Challenges and Opportunities of Feeding DDGS to Swine

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Opportunities

- Cost effective partial replacement for
  - Corn
  - Soybean meal
  - Dicalcium phosphate
- Potential positive gut health benefits
- Potential to increased litter size weaned
- Increased lactating sow feed intake and litter weight gain
- Adding DDGS with phytase can decrease manure P excretion

Challenges

- Variability in nutrient content and digestibility
- Variability in particle size, bulk density, and flowability
- Potential risk of mycotoxins
- Impact of DDGS on feed intake
- Impact of feeding DDGS on pork fat quality
- Diet dry matter digestibility is reduced
  - Slight increase in manure volume
- New distiller's by-products

DDGS Varies in Nutrient Content, Digestibility, Color, Bulk Density 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

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

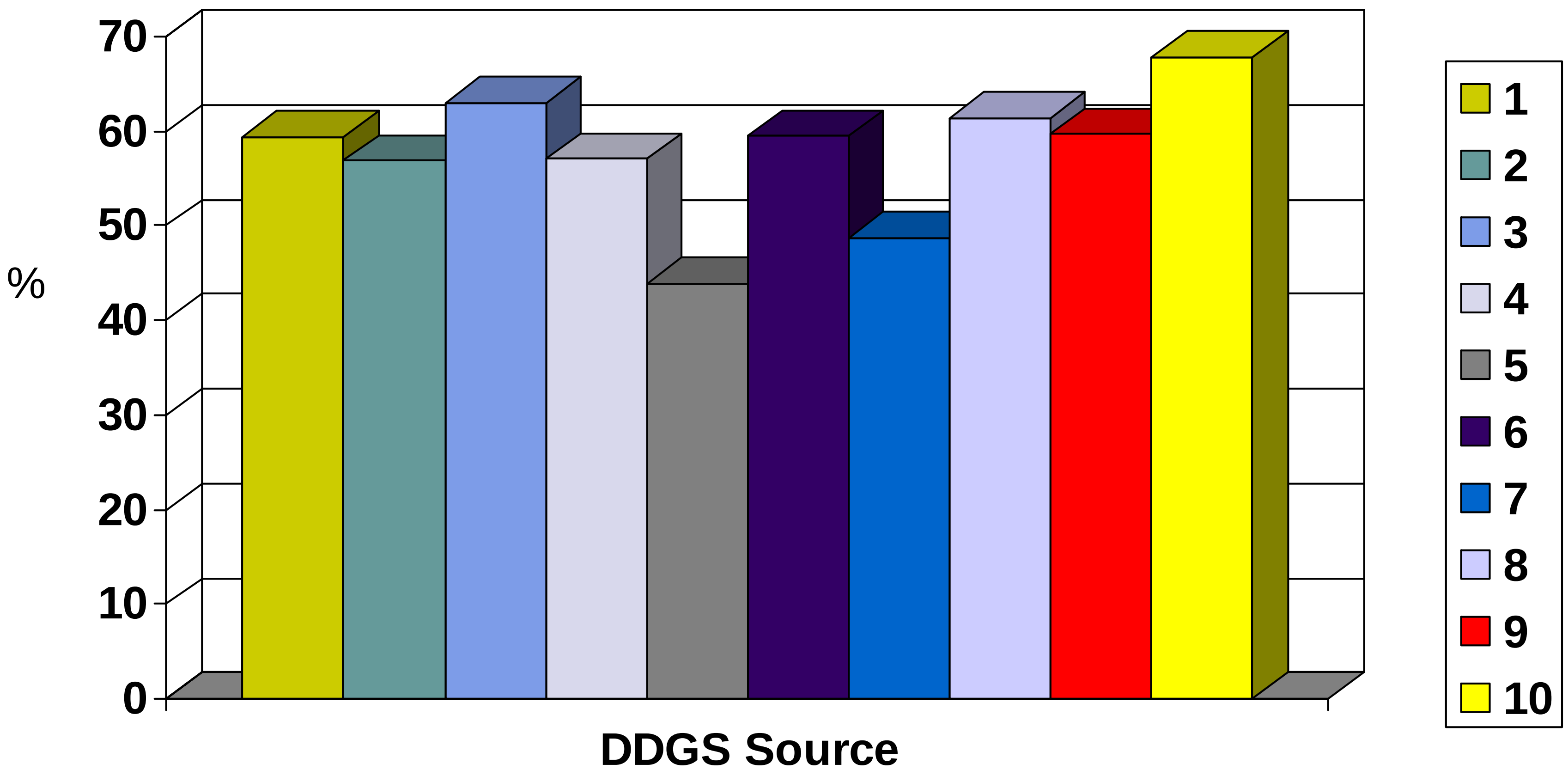
	Golden Corn DDGS	"DDGS"	High Fat DDGS	Partial De-germed DDGS	Whiskey DDGS	Pelleted DDGS
Protein, %	31.8	29.3	31.6	30.1	29.9	27.0
Fat, %	11.3	3.5	15.3	8.9	8.8	9.00
Crude fiber, %	6.3	7.9	No data	7.8	10.6	15.10
ADF, %	12.4	11.8	17.9	21.0	20.2	No data
Ash, %	6.9	5.3	4.6	7.3	3.7	4.28
DE, kcal/kg*	4053	3808	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

