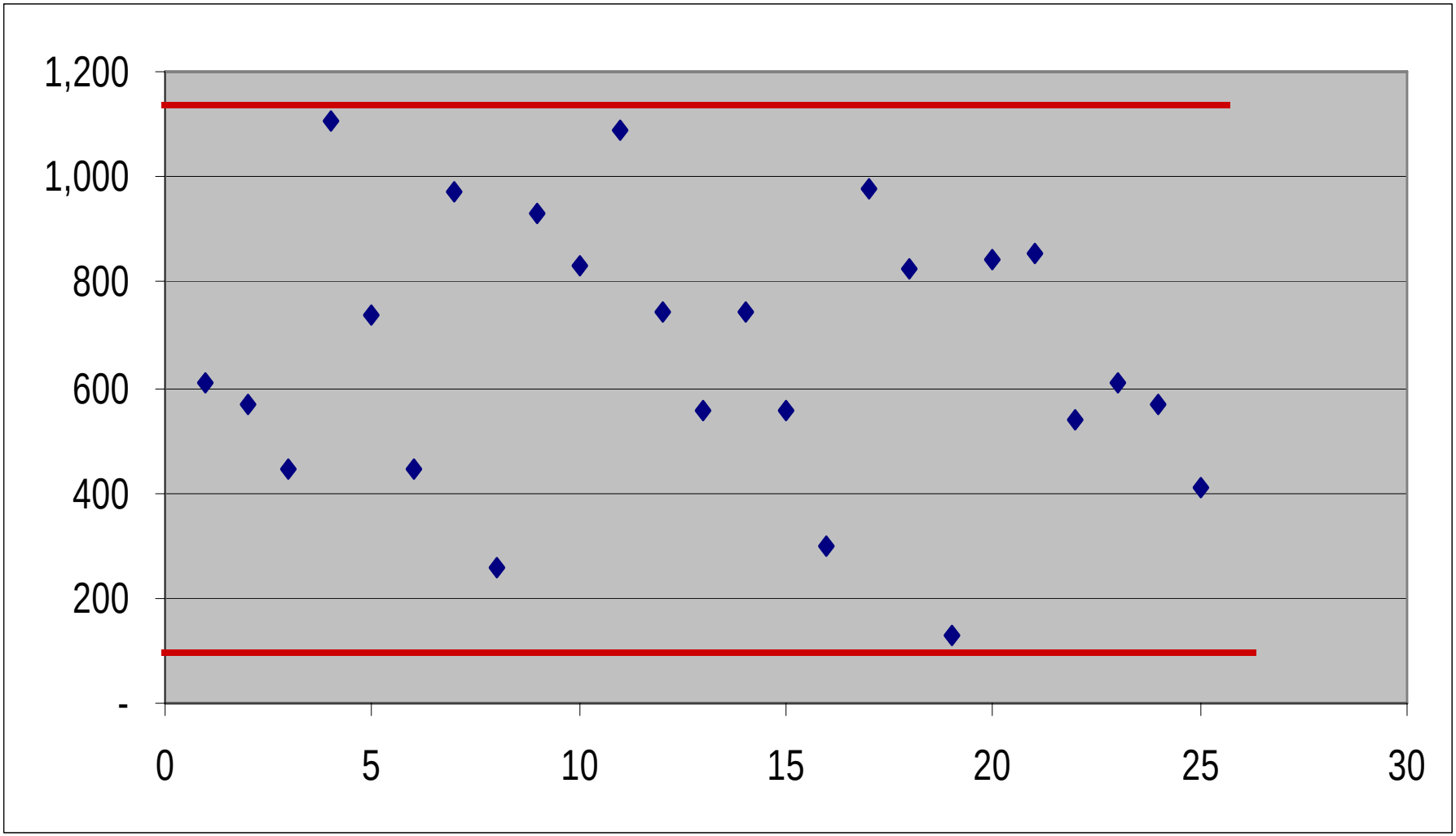
Averages, Coefficients of Variation, and Ranges of Selected Nutrients Among 32 U.S. DDGS Sources (100% Dry Matter Basis)

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

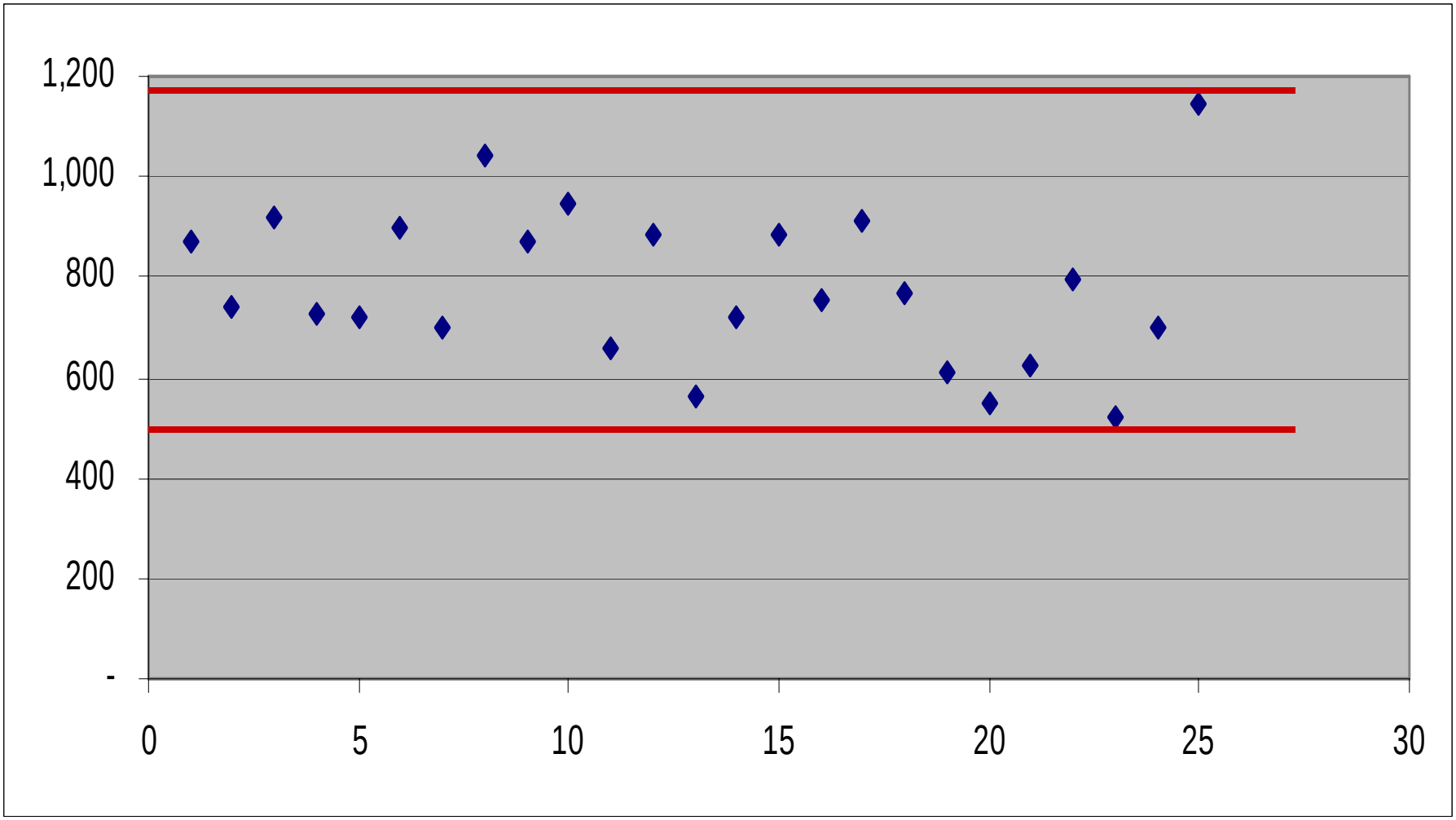
How Does DDGS Compare to Soybean Meal?

Variability (CV, %) of Selected Nutrients Among U.S. DDGS Sources vs. U.S. Soybean Meal Sources

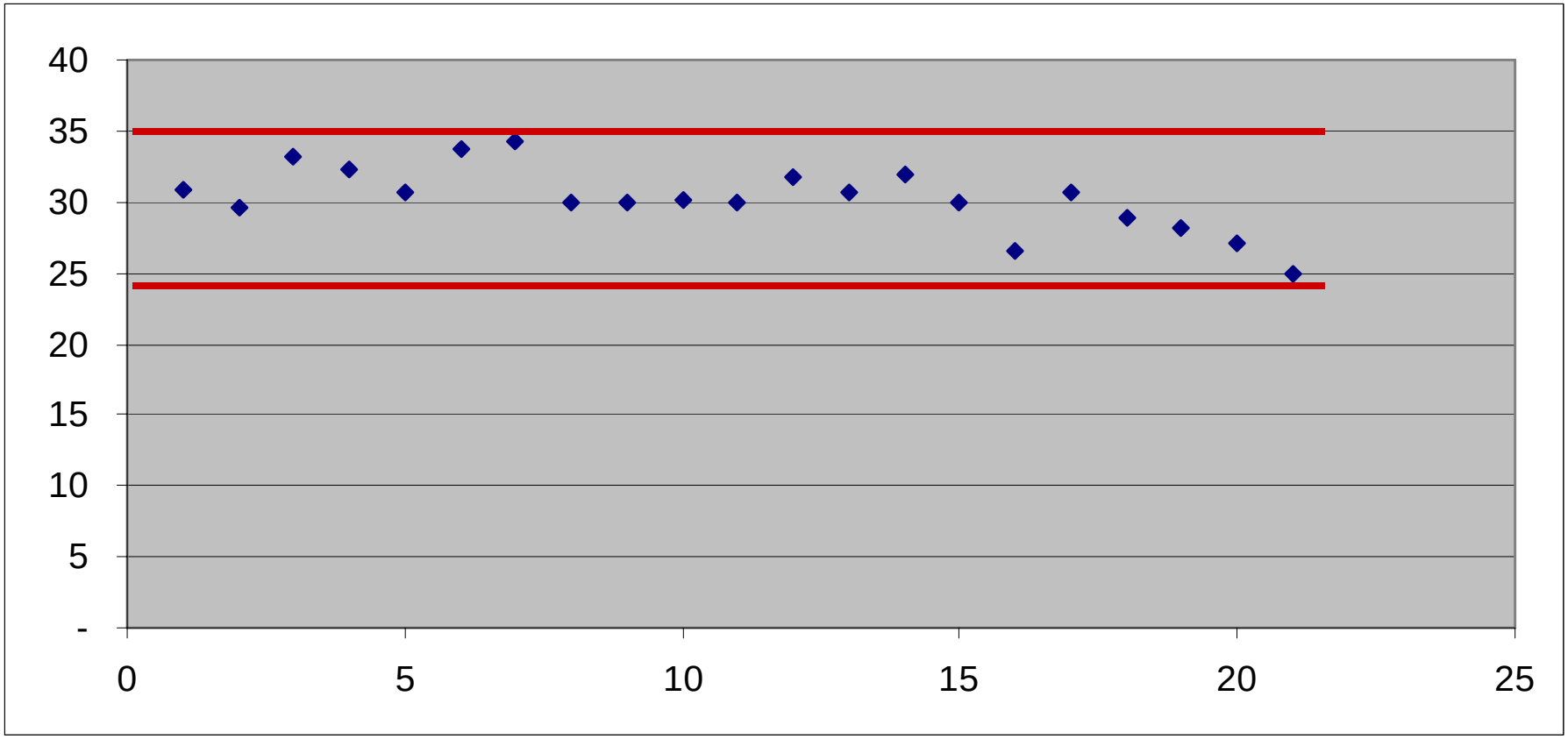
Nutrient	DDGS	Soybean Meal
Crude protein	4.5	2.3
Crude fat	17.1	30.9
Crude fiber	18.9	9.5
Ash	27.2	6.6
Lysine	12.1	3.0
Methionine	8.5	5.3
Threonine	5.8	4.2
Tryptophan	12.0	7.3
Calcium	117.5	25.8
Phosphorus	19.4	9.1



