

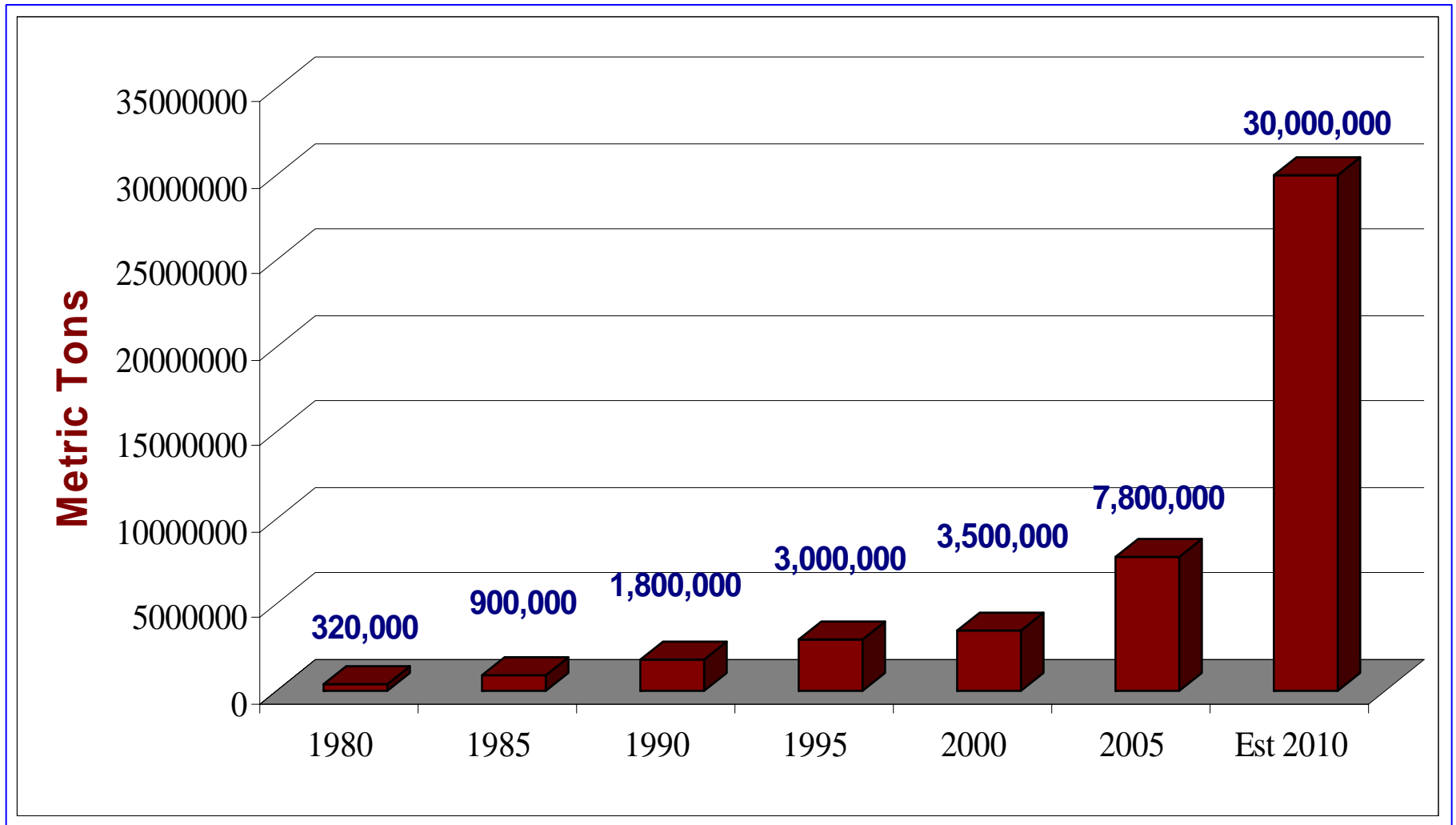
Feeding DDGS to Livestock and Poultry

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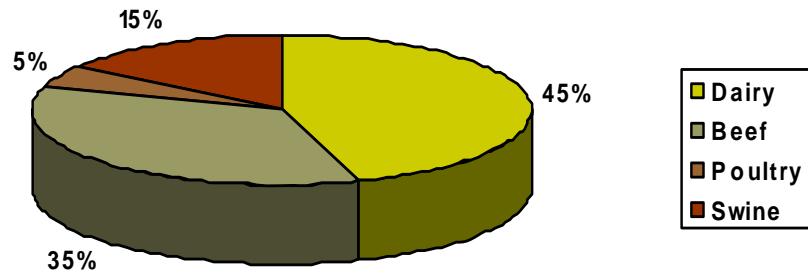
North American DDGS Production



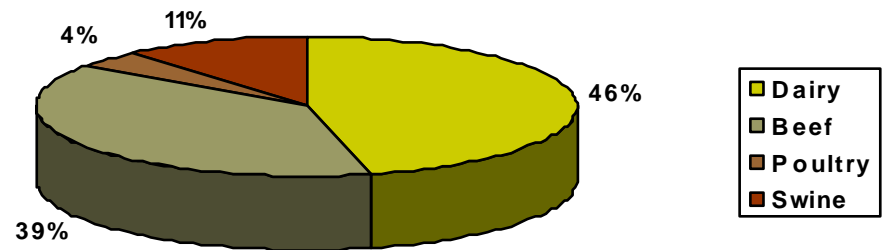
Source: Sean Broderick, Commodity Specialists Company