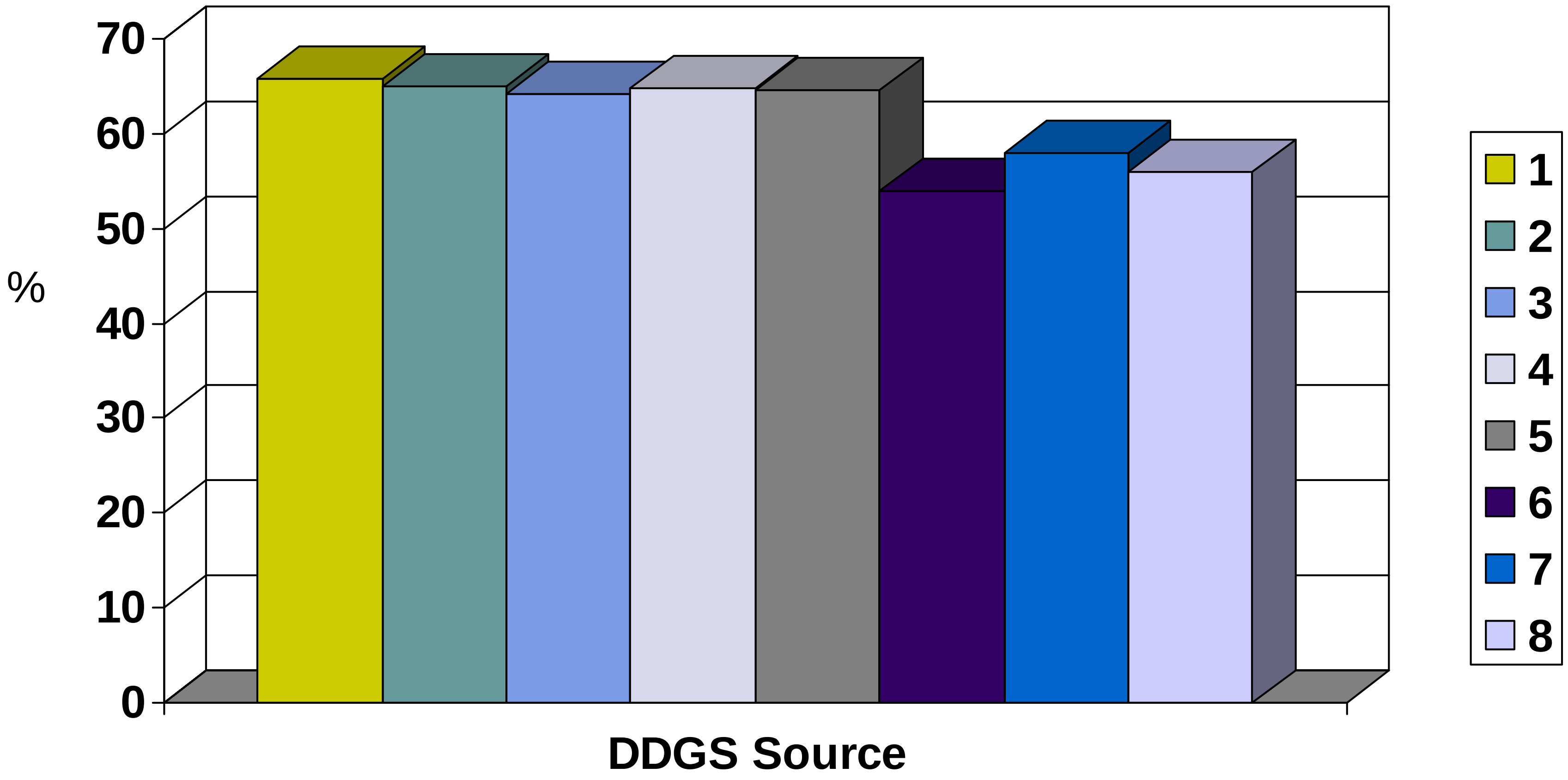
Variability (CV, %) of Selected Nutrients Among U.S. DDGS Sources vs. U.S. Soybean Meal Sources