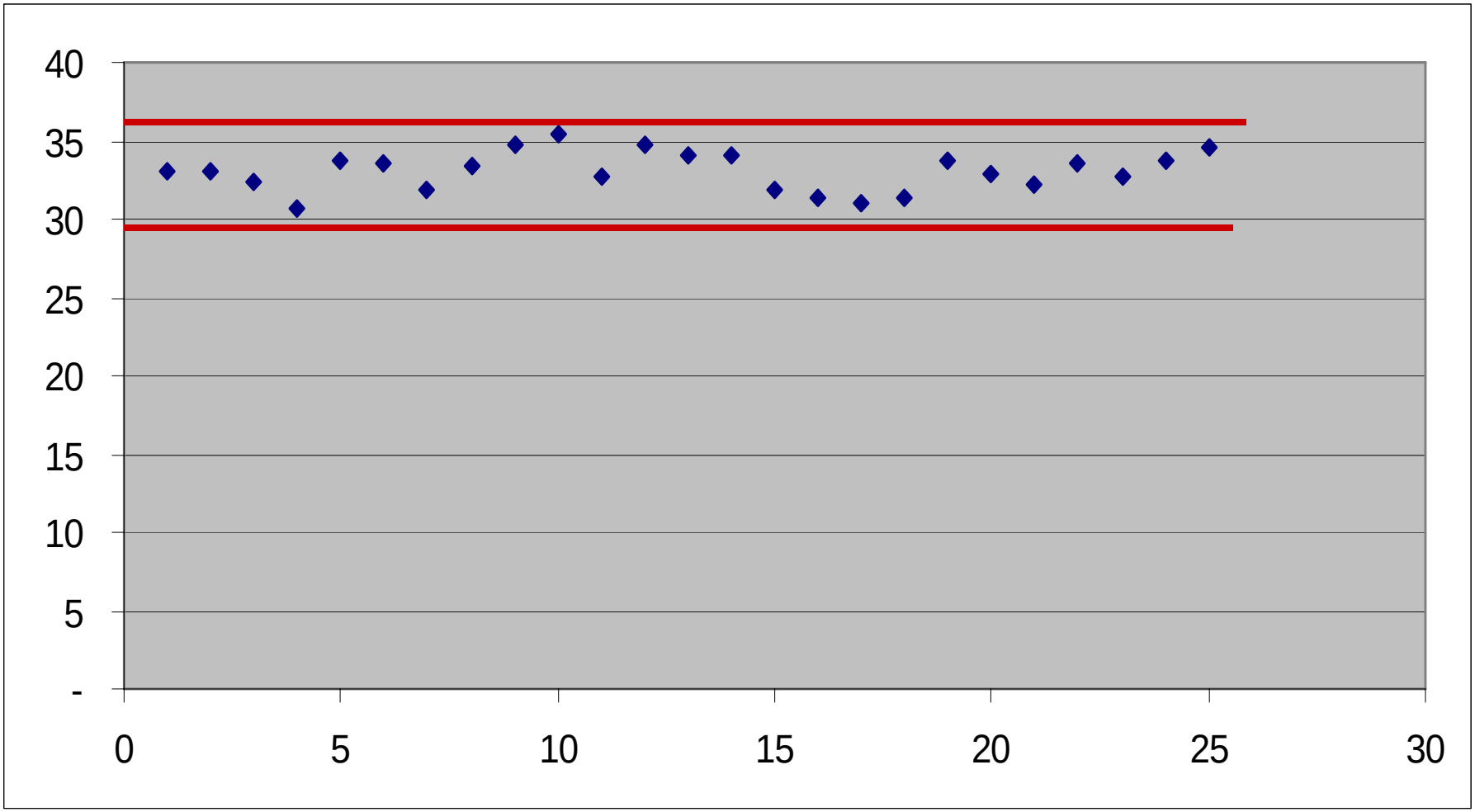
Variation in Particle Size Among DDGS Samples Representing 25 U.S. Ethanol Plants 2005



Variation in Particle Size Among Soybean Meal Samples Representing 6 U.S. Plants 2005



Variation in Bulk Density (Lbs/Cubic Ft.) Among DDGS Samples Representing 25 U.S. Ethanol Plants
1/05



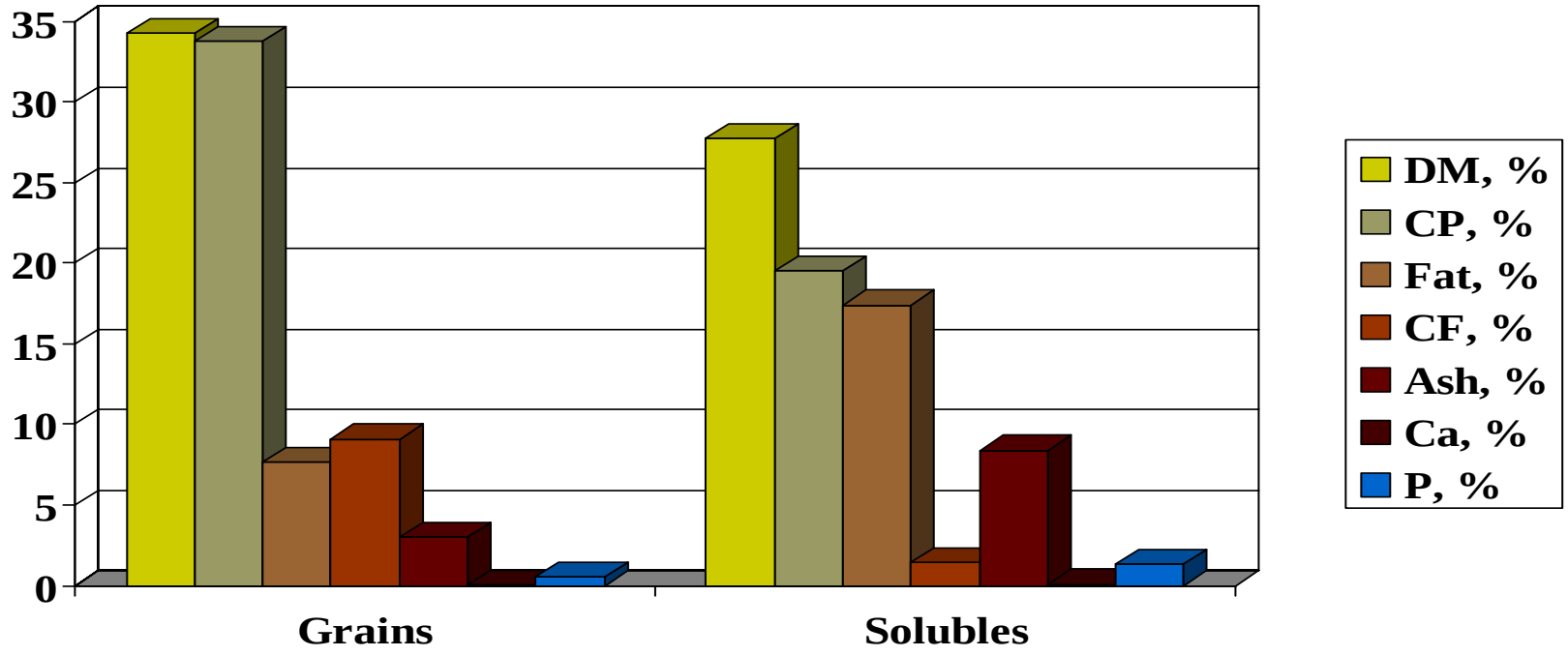
Variation in Bulk Density (Lbs/Cubic Ft.) Among Soybean Meal Samples Representing 6 U.S. Plants 2003

DDGS Definition and Terminology in the Market

Distillers Products Definitions

- 27.6 ____ **Distillers Dried Grains with Solubles** is the product obtained after the removal of ethyl alcohol by distillation from the yeast fermentation of a grain or a grain mixture by condensing and drying at least ¾ of the solids of the resultant whole stillage and drying it by methods employed in the grain distilling industry. The predominating grain shall be declared as the first word in the name.