U.S. DDGS Consumption

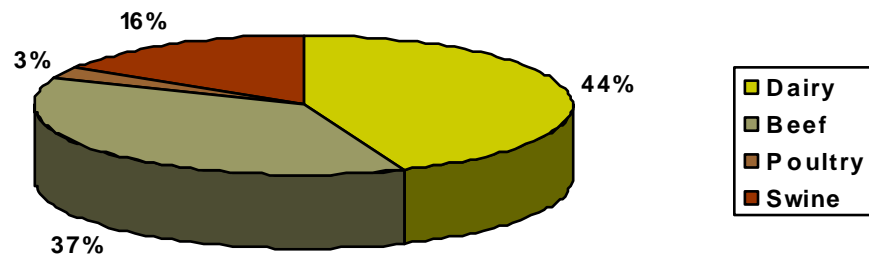
Estimate 2002



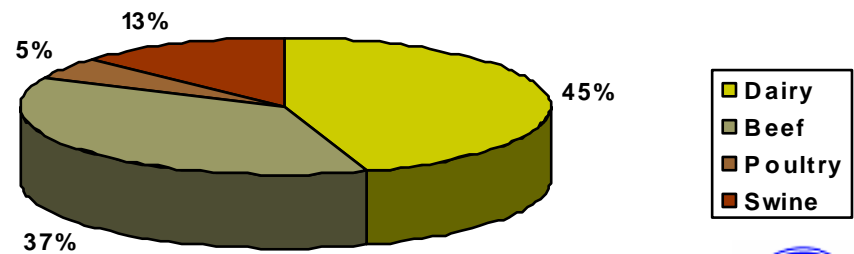
Estimate 2003



Estimate 2004



Estimate 2005





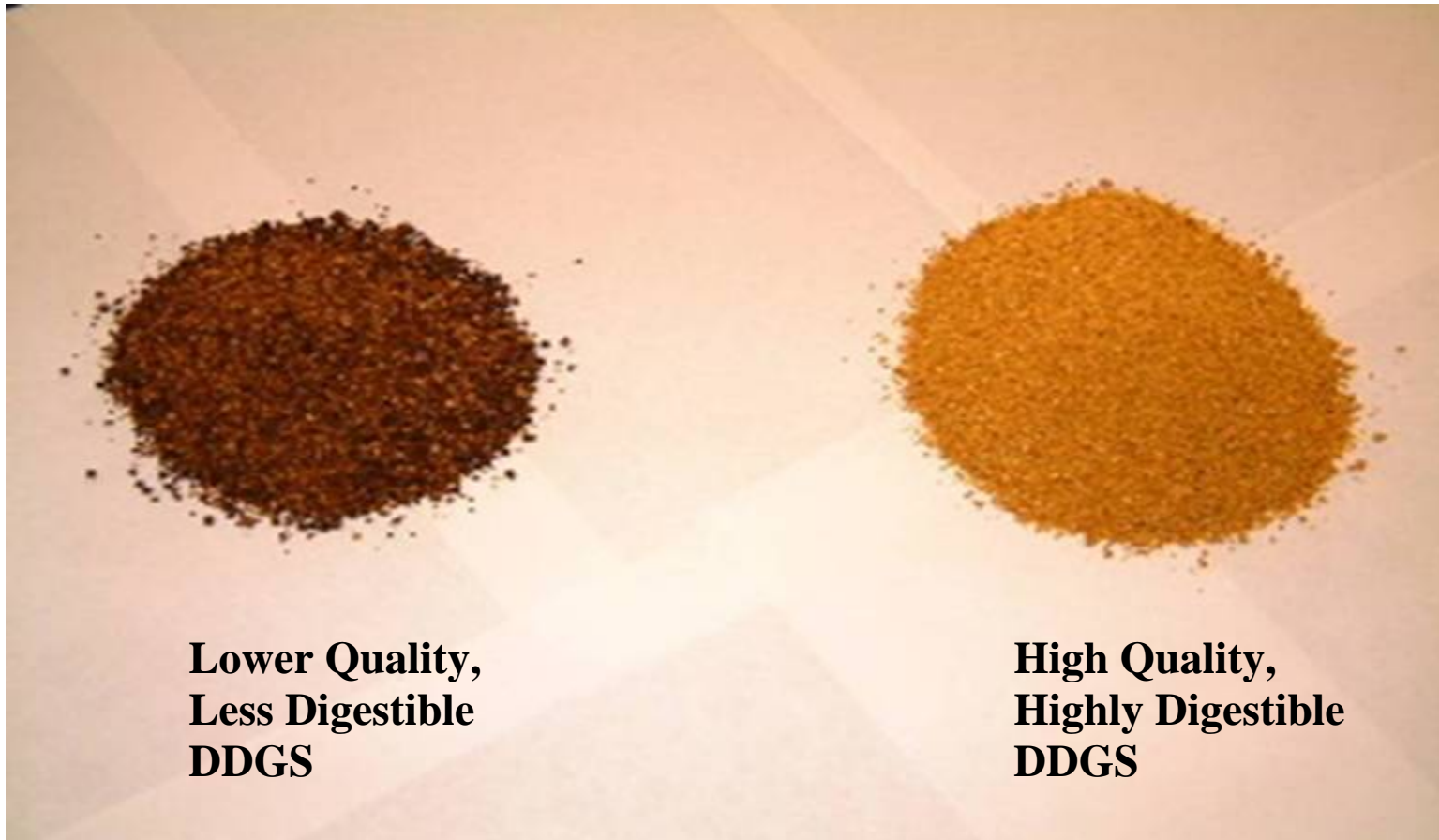
Types of Distiller's By-Products from Dry-Grind Ethanol Plants

- Wet distiller's grains
 - Primarily beef, some dairy
- Dry distiller's grains
 - Beef and dairy
- Wet distiller's grains with solubles
 - Beef and dairy
- Dried distiller's grains with solubles
 - Dairy, swine, poultry, some beef
- Modified wet cake (blend of wet and dry distiller's grains)
 - Primarily beef, some dairy
- Condensed distiller's solubles
 - Beef and dairy
 - Ontario, Canada - swine liquid feeding systems