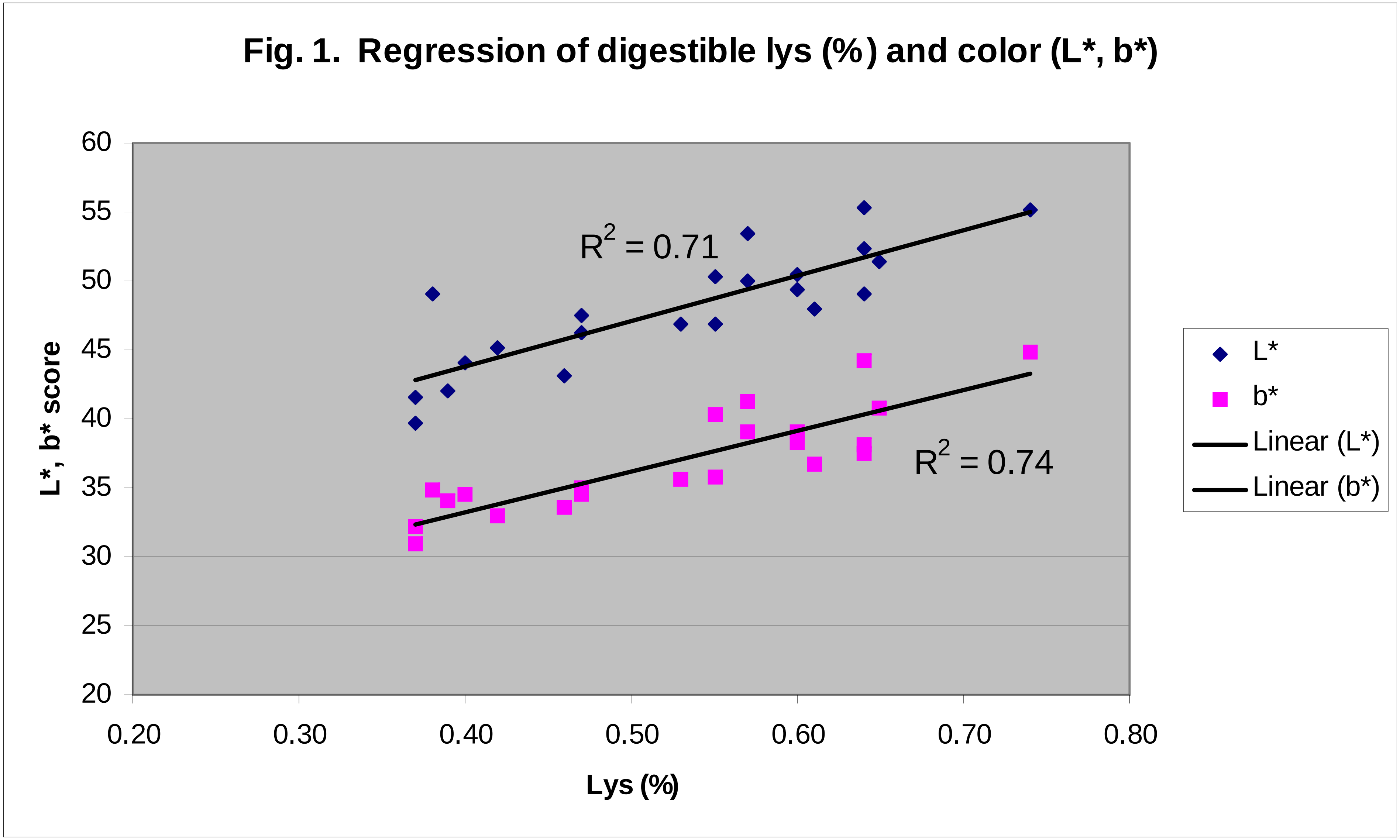
Nutrient	DDGS	Soybean Meal
Crude protein	4.5	2.3
Crude fat	17.1	30.9
Crude fiber	18.9	9.5
Ash	27.2	6.6
Lysine	12.1	3.0
Methionine	8.5	5.3
Threonine	5.8	4.2
Tryptophan	12.0	7.3
Calcium	117.5	25.8
Phosphorus	19.4	9.1

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



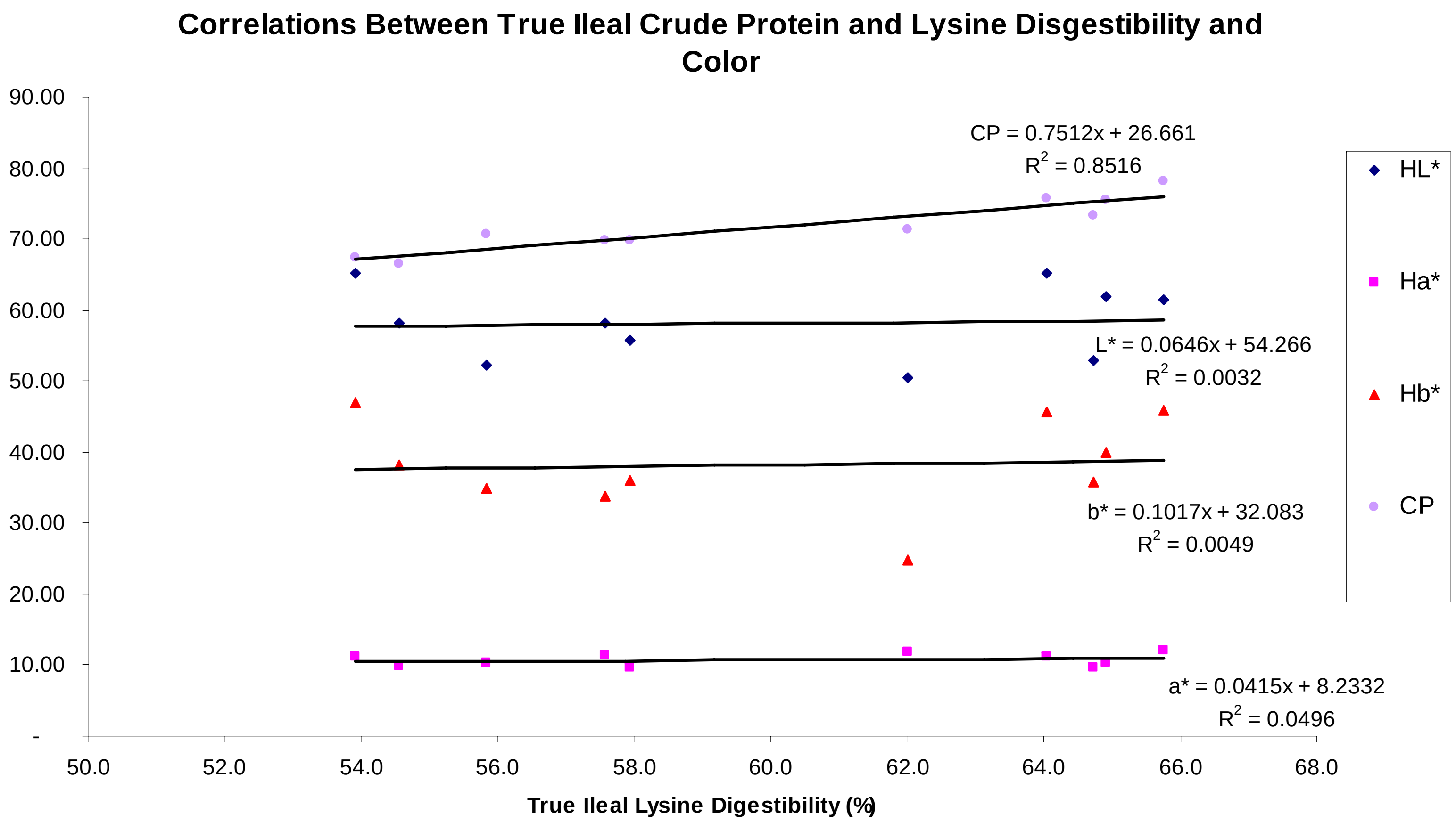
Standardized Ileal Lysine Digestibility Coefficients Among 8 “Golden” Corn DDGS Sources (Urriola et al., 2006 unpublished)