Comparison of the Nutrient Content of Corn Distiller's Grains and Corn Condensed Distiller's Solubles



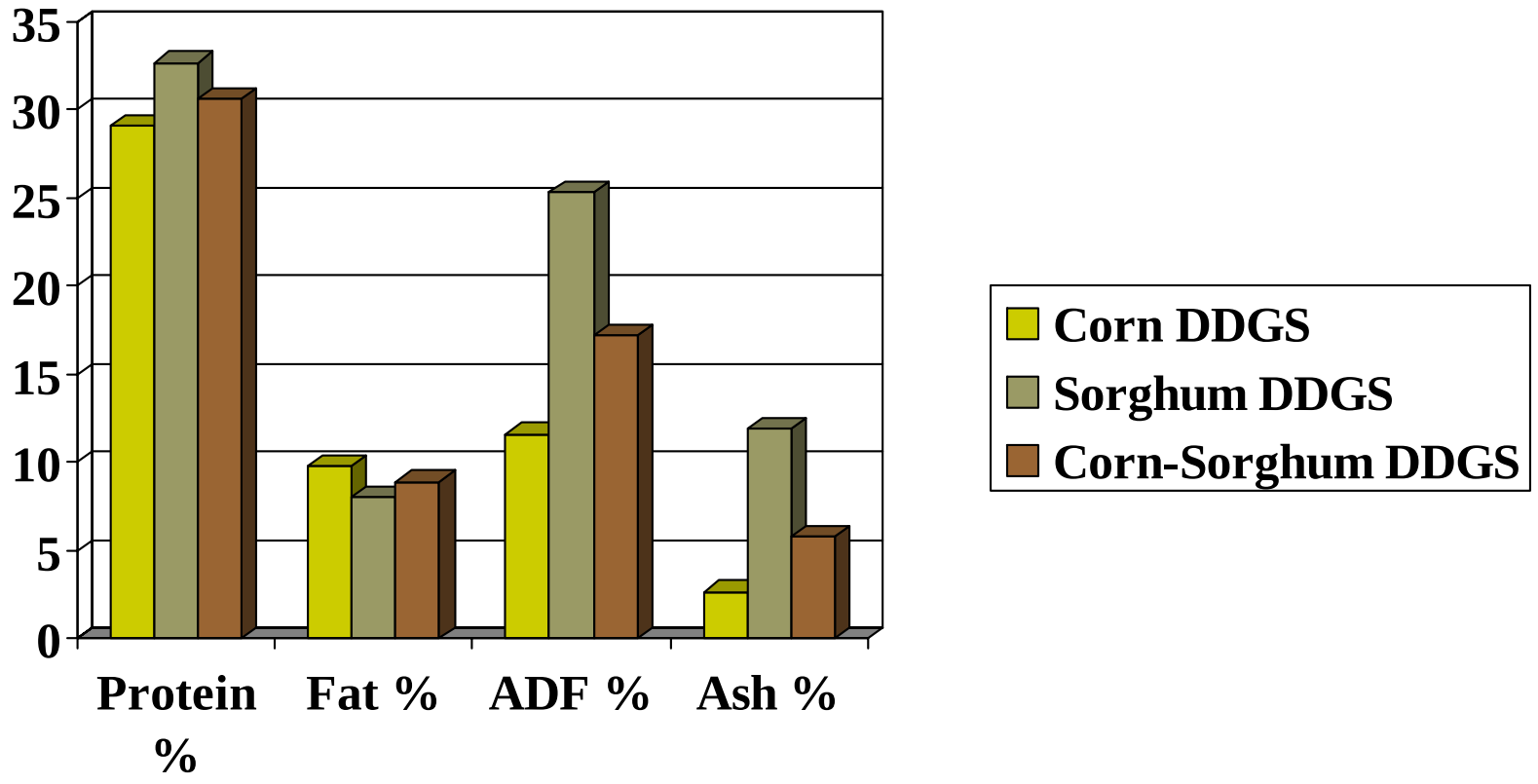
Comparison of Nutrient Composition of Golden DDGS to Other "DDGS Sources" (100% Dry Matter Basis)

	Golden Corn DDGS	"DDGS"	High Fat DDGS	Partial De-germed DDGS	Whiskey DDGS	Pelleted DDGS
Protein, %	31.8	29.3	31.6	30.1	29.9	27.0
Fat, %	11.3	3.5	15.3	8.9	8.8	9.00
Crude fiber, %	6.3	7.9	No data	7.8	10.6	15.10
ADF, %	12.4	11.8	17.9	21.0	20.2	No data
Ash, %	6.9	5.3	4.6	7.3	3.7	4.28
DE, kcal/kg*	4053	3808	No data	3796	No data	No data
ME, kcal/kg*	3781	3577	No data	3560	3789	No data
Lys, %	0.92	0.61	0.90	0.83	0.99	No data
Met, %	0.62	0.54	0.54	0.66	0.61	No data
Thr, %	1.17	1.01	1.04	1.13	1.10	No data
Trp, %	0.25	0.18	0.23	0.25	0.27	No data
Ca, %	0.07	0.12	0.06	0.51	0.04	0.17
P, %	0.77	0.78	0.89	0.68	0.57	0.62

*Calculated energy values for swine

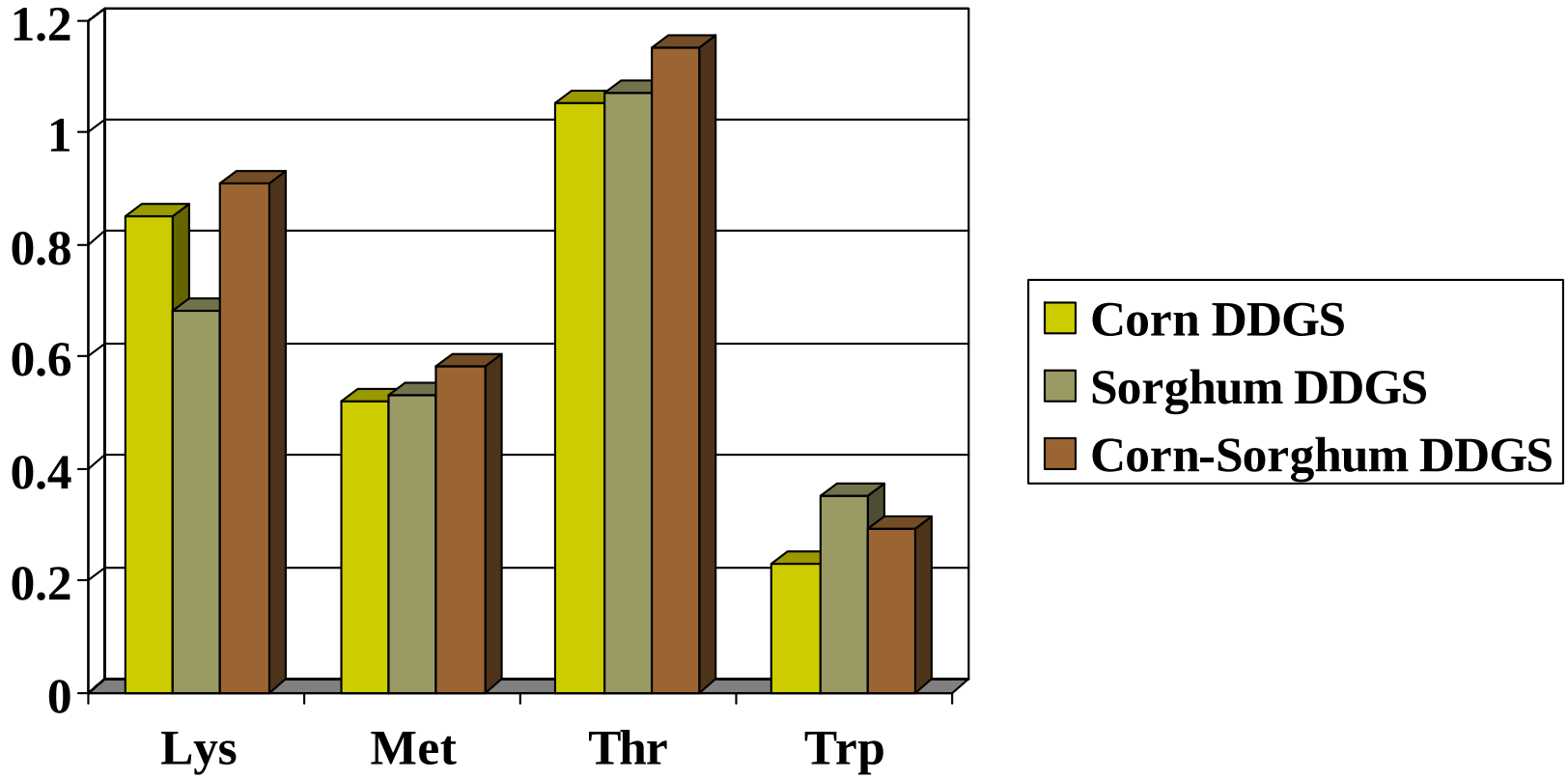
Grain Source Affects Nutrient Content and Digestibility

Comparison of Nutrient Composition of Corn DDGS, Sorghum DDGS, and a Corn-Sorghum Blend (As-is basis)