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



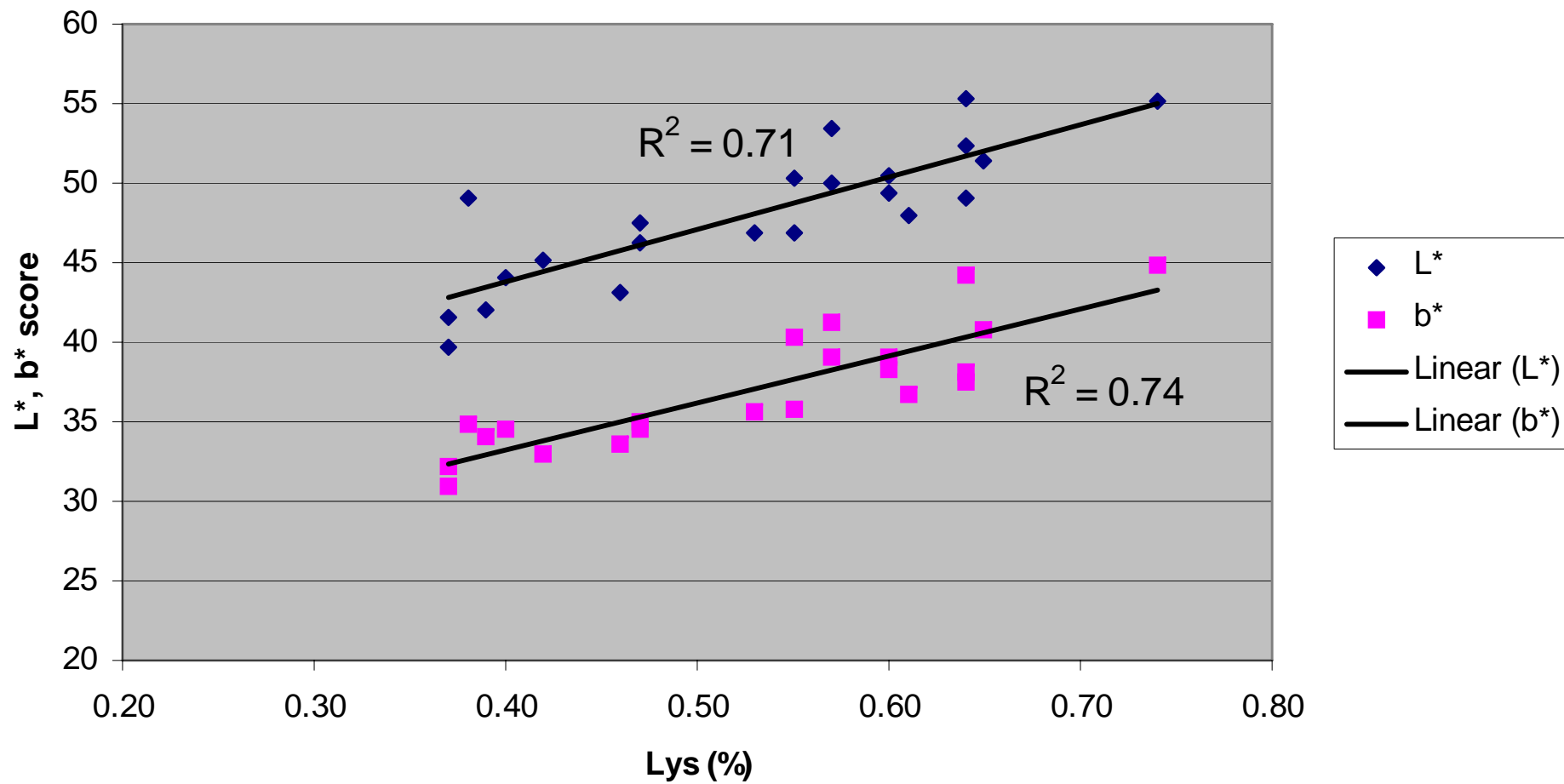
Color Extremes of DDGS



**Lower Quality,
Less Digestible
DDGS**

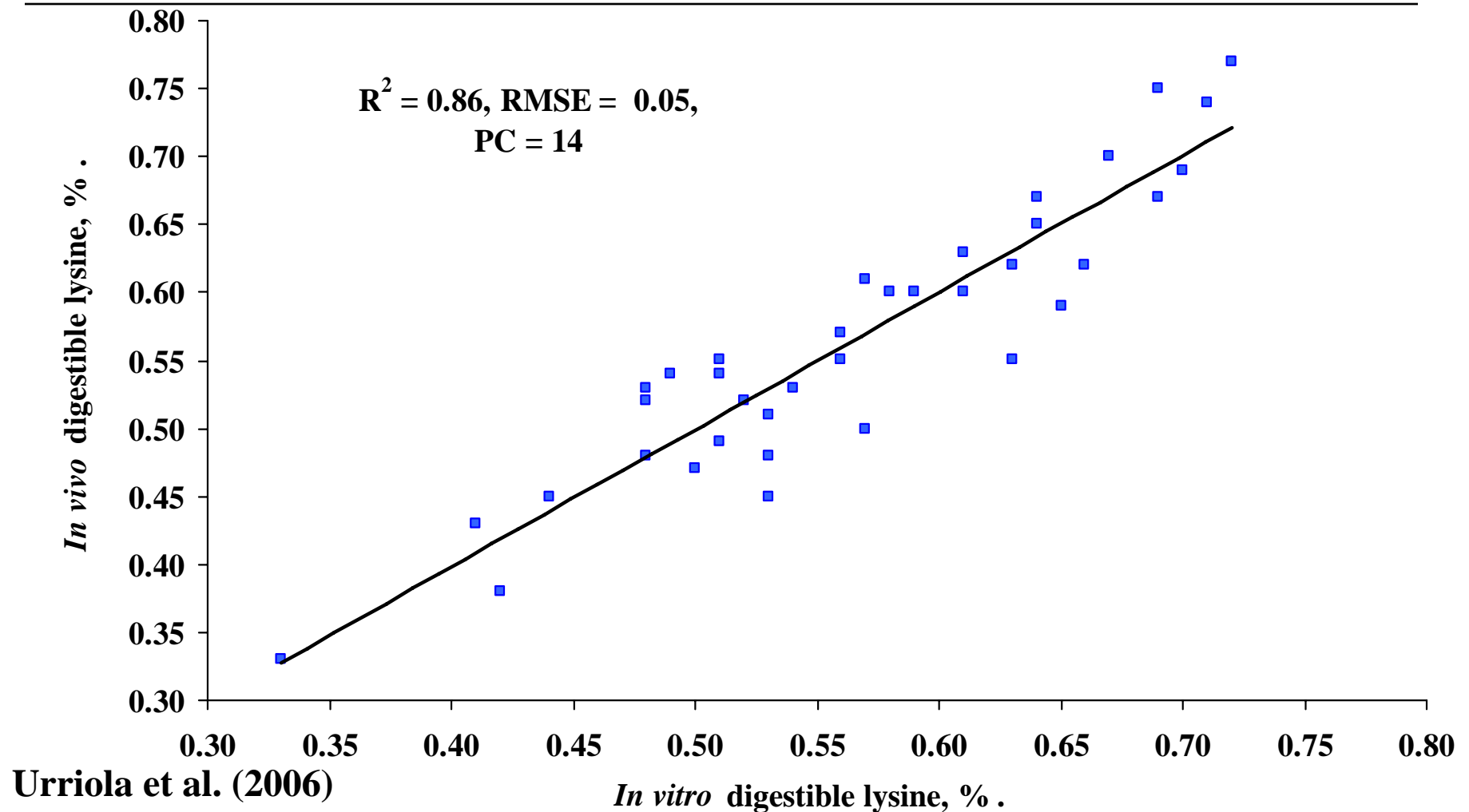
**High Quality,
Highly Digestible
DDGS**

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



Source: Dr. Sally Noll (2003)

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



Urriola et al. (2006)

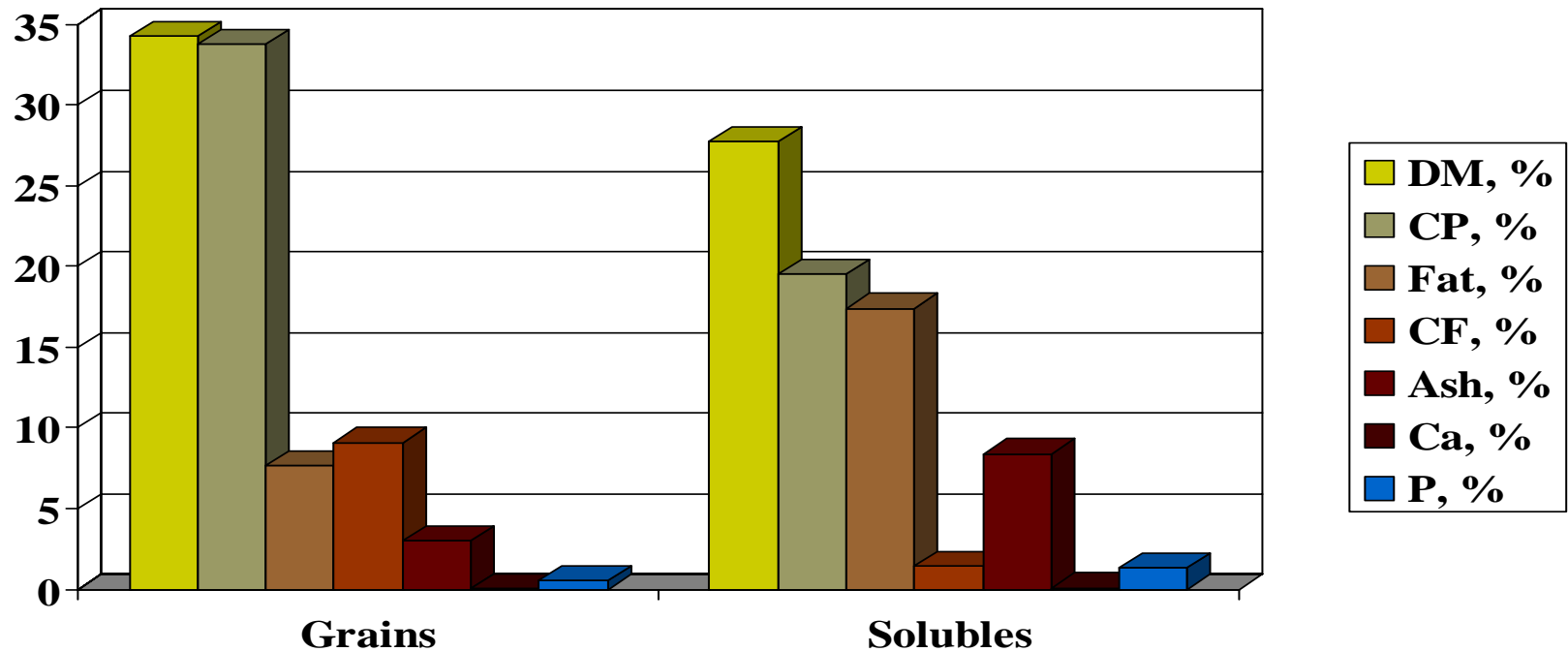
Averages, Coefficients of Variation, and Ranges of Selected Nutrients Among 32 U.S. DDGS Sources (100% Dry Matter Basis)

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

AAFCO DDGS Definition

- 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 $\frac{3}{4}$ 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

Use of DDGS in Dairy Rations





Benefits and Limitations for Lactating Dairy Cows

Benefits

- More protein and energy than corn
- Feed at up to 20% of ration dry matter
- Highly digestible fiber source
 - Fewer digestive upsets
 - Can be a partial forage replacement
- “Golden” DDGS gives best performance
- Highly palatable