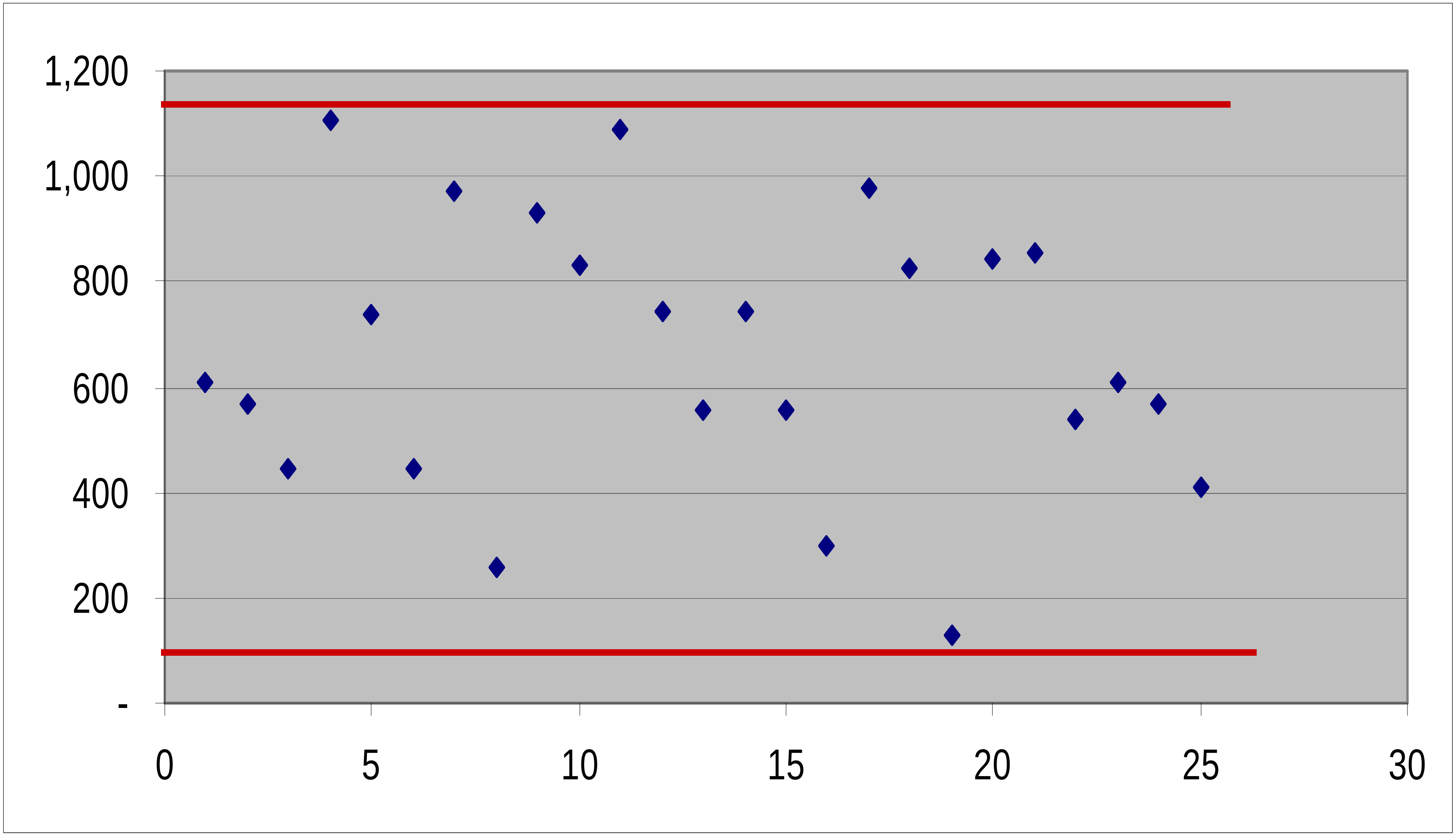


Source: Dr. Sally Noll (2003)