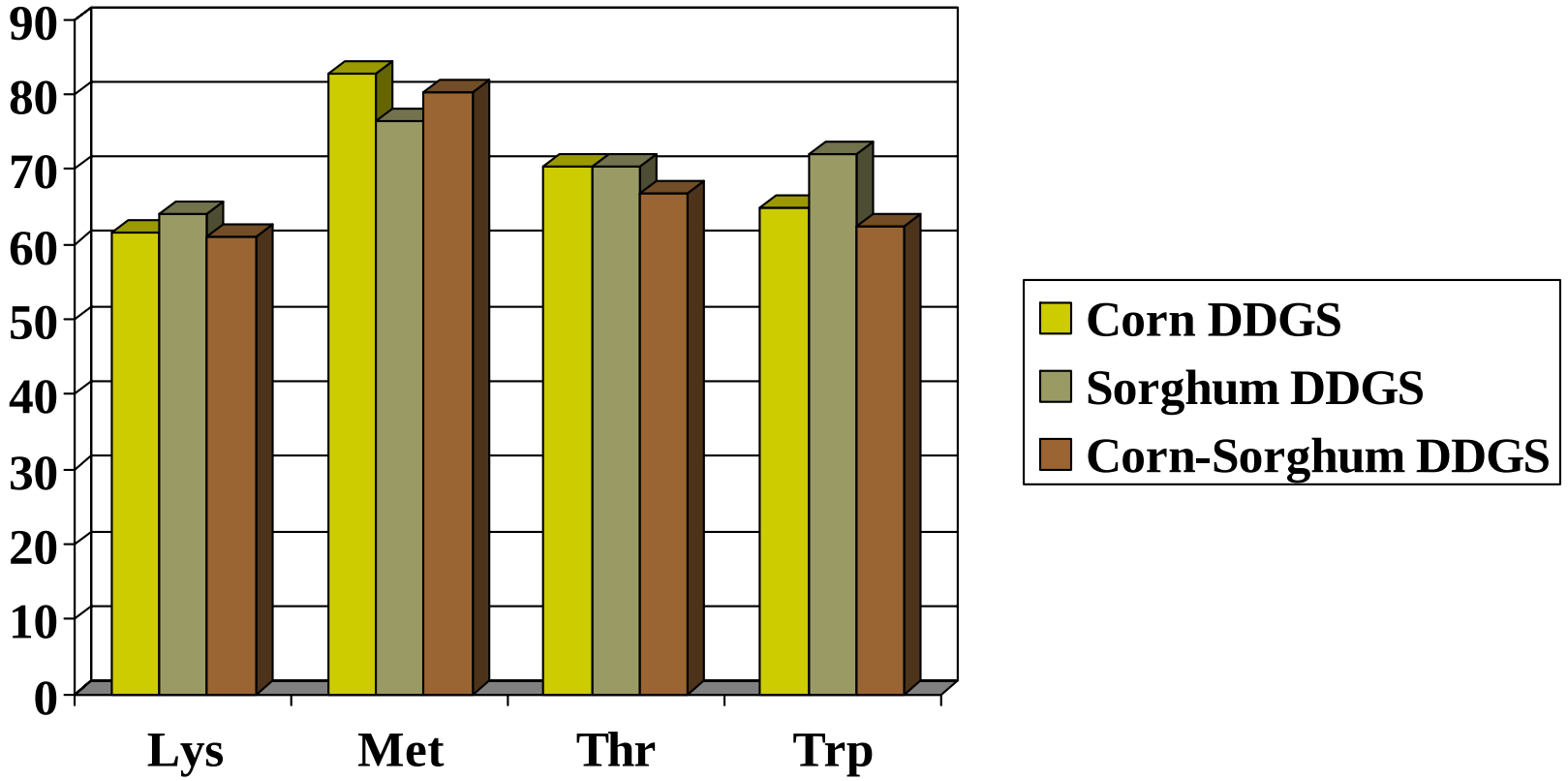
Urriola et al. (2006)

Comparison of Total Lysine, Methionine, Threonine, and Tryptophan of Corn DDGS, Sorghum DDGS, and a Corn-Sorghum Blend of DDGS for Swine



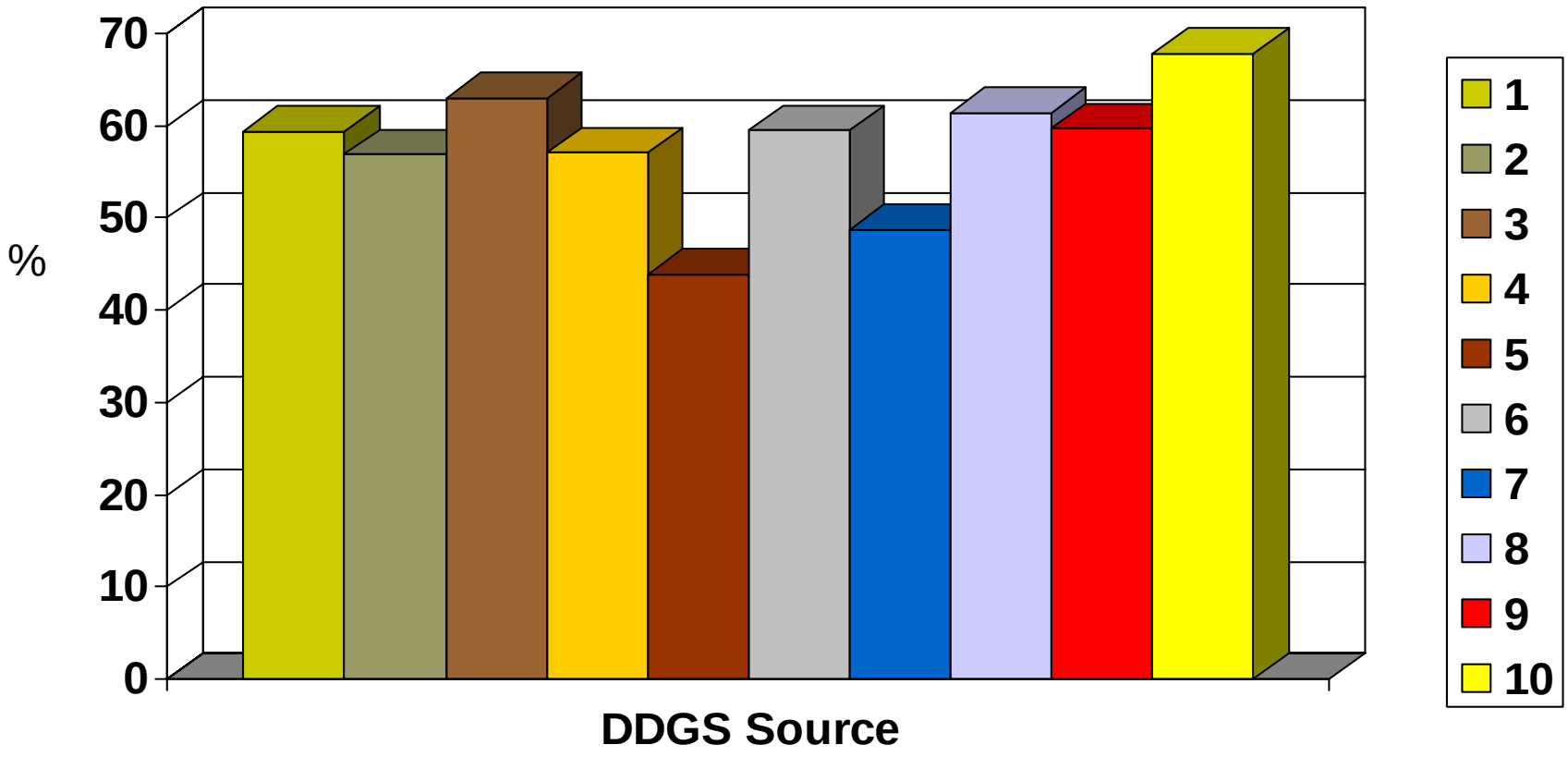
Urriola et al. (2006)

Comparison of Lys, Met, Thr, and Trp Digestibilities of Corn DDGS, Sorghum DDGS, and a Corn-Sorghum Blend of DDGS for Swine

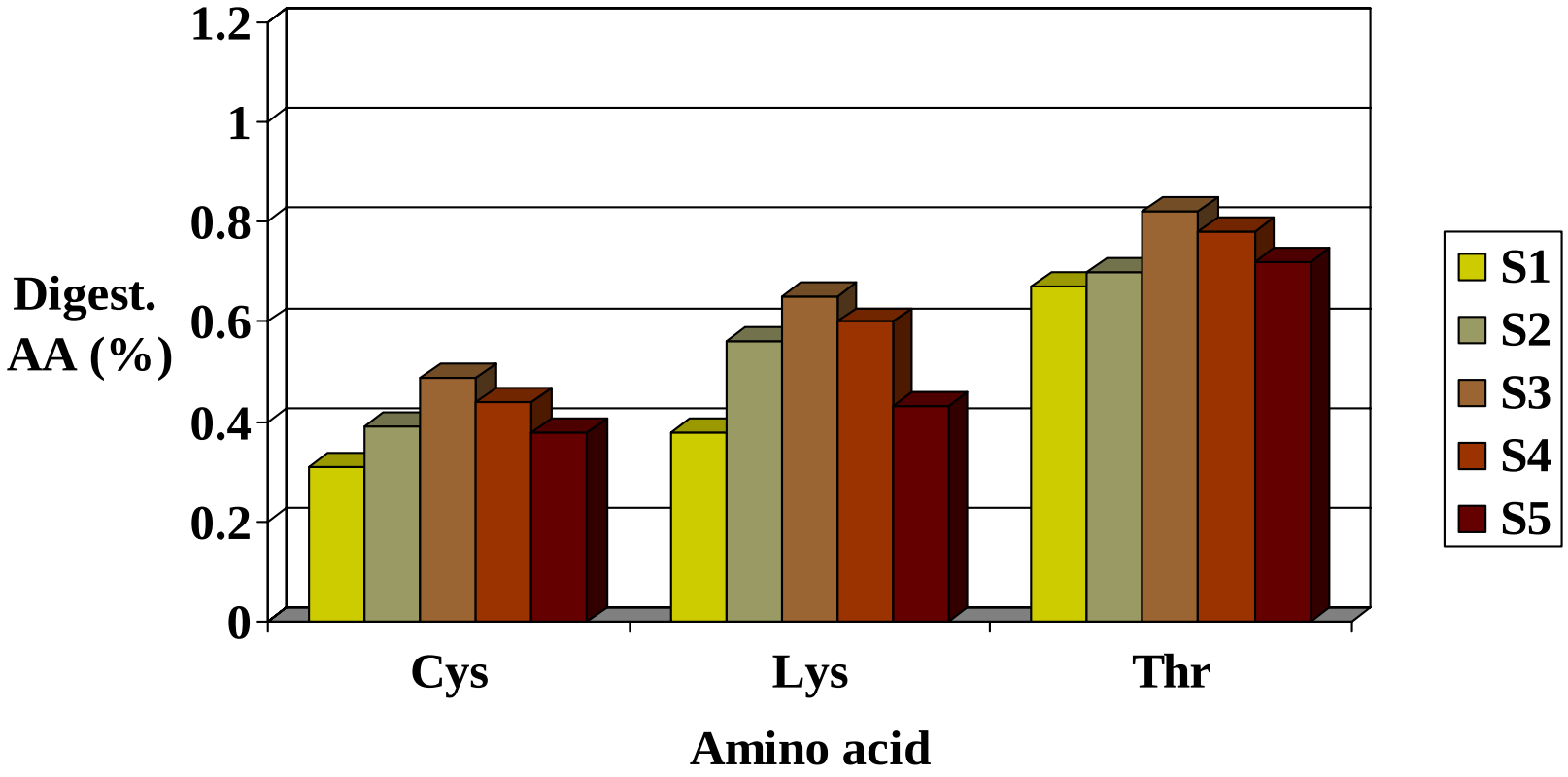


Urriola et al. (2006)