Limitations

- Low protein (lysine) quality
 - add other supplements high in lysine
- Manure P excretion increases at high feeding levels
- No effect on milk fat if adequate forage in the ration

Use of DDGS in Beef Rations



Benefits and Limitations for Finishing Feedlot Cattle

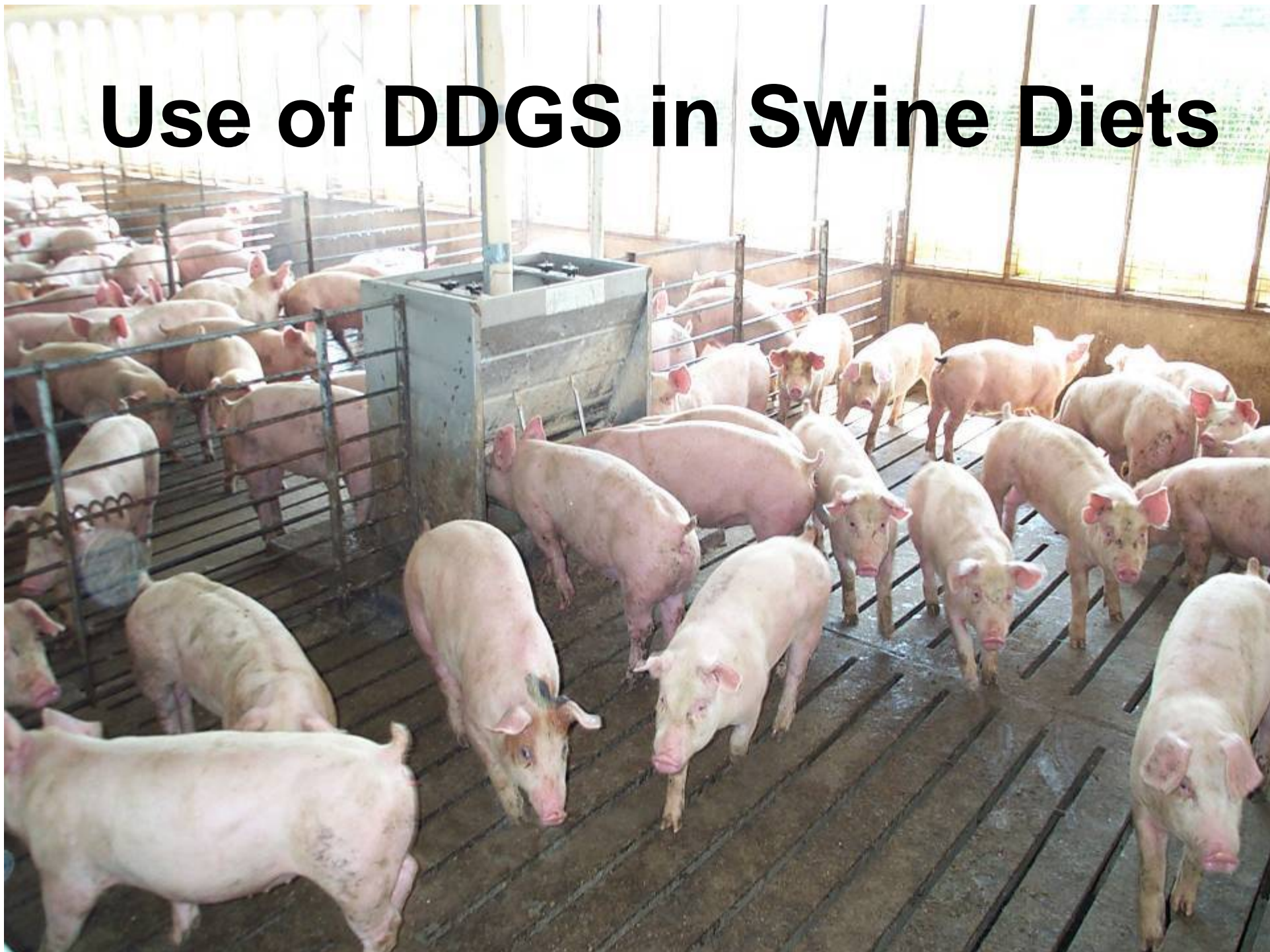
Benefits

- More protein and energy than corn
- Feed up to 40% of ration dry matter to replace corn
 - Feed excess protein and P
- Highly digestible fiber source
 - Fewer digestive upsets
- “Golden” DDGS gives best performance
- No effect on carcass yield, quality, or eating characteristics of beef

Limitations

- Need to supplement calcium to achieve proper Ca:P ratio
 - Avoid urinary calculi
- Manure N and P excretion increases at high feeding levels
- Monitor sulfur level of water and diet (< 0.4% ration DM)
 - Avoid polioencephalomalacia

Use of DDGS in Swine Diets



Benefits and Limitations for Swine

Benefits

- Energy value = corn
- High available P
 - Reduce diet P supplementation
 - Reduce manure P excretion
- Commonly fed at 10% of diet
 - Higher levels can be used if amino acids are supplemented
- Only “golden” DDGS should be used
 - High amino acid digestibility
- Appears to reduce gut health problems due to ileitis
- May increase litter size weaned and pig weaning weights when fed at high levels to sows

Limitations

- Low protein (lysine) quality
 - add other supplements high in lys and trp
- Manure N excretion increases
- Belly firmness and pork fat quality may be reduced when > 20% in the diet
- Mycotoxin free grain should be used to produce ethanol and DDGS
- Short-term feed intake may be reduced when transitioning from a corn-SBM diet to high DDGS diets for sows

Use of Corn DDGS for Poultry





Benefits and Limitations for Poultry

Benefits

- Good energy and amino acid source when limited to < 15% of the diet
- Source of highly available P
 - Reduce manure P
- May improve egg yolk and skin color (xanthophyll)
- Source of “unidentified growth factors”?
- “Golden” DDGS gives best performance
- Highly palatable