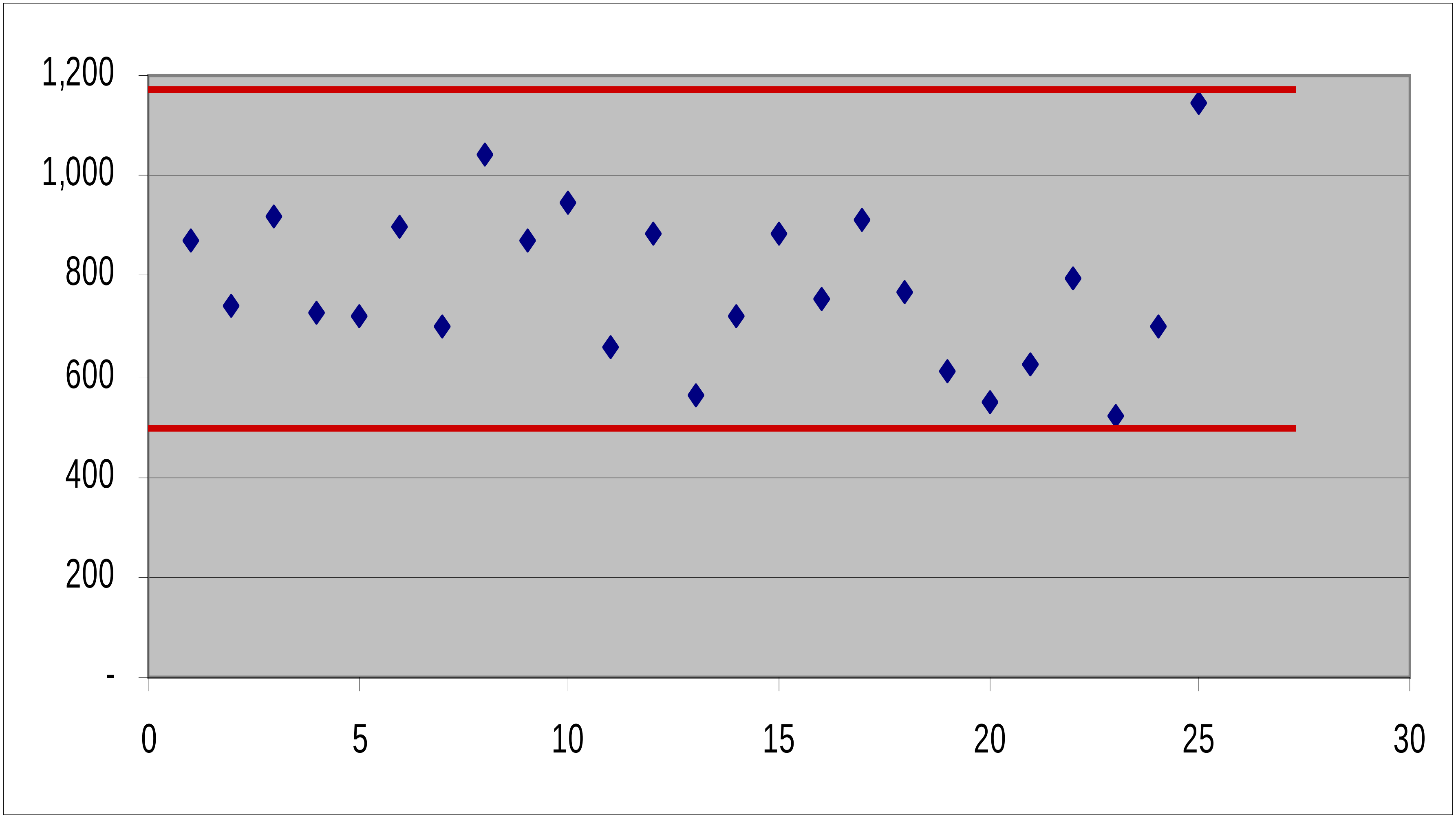
Color Appears to Be Less Predictive of Lysine Digestibility Among Light Colored, Golden DDGS Sources



DDGS Sources Vary in Particle Size and Flowability



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

Some of the Nutrient Variability is Due to the Use of Different Approved 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

Comparison of AOAC Approved Fat Testing Methods

- Diethyl ether extract
- Petroleum ether extract

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

Facts About Mycotoxins in DDGS

- Risk of mycotoxins in corn in southern MN are low
  - Exception may be last year's corn crop
    - Many corn piles still outside
    - A few isolated cases of ethanol plants using contaminated corn
- Screening procedures for mycotoxins in corn at ethanol plants
  - range from very aggressive to minimal
- If mycotoxins are present in corn used for ethanol and DDGS production…
  - they will be concentrated 3X in DDGS

Facts About Mycotoxins in DDGS

- Keep the potential contribution of mycotoxins from DDGS in perspective
  - About 65 to 85% of swine grow-finish diets are comprised of corn
    - If corn contained 1 ppm zearalenone, it would contribute .13 to .17 g/ton of feed
  - Most grow-finish diets contain 10% DDGS
    - If the same corn was used to produce DDGS…
      - the zearalenone level would be 3 ppm
      - the contribution to the total diet would be 0.06 g/ton of feed