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



Differences in Digestible Amino Acid Content Among DDGS Sources for Poultry



Noll et al. (2006)

Prediction of Amino Acid Digestibility Among Sources of DDGS for Swine and Poultry

Hunter Lab and Minolta Color Measurements

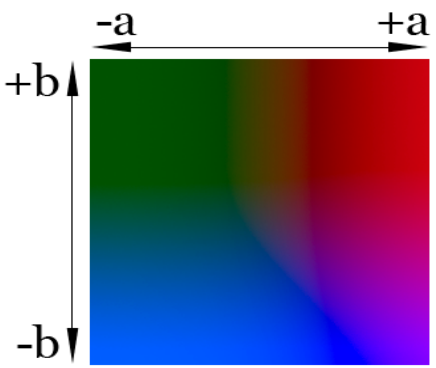
Commission of illumination color scale (Minolta):

L* = Lightness

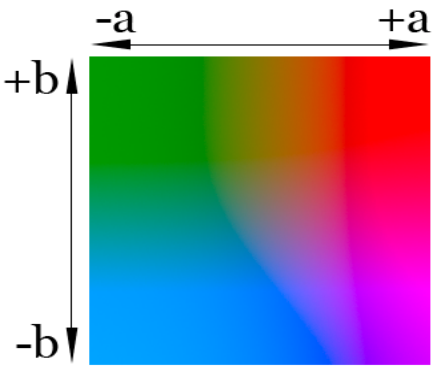
a* = redness

b* = yellowness

Lightness 25%



Lightness 50%



Lightness 75%

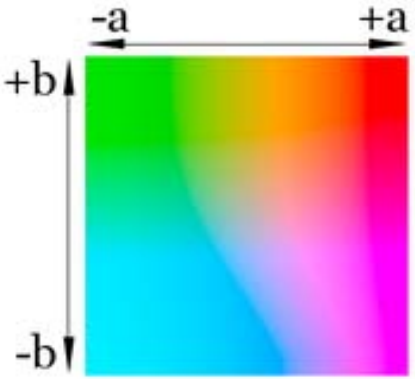
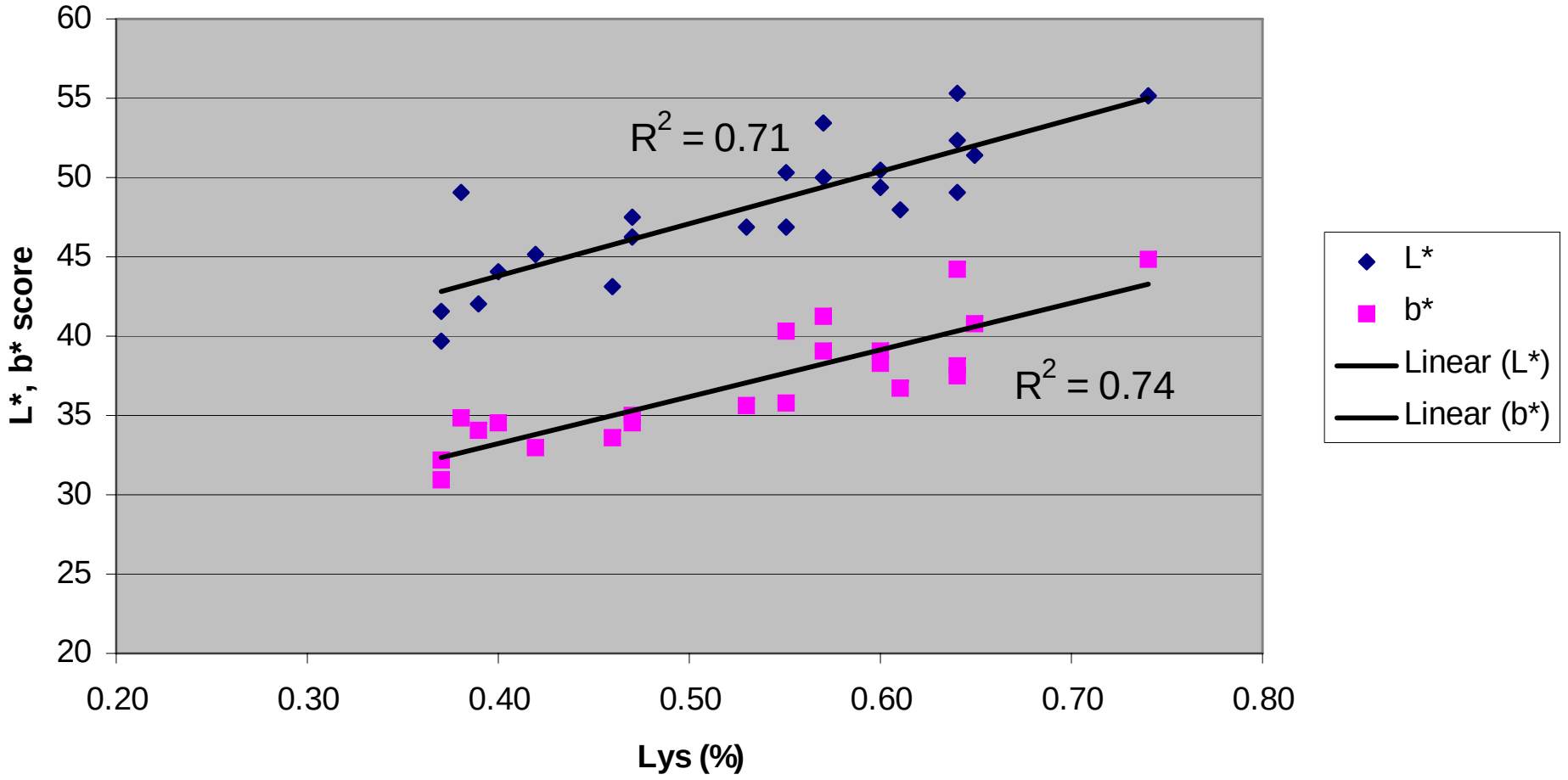
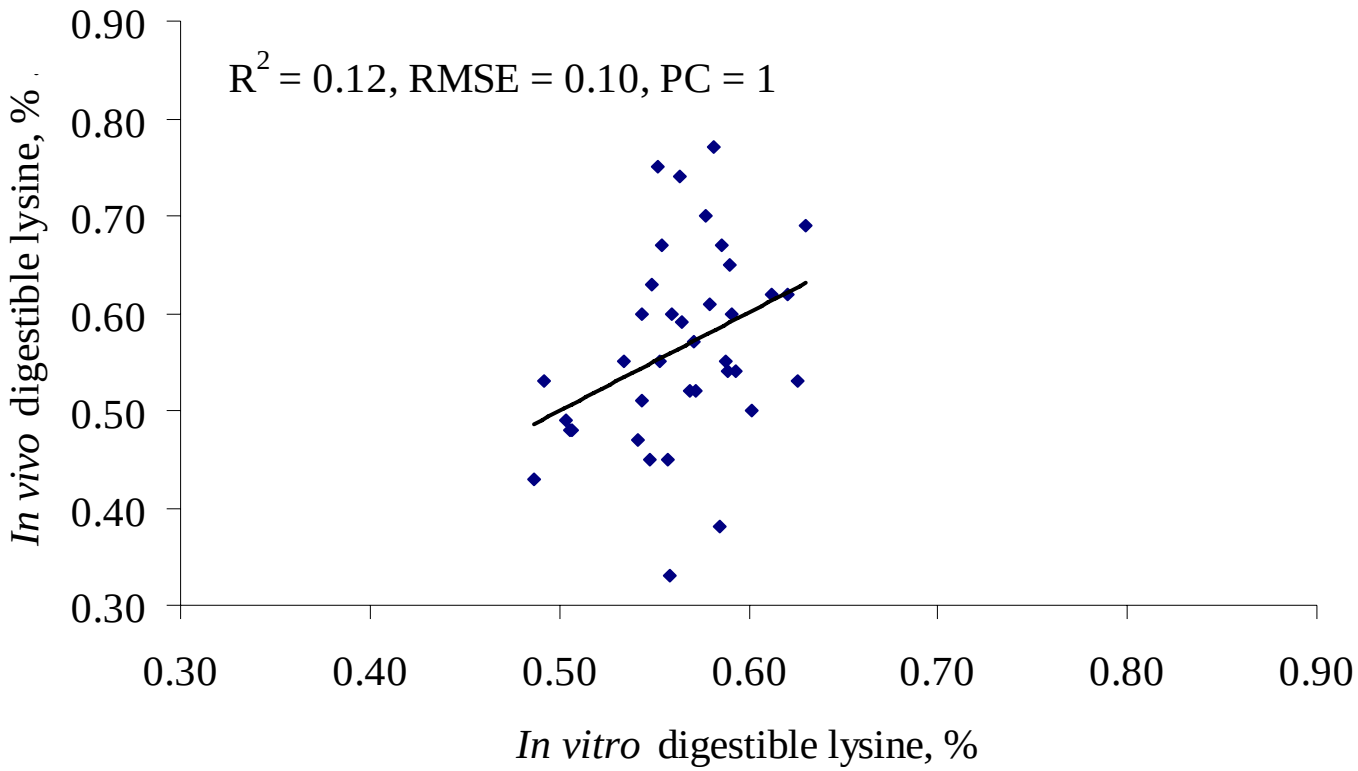