Limitations

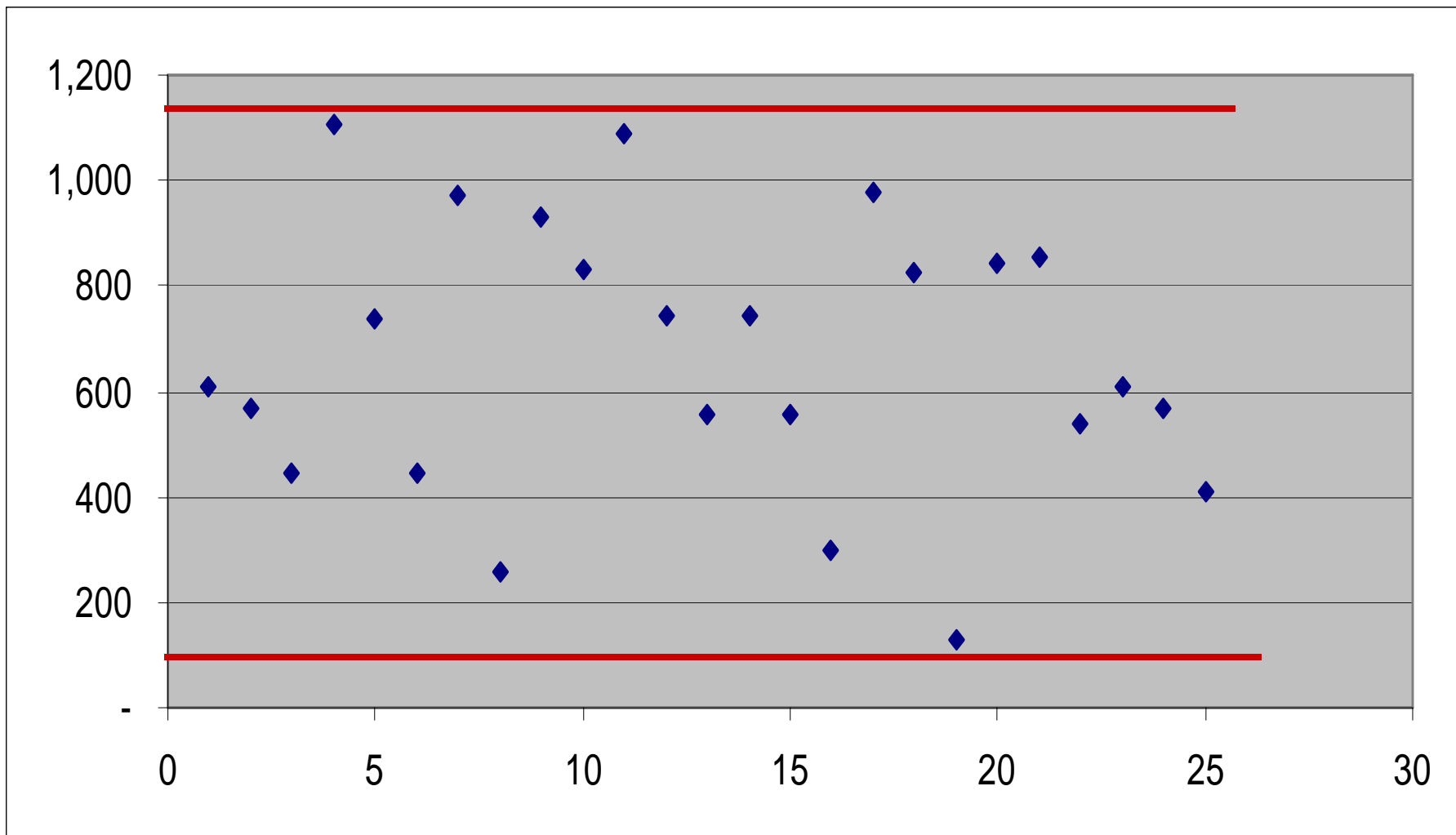
- Energy value ~ 84% of corn
- Low protein quality
 - add other supplements high in lys, arg, trp
- Sources high in sodium may increase litter moisture if adjustments to dietary salt levels are not made

Relative Value of DDGS Differs Depending on Species

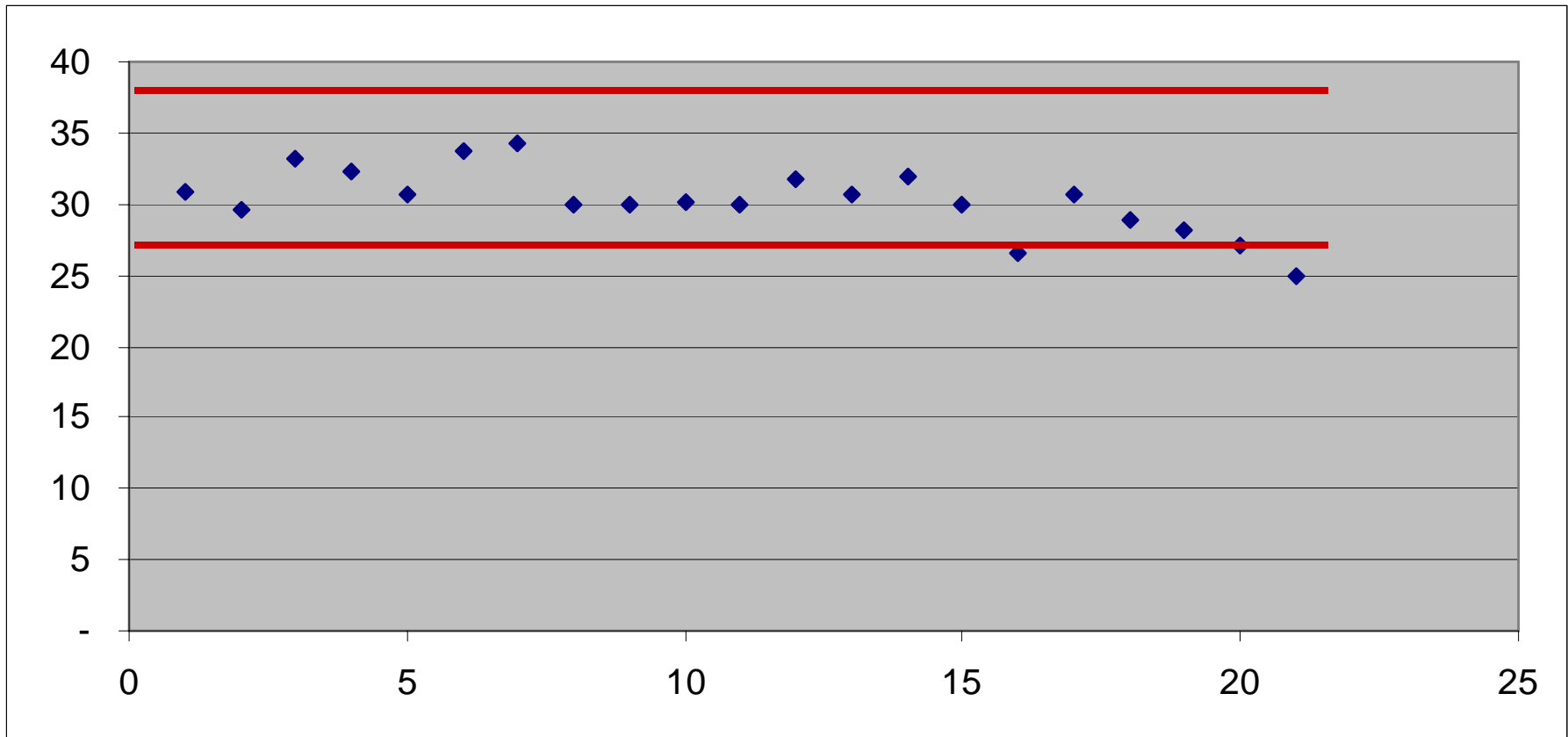
	Feed	Dollars/ ton
Assumptions:	Dairy Lactation	\$114.24
•Corn \$2.00 / bu	Poultry Finisher	\$100.09
•SBM \$175.00 / ton	Layer Diet	\$104.66
•Urea \$360.00 / ton	Swine G-F Diet	\$96.34
•Non-ruminant diets corn/SBM	Beef Feedlot	\$108.00
•Ruminant diets typical diets with competing by-products.		