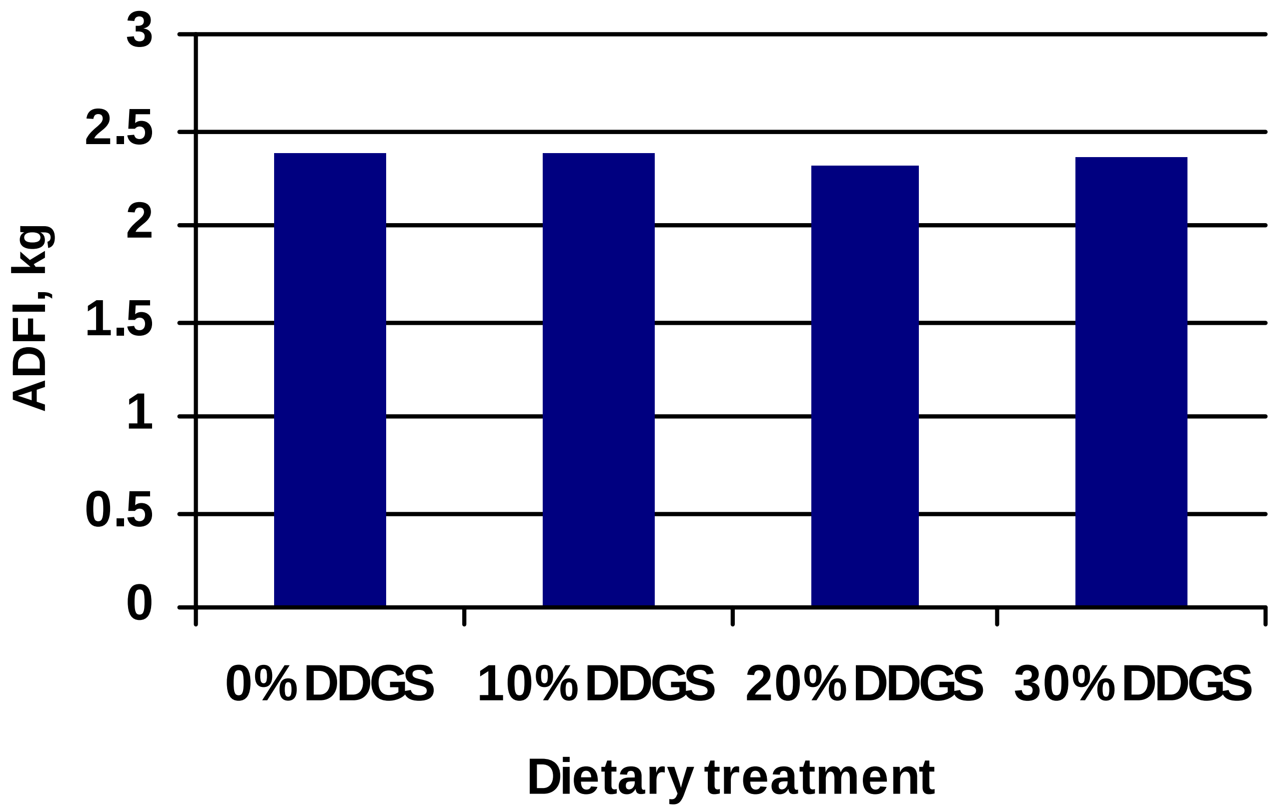
Facts About Mycotoxins in DDGS

- When testing for mycotoxins in DDGS, send samples only to laboratories that use HPLC procedures
  - ELISA test kits work well for corn
  - ELISA test kits **DO NOT** work well for detecting mycotoxins in DDGS
    - ELISA gives false, high readings due to interfering compounds that are read as mycotoxins but are actually not during detection

Effect of DDGS on Feed Intake of Growing Pigs (Published)

- No Effect
  - Hansen, E.L., G.W. Libal, D.N. Peters, and C.R. Hamilton. 1997. J. Anim. Sci. Vol. 75 (Suppl. 1) p. 194.
  - Whitney, M.H., G.C. Shurson, L.J. Johnston, D. Wulf, and B. Shanks. 2001. J. Anim. Sci. 79:108 (Suppl. 1).
  - Whitney, M.H. and G.C. Shurson. 2004. J. Anim. Sci. 82:122-128.
  - DeDecker, J.M., M. Ellis, B.F. Wolter, J. Spencer, D.M. Webel, C.R. Bertelsen, and B.A. Peterson. 2005. J. Anim. Sci. Vol. 83 (Suppl. 2) p. 79.
- Decrease
  - Fu, S.X., M. Johnston, R.W. Fent, D.C. Kendall, J.L. Usry, R.D. Boyd, and G.L. Allee. 2004. J. Anim. Sci. Vol. 82 (Suppl. 2) p. 50.
  - Hastad, C.W., J.L. Nelssen, R.D. Goodband, M.D. Tokach, S.S. Dritz, J.M. DeRouchey, and N.Z. Frantz. 2005. J. Anim. Sci. Vol. 83 (Suppl. 2) p. 73.