Fig. 1. Regression of digestible lys (%) and color (L*, b*)



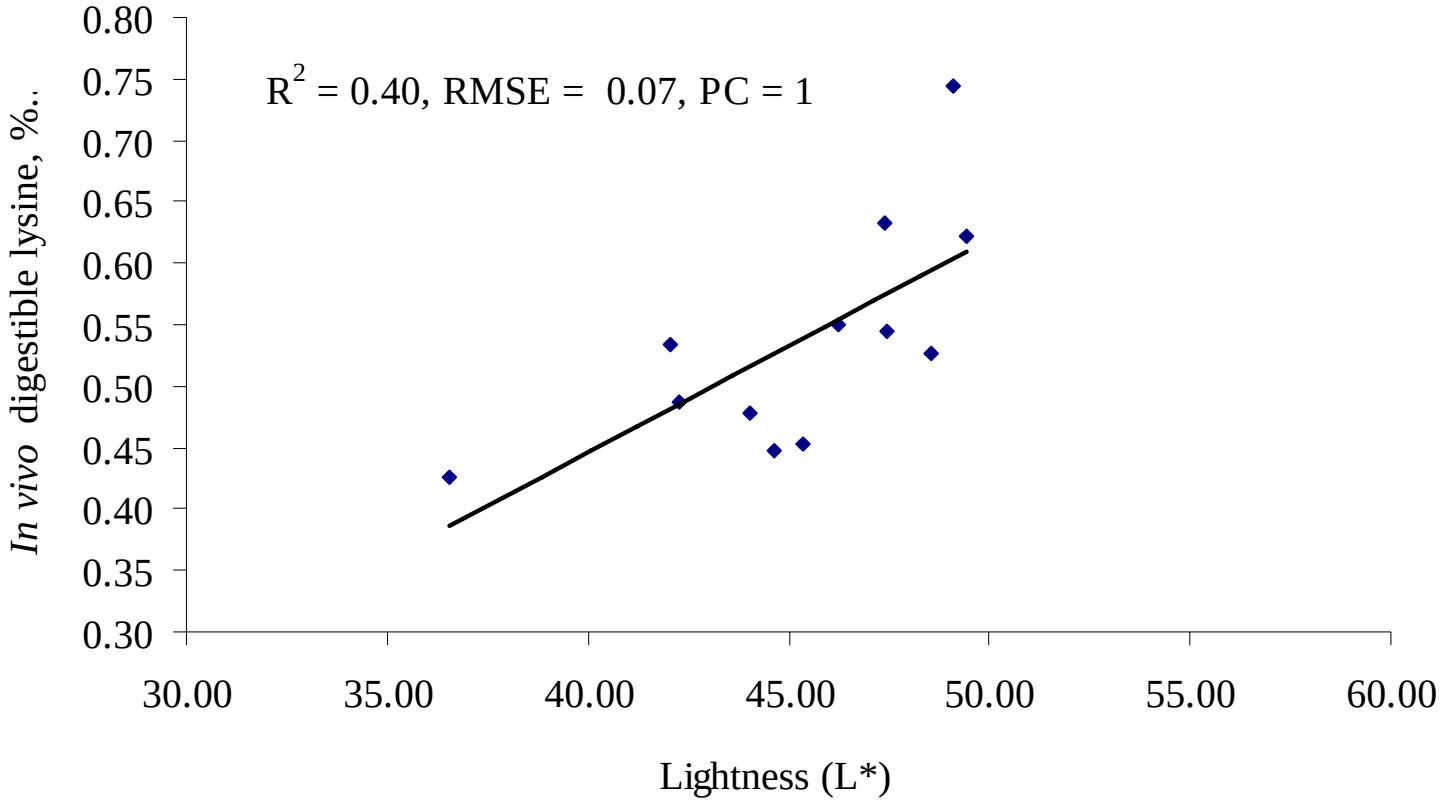
Source: Dr. Sally Noll (2003)

Prediction of Digestible Lysine from Color (L*, a*, and b*) Among DDGS Sources for Swine



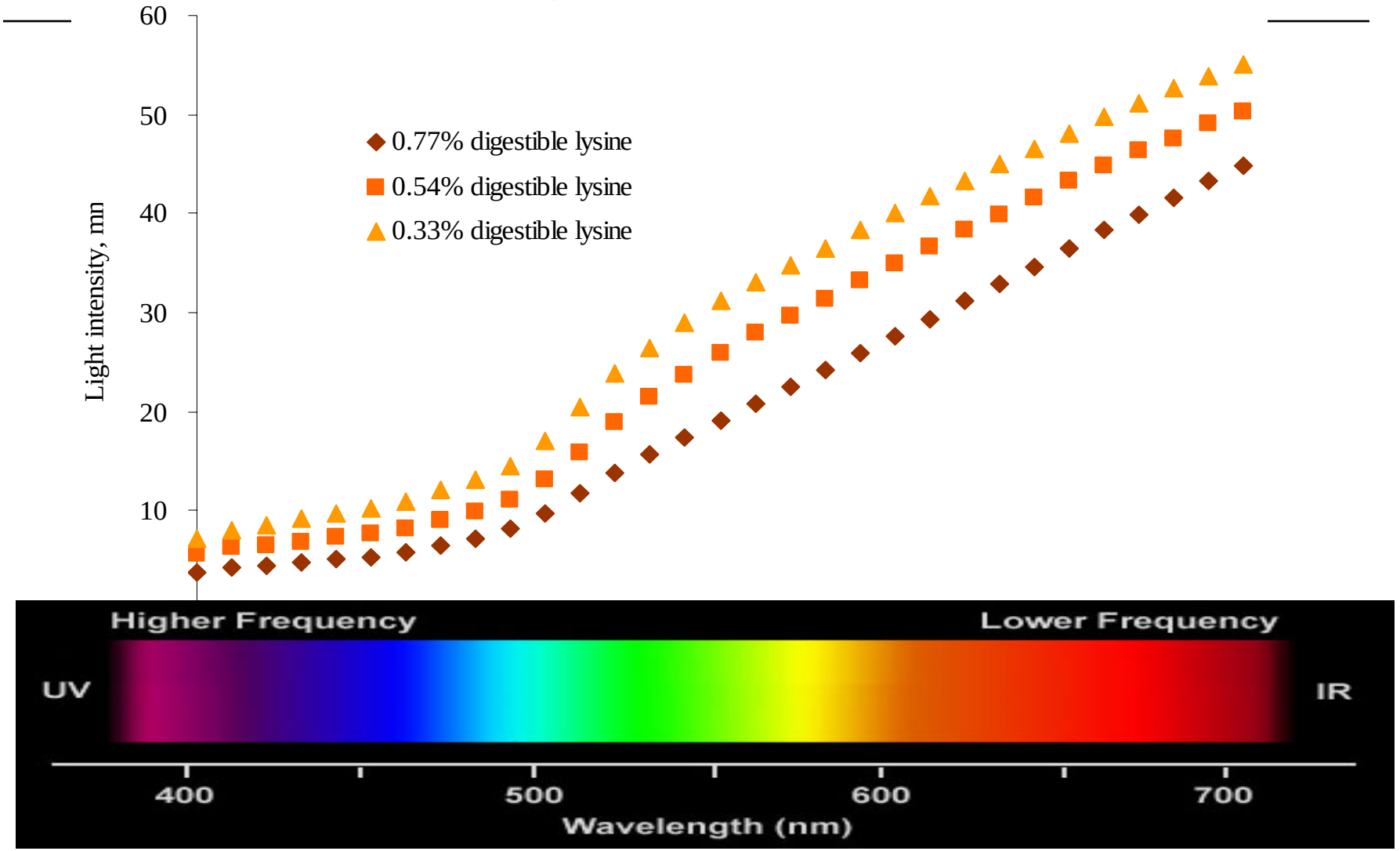
Urriola et al. (2006)

Prediction of Digestible Lysine from Color L*, a*, and b* (L* < 50 in corn DDGS)