Source: Tilstra, Land O' Lakes





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



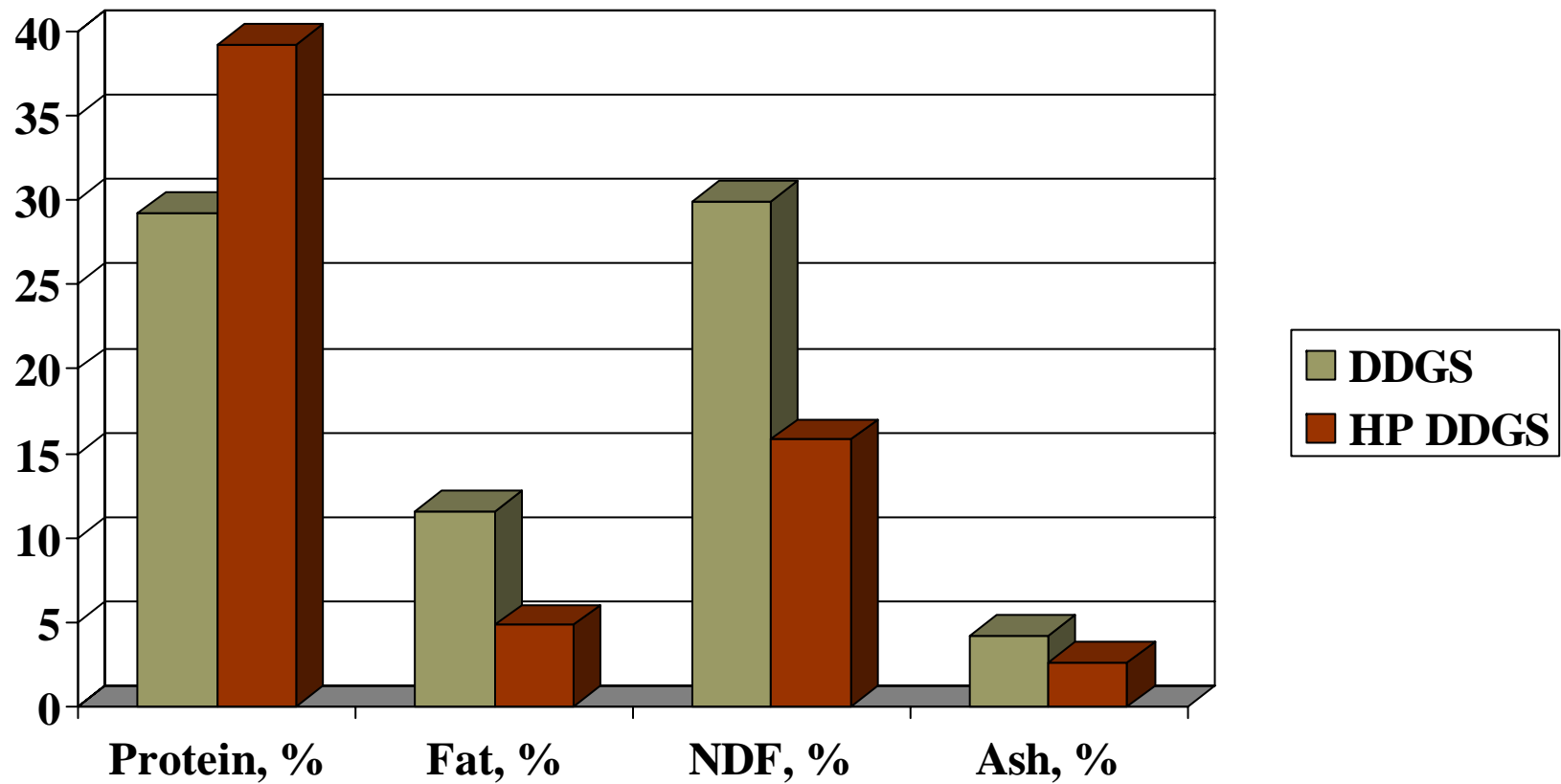
**Variation in Bulk Density (Lbs/Cubic Ft.) Among DDGS
Samples Representing 25 U.S. Ethanol Plants
1/05**



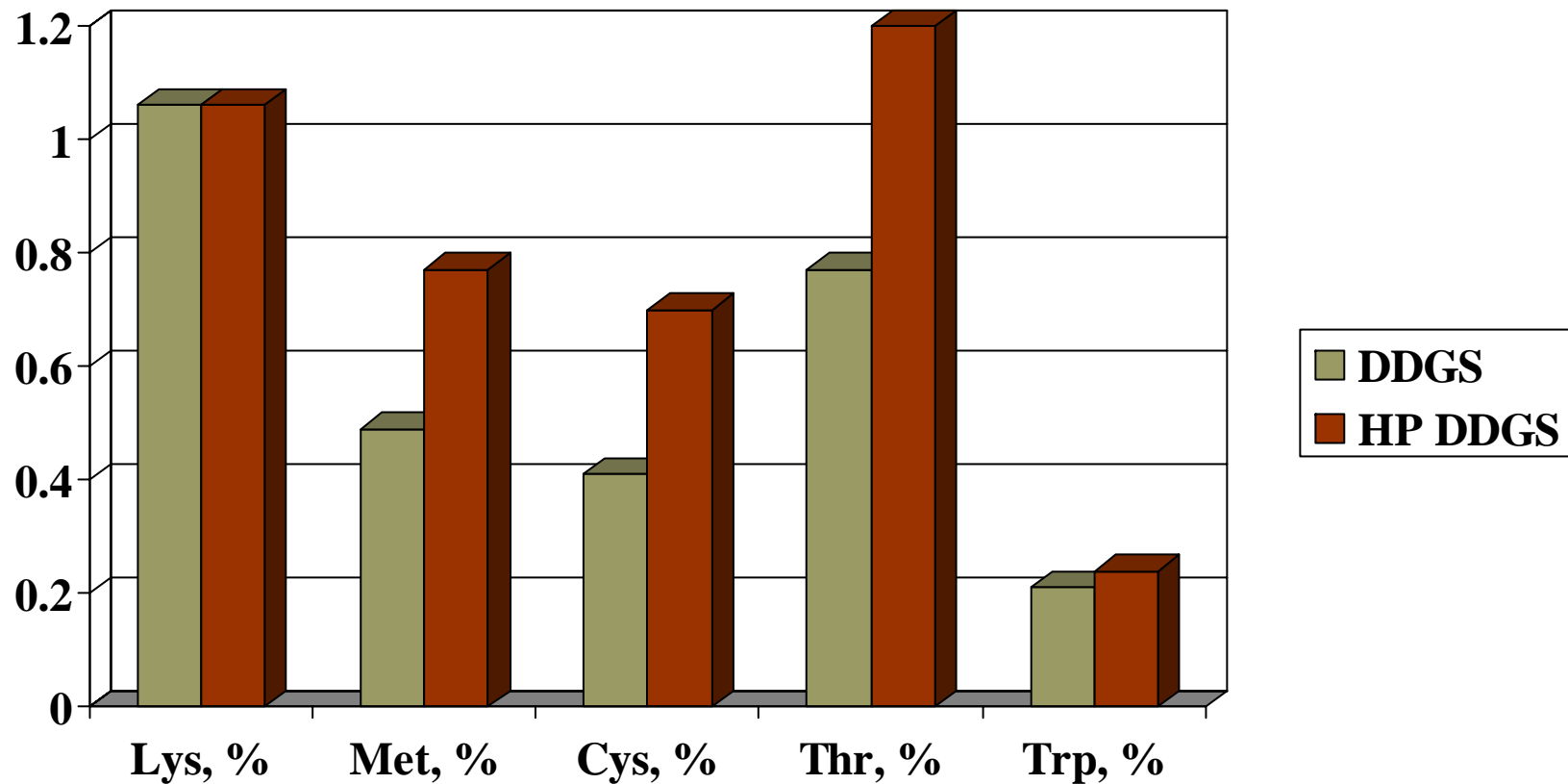
New Distiller's Grains By-Products

- Examples of modified processes
 - Use of new enzyme technology to increase DDGS protein
 - Removal of bran and/or germ prior to fermentation
 - Removal of phosphorus