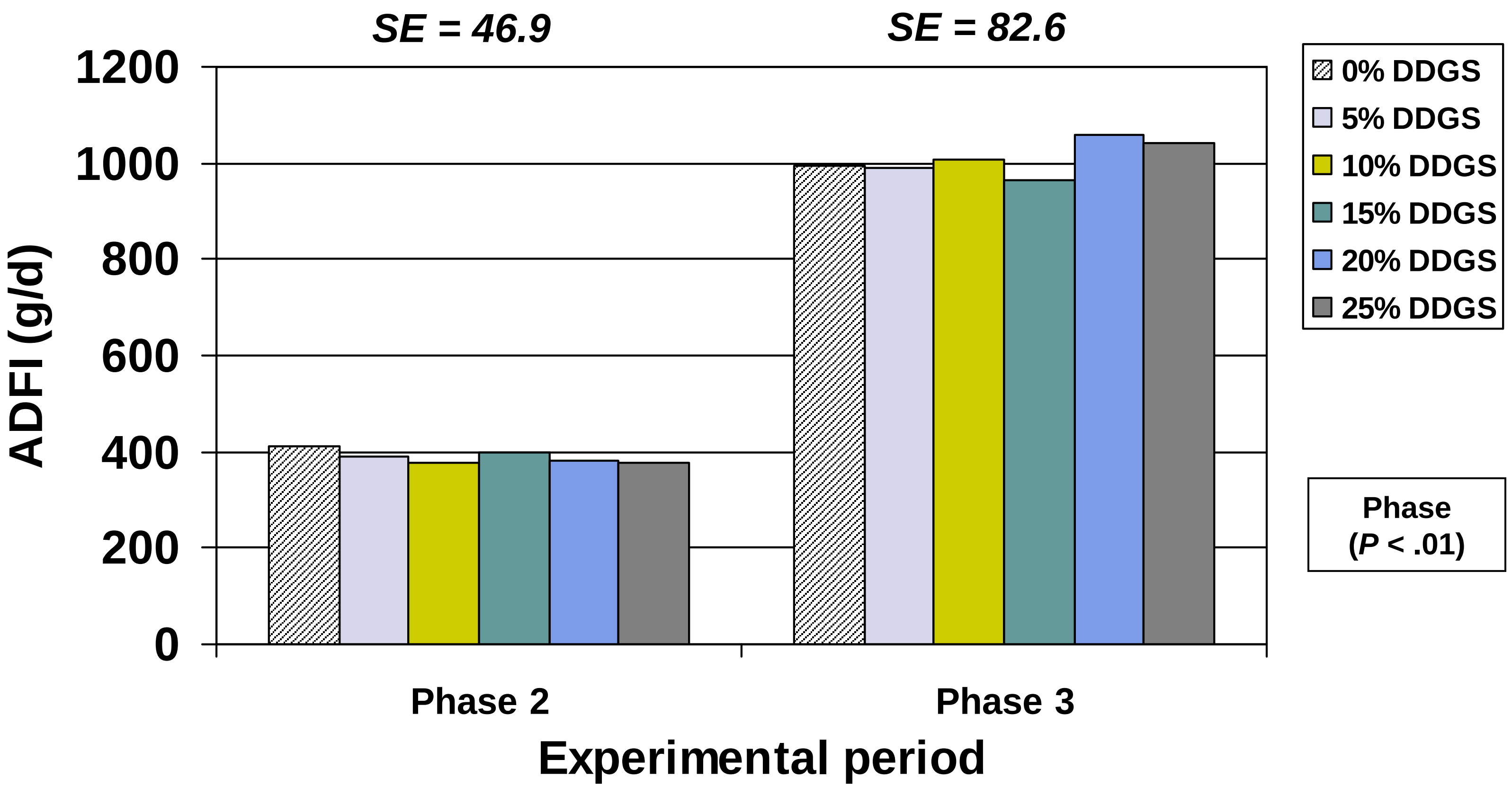
Effect of Dietary DDGS Level on Overall ADFI of Grow-Finish Pigs



No significant differences among dietary treatments

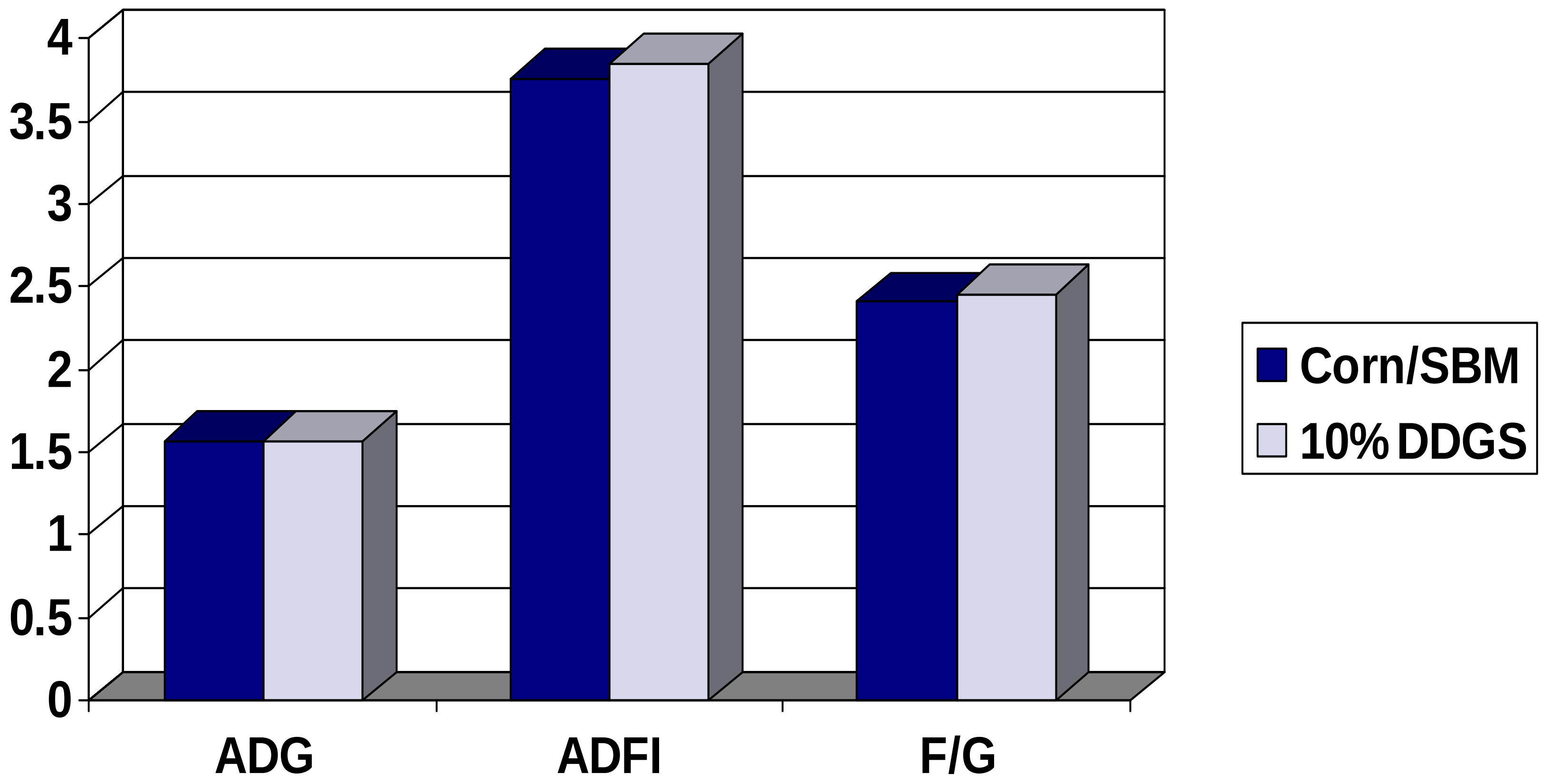
Whitney et al. (2001)