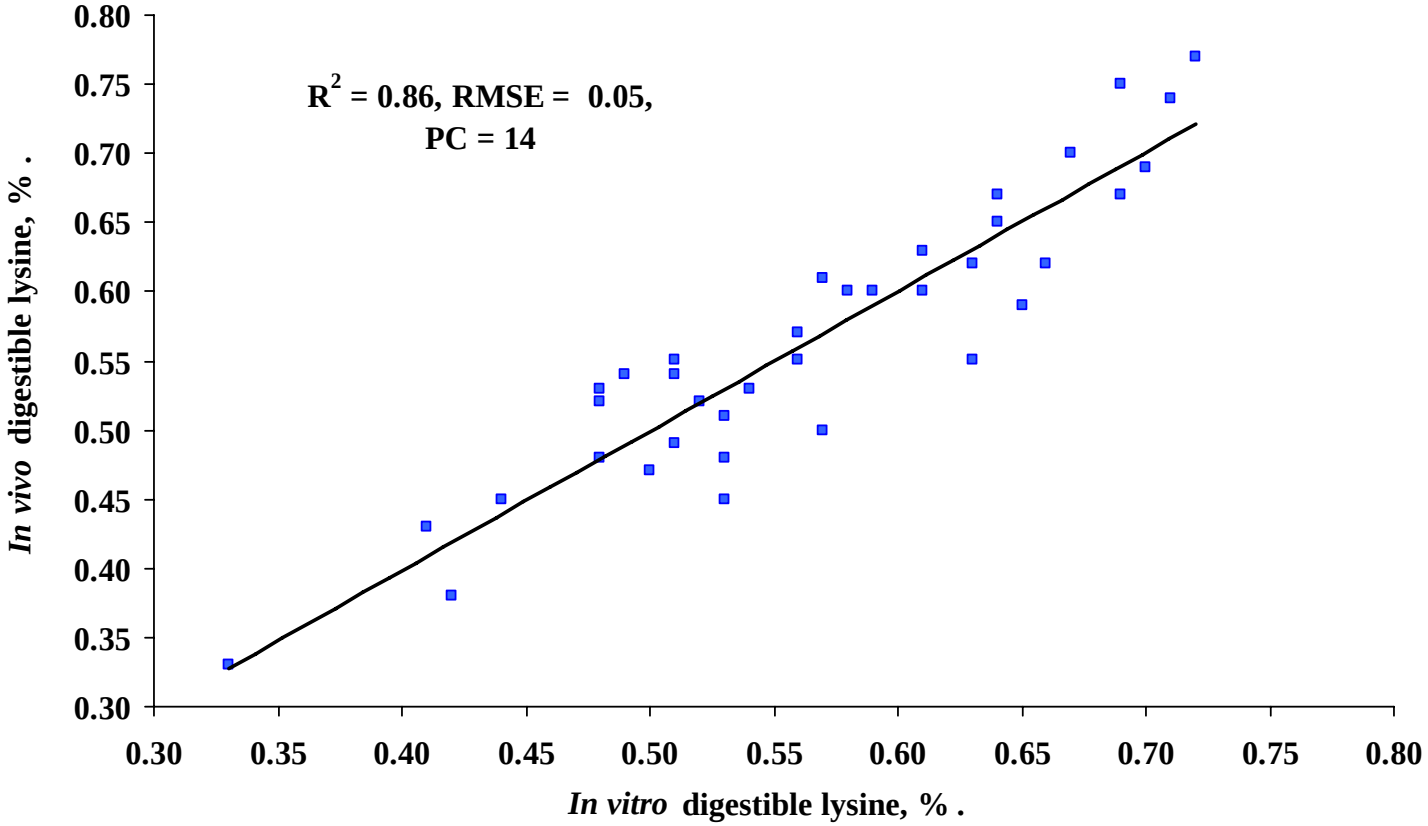


Urriola et al. (2006)

Prediction of Digestible Lysine Content of DDGS Using Optical Density

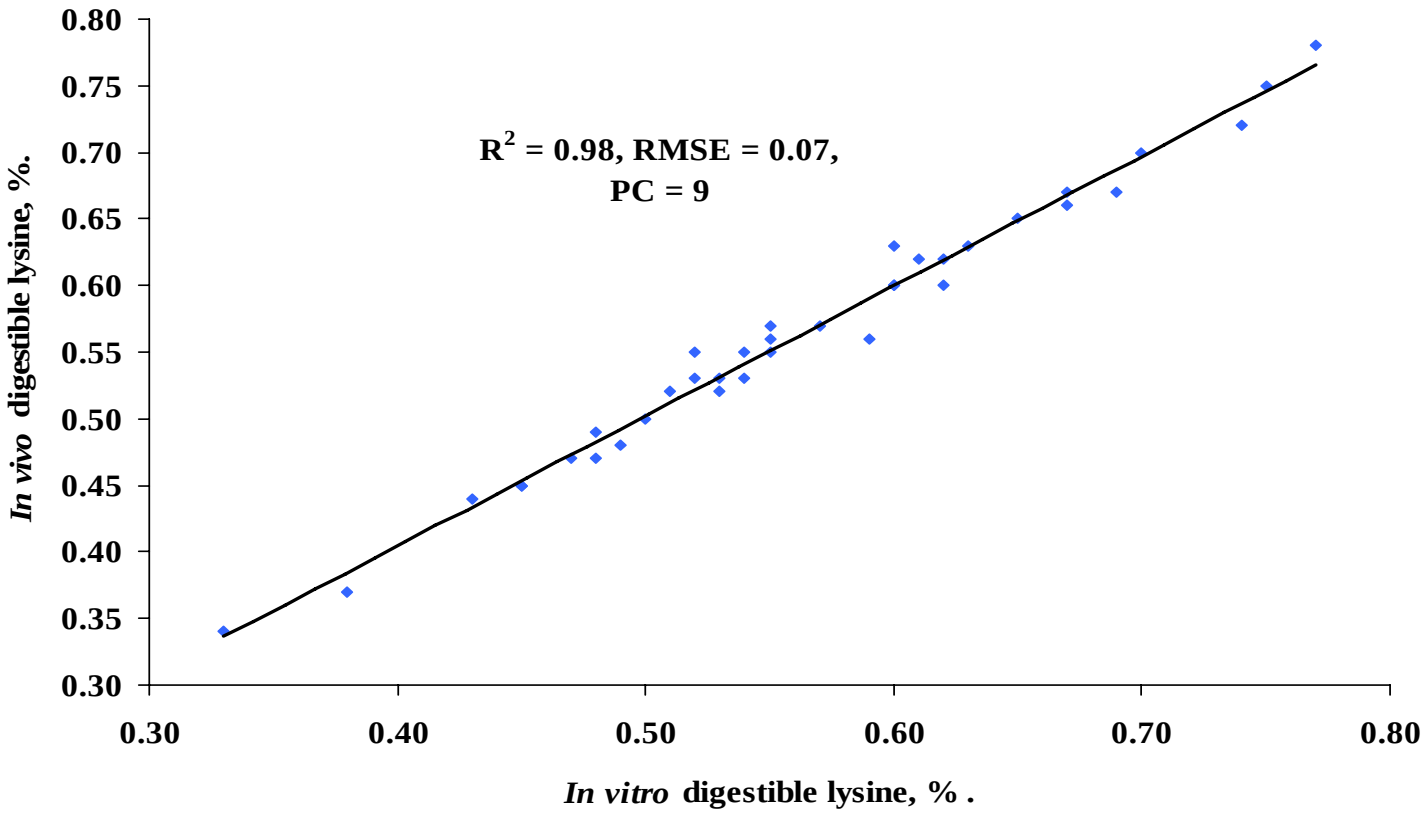


Prediction of Digestible Lysine from Optical Density (400 to 700 nm)



Urriola et al. (2006)

Prediction of Digestible Lysine in DDGS Using Front Face Fluorescence



Urriola et al. (2006)

Some of the Nutrient Variability Among DDGS Sources is Due to the Use of Different Laboratory Testing Procedures

Comparison of AOAC Approved Moisture Testing Methods

- 130-135° C for 1 hour
- 100-105° C for 3 hours
- 100-105° C for 4 hours
- 60-70° C for 24 hours

Variability of Laboratory Results from the Same DDGS Sample Sent to 5 Different Commercial Laboratories

	Moisture	Fat	Protein
Lab 1	12.69	13.73	26.00
Lab 2	10.48	10.01	26.30
Lab 3	10.09	10.04	27.02
Lab 4	10.64	8.73	26.13
Lab 5	13.30	10.15	26.29
NIR	12.60	9.40	25.00

An "Ideal" DDGS Quality Assurance Program for Ethanol Plants

- Monitor incoming corn for mycotoxins and reject postive loads
- Standardize the amount of solubles added to the grains fraction to produce DDGS
- Use minimal drying time and temperature to produce DDGS
  - Dryer temperatures range from 445° F to 1150°F
- Segregate poor quality DDGS from good quality DDGS when it is produced
  - Price different qualities accordingly
- Provide transparent and frequent nutrient profile information to customers on the DDGS being produced
- Specify the testing procedures used to determine nutrient content
- Become ISO 9000:2001 and HAACP certified

Physical Characteristics to Monitor

- Bulk density
- Particle size
- Hunter color scores
  - L*
  - a*
  - b*
- pH

Nutrients to Monitor

- Moisture
- Crude protein
- Crude fat
- Crude fiber
- ADF
- NDF
- Ash
- Swine DE, ME, NE (calculated)
- Starch

Minerals

- Calcium
- Phosphorus
- Sulfur
- Chloride
- Sodium

Amino acids

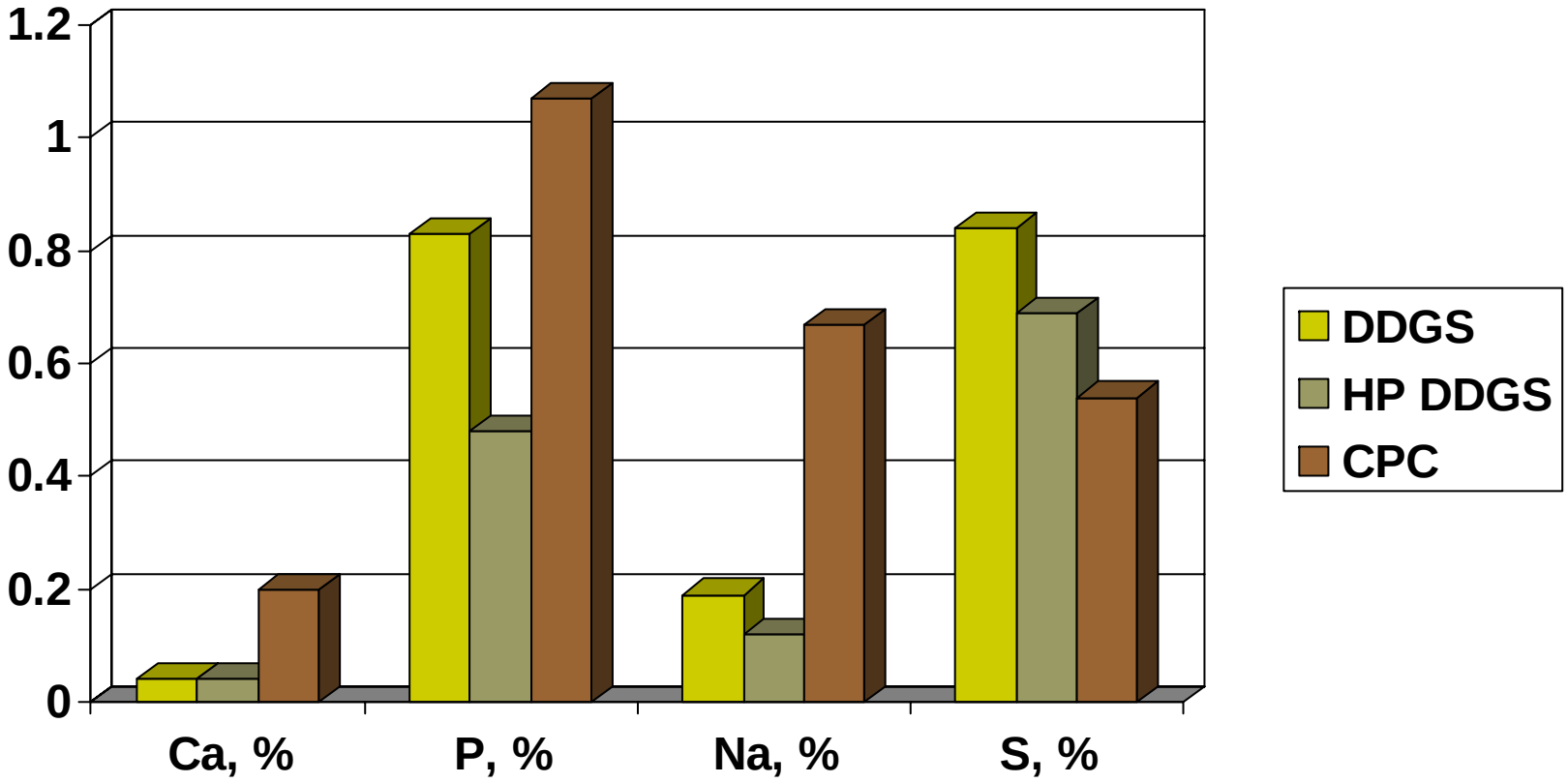
- Lysine
- Methionine
- Threonine
- Tryptophan
- Cystine