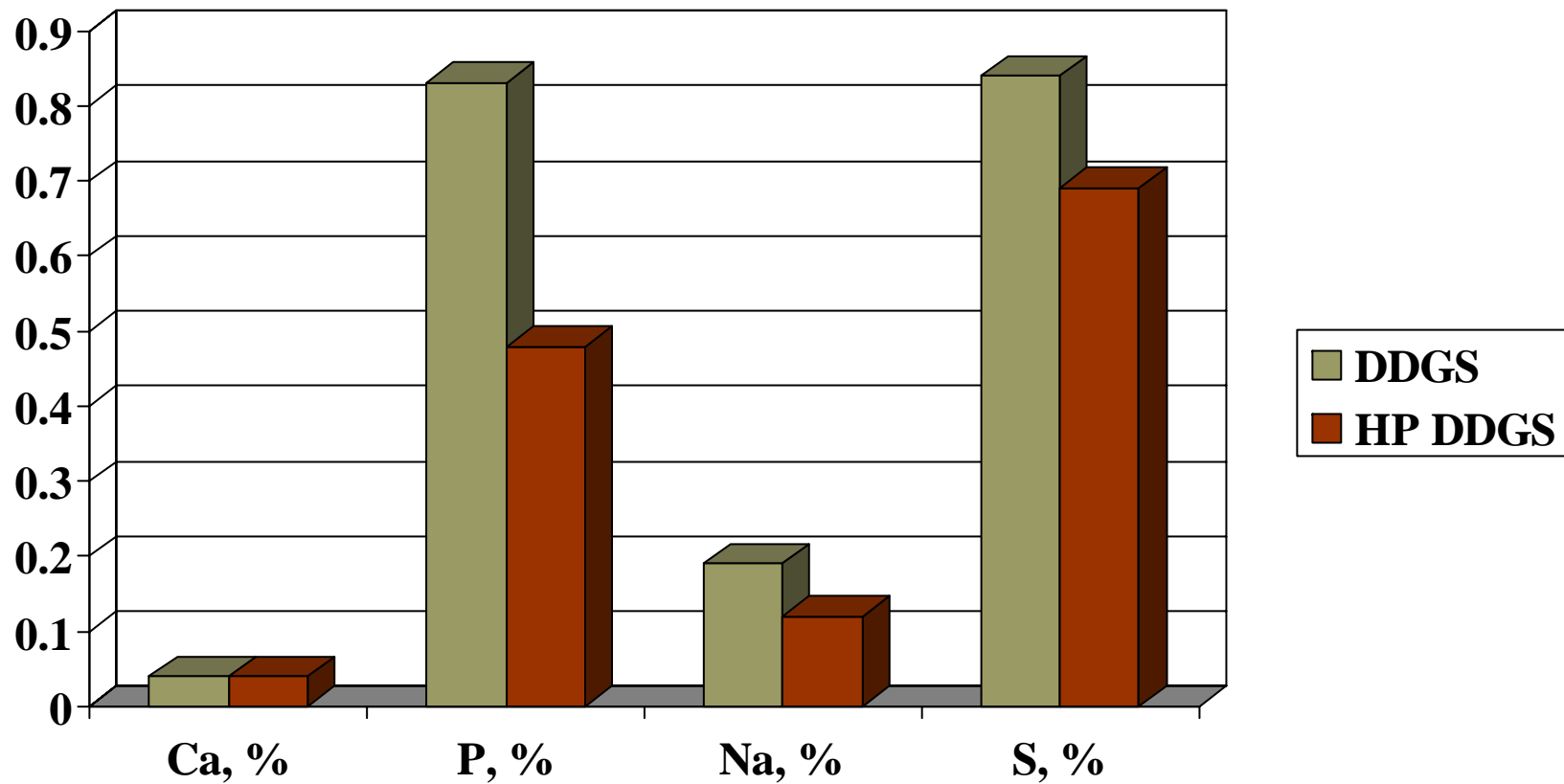
Comparison of Nutrient Content of Dakota Gold DDGS with High Protein Dakota Gold (100% DM Basis)



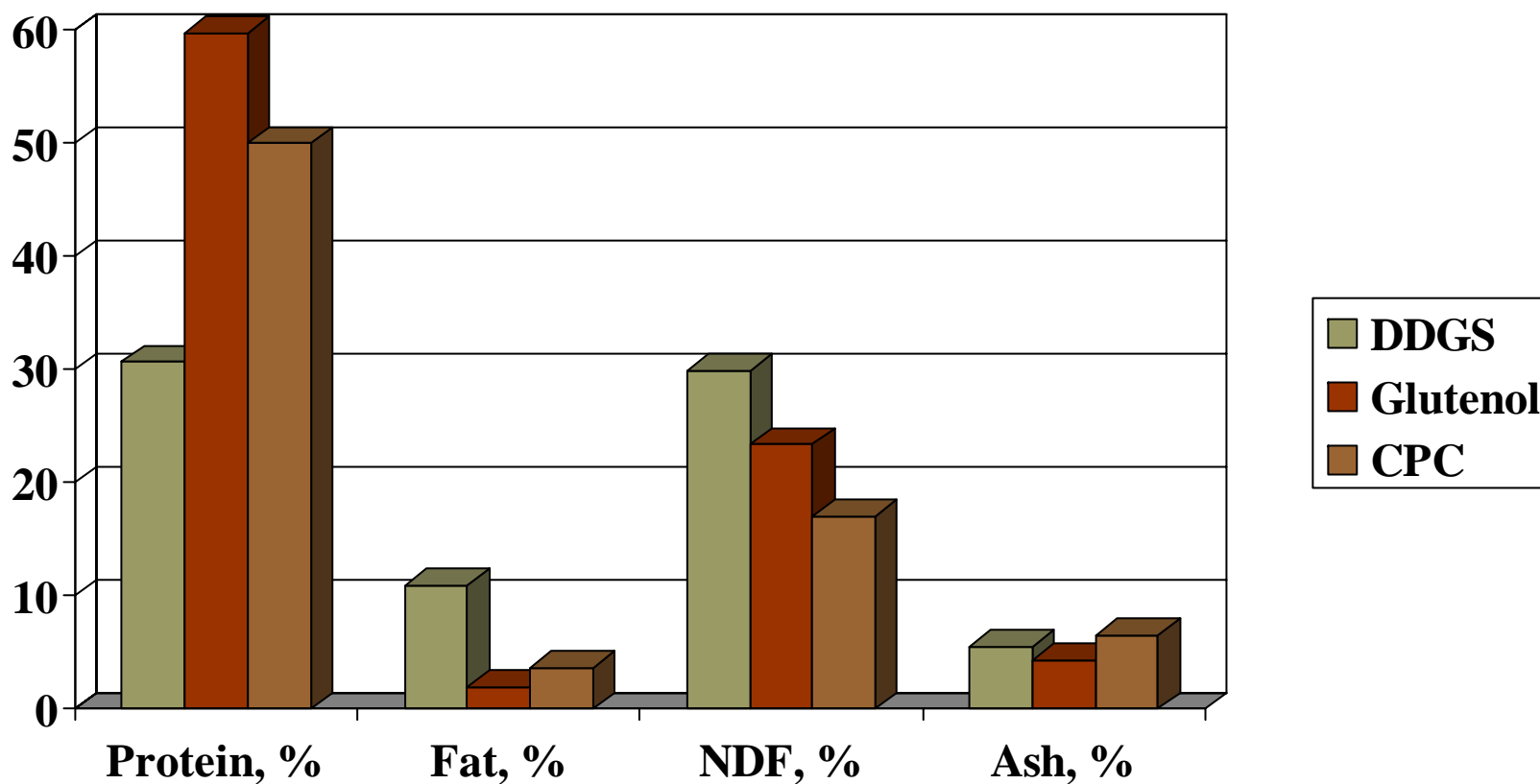
Comparison of Amino Acid Content of Dakota Gold DDGS with High Protein Dakota Gold (100% DM Basis)



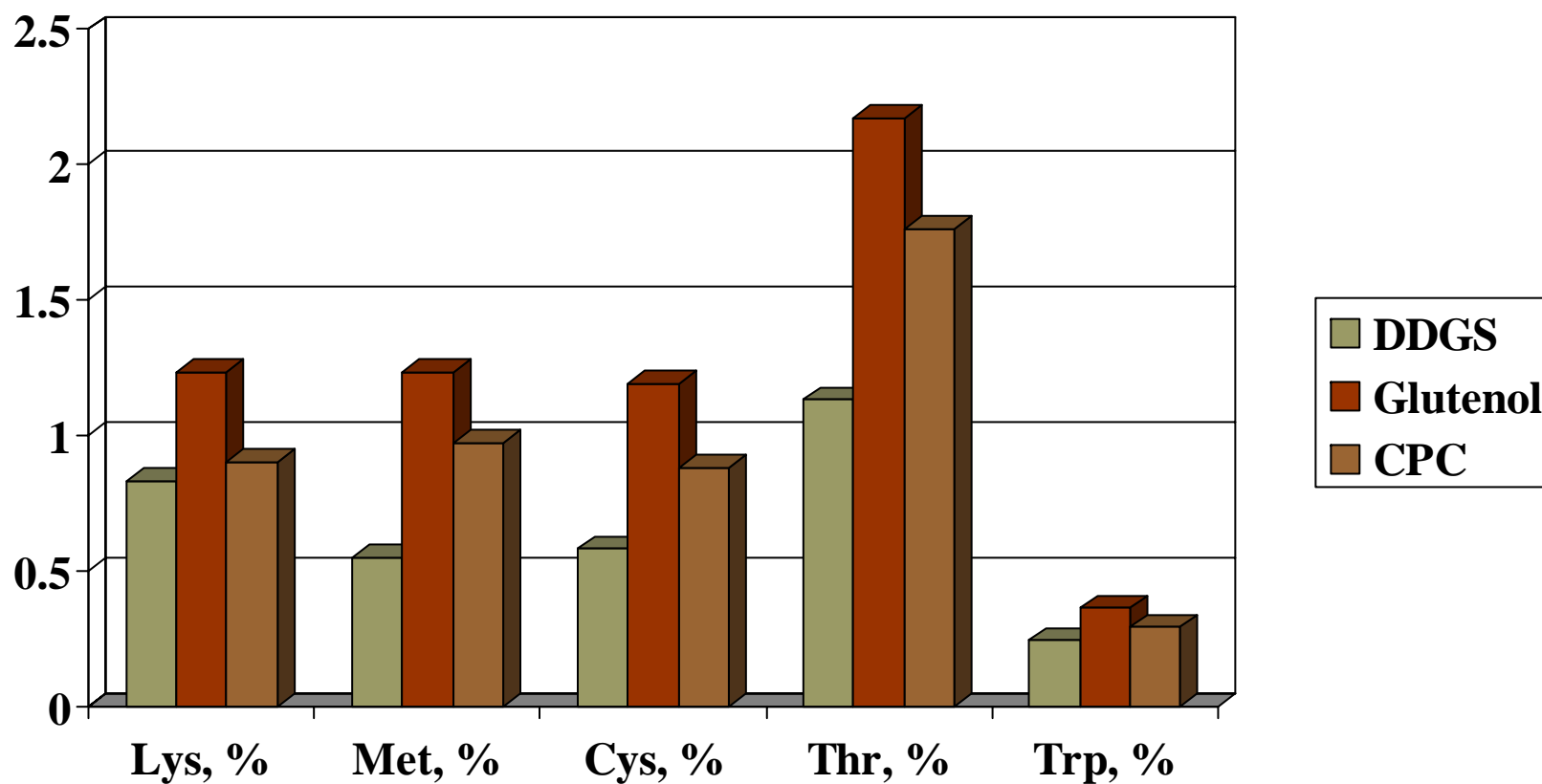
Comparison of Mineral Content of Dakota Gold DDGS with High Protein Dakota Gold (100% DM Basis)



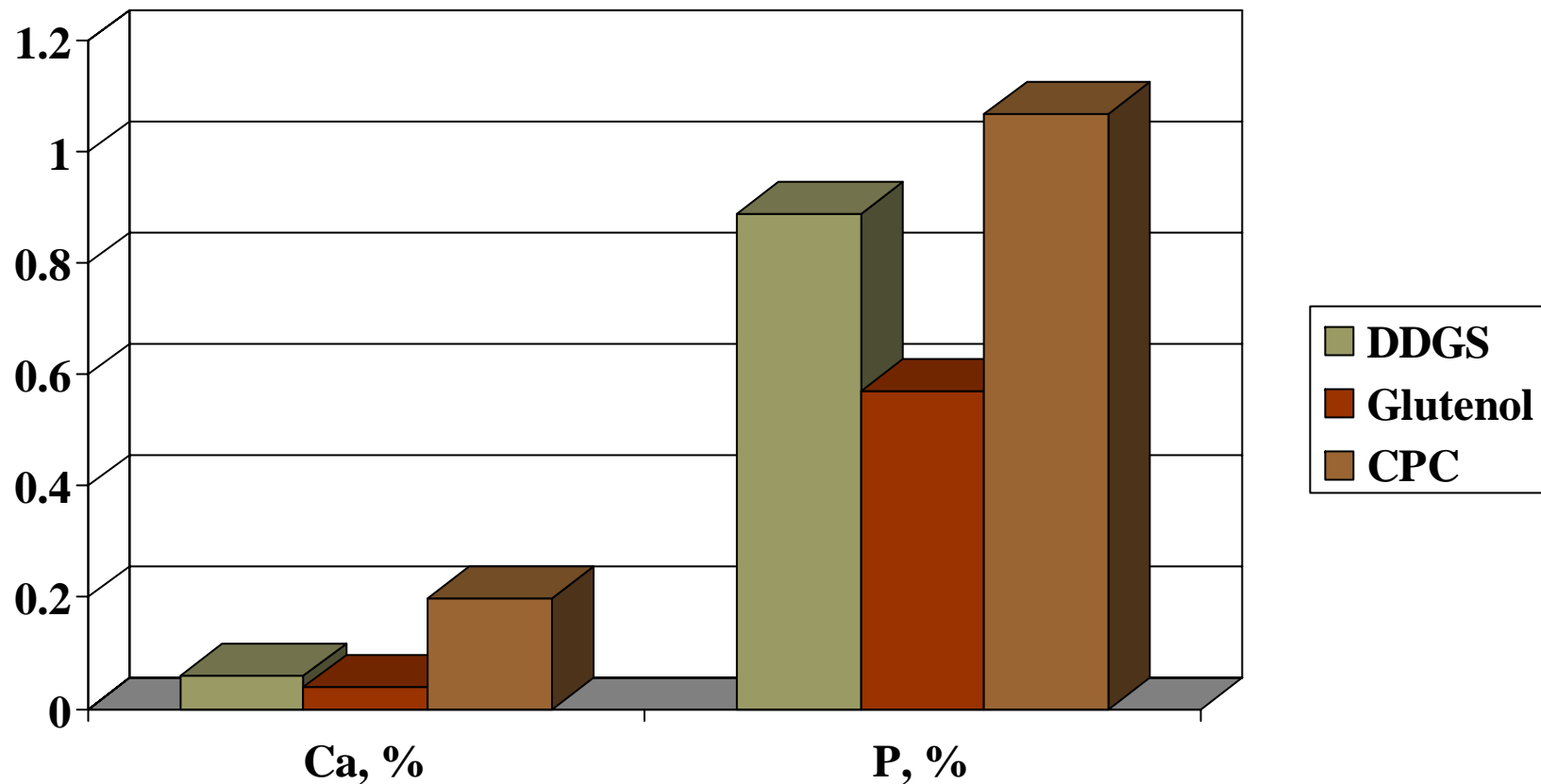
Comparison of Nutrient Content of DDGS with Glutenol and CPC (100% DM Basis)



Comparison of Amino Acid Content of DDGS with Glutenol and CPC (100% DM Basis)



Comparison of Calcium and Phosphorus Content of DDGS with Glutenol and CPC (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



Key Points for Evaluating and Using DDGS and New Distiller's By-Products

- Remember the primary components that affect nutritional and economic value
 - Metabolizable energy
 - Level and digestibility of amino acids
 - Level and availability of P

- Minimize variability in nutrient content by limiting the number of sources used

- Question generic nutrient specification values provided by the supplier when formulating diets



Key Points for Evaluating and Using DDGS and New Distiller's By-Products

- Request current, complete nutrient profiles from source(s) being considered
 - www.ddgs.umn.edu

- Request evidence of consistent quality and nutrient content from each source

- Although higher protein distiller's by-products may initially appear to have higher value, they are:
 - generally lower in fat and P content
 - still have inferior protein quality



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