Mycotoxins

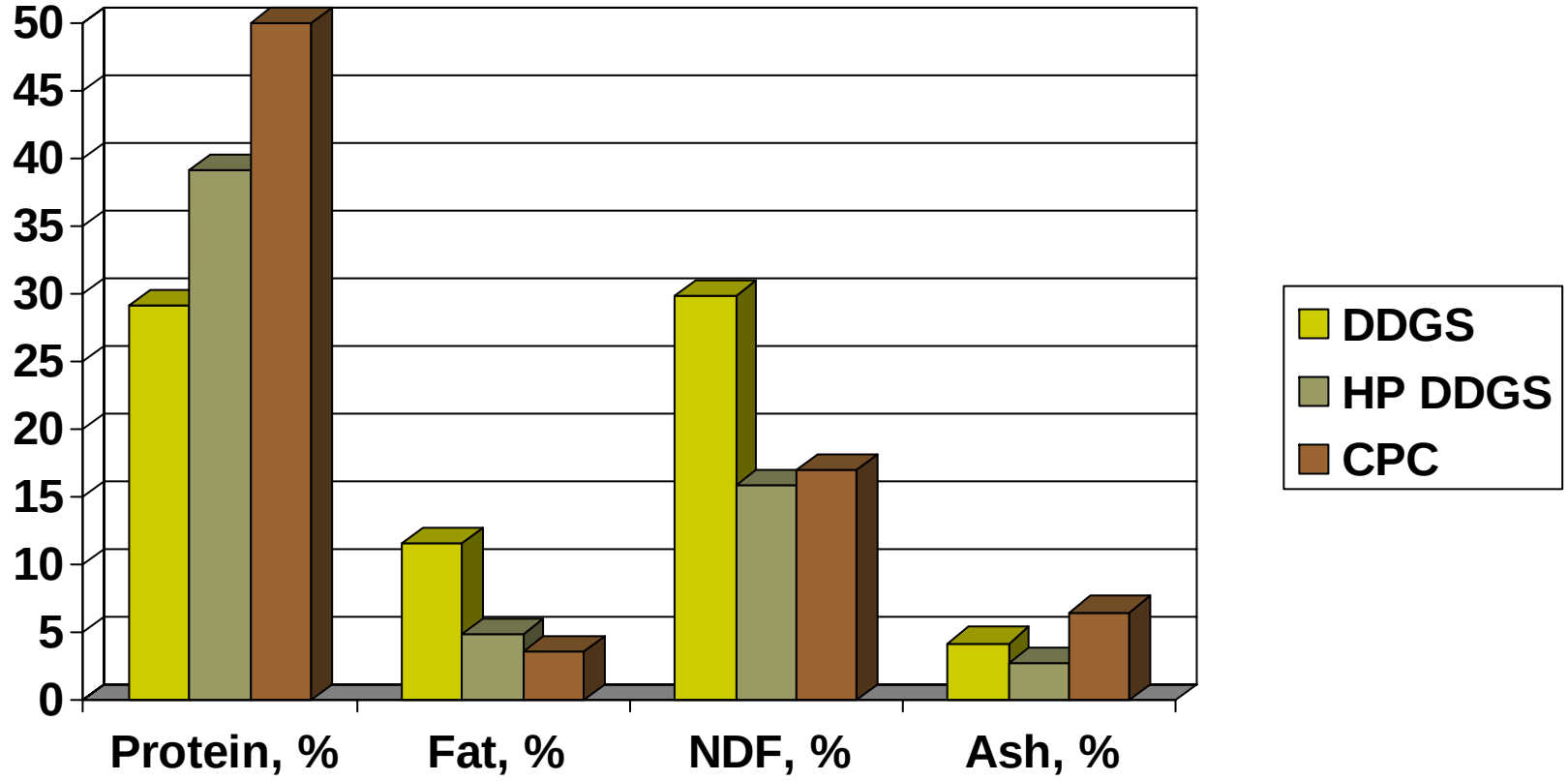
- Aflatoxins
  - B_1, B_2, G_1, G_2
- Deoxynivalenol (DON)
- Zearalenone
- Fumonisins
  - B_1, B_2, B_3

The Value of New Distiller's By-Products in Swine Diets

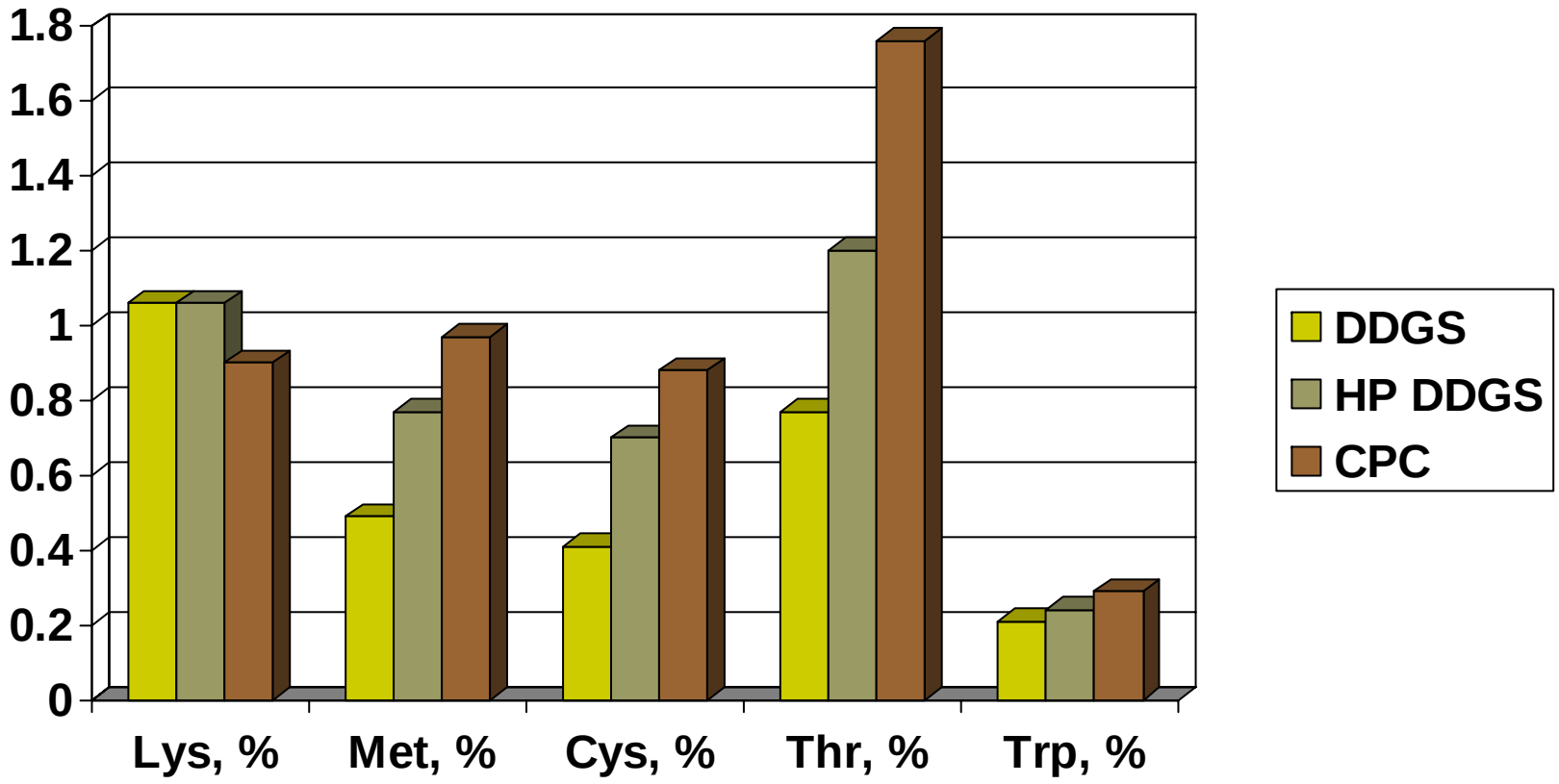
Comparison of Mineral Content of Dakota Gold DDGS with High Protein Dakota Gold and Corn Protein Concentrate (100% DM Basis)



Comparison of Nutrient Content of Dakota Gold DDGS with High Protein Dakota Gold and Corn Protein Concentrate (100% DM Basis)



Comparison of Amino Acid Content of Dakota Gold DDGS with High Protein Dakota Gold and Corn Protein Concentrate (100% DM Basis)



Opportunity Costs of Corn By-Products in Swine and Poultry Diets

	DDGS Spec. 1	DDGS Spec. 2	HP DDGS	Glutenol	CPC
Swine	$80.00	$78.00	$51.00	$63.40	$61.60
Poultry	$80.00	$75.20	$53.00	$75.20	$43.00

U of M DDGS Web Site
www.ddgs.umn.edu

We have developed a DDGS web site featuring:

* nutrient profiles and photos of DDGS samples
* research summaries
    - swine, poultry, dairy, & beef
    - DDGS quality
* presentations given
* links to other DDGS related web sites
* international audiences