Effect of DDGS Level on ADFI of Nursery Pigs (>15 lbs BW)



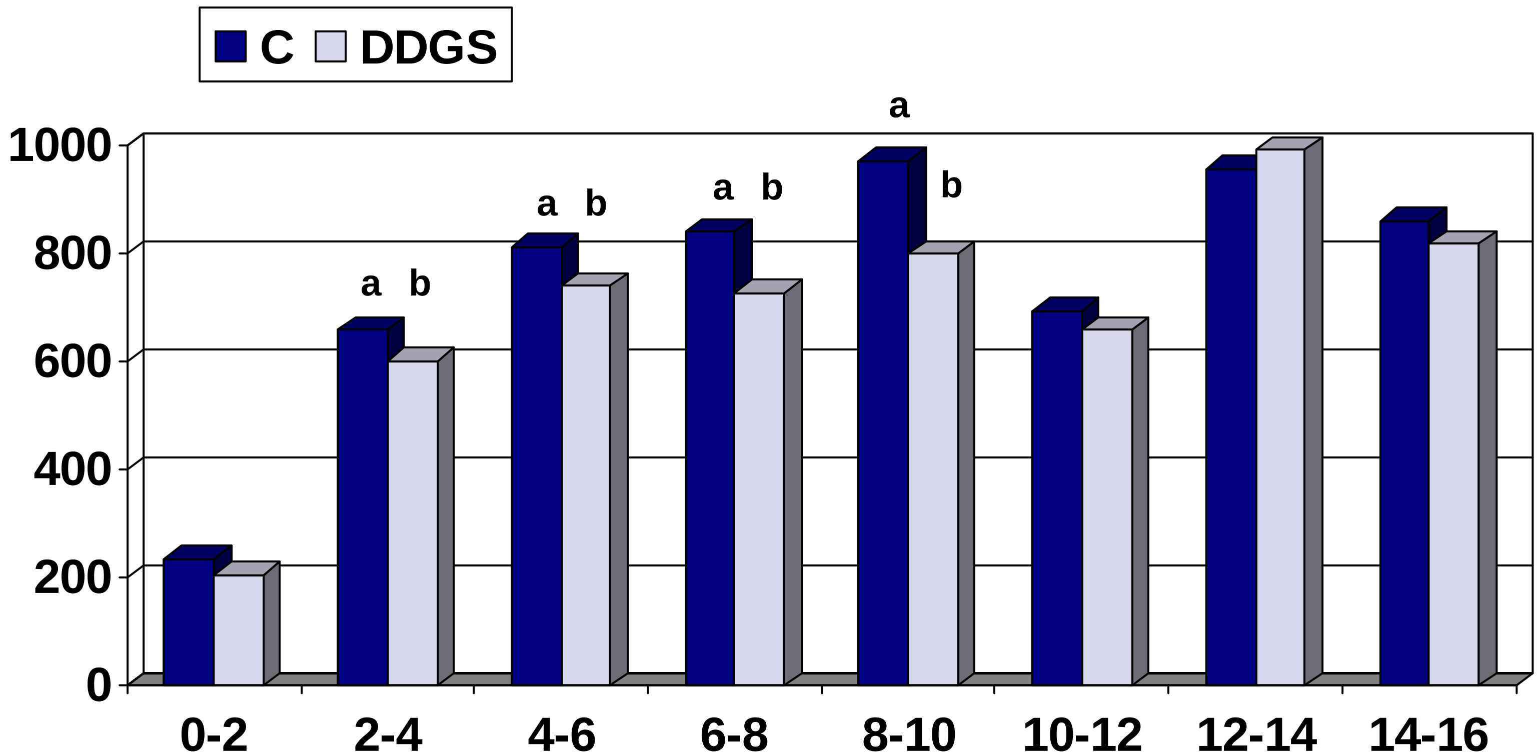
Whitney and Shurson (2004)

Effect of Adding 10% DDGS to Grow-Finish Diets on ADG, ADFI, and F/G for a 64 d Grow-Finish Period



Lawrence (2003) – Hubbard Milling Commercial Feeding Trial

Effect of Feeding a Diet Containing 50% DDGS on ADG of Growing-Finishing Pigs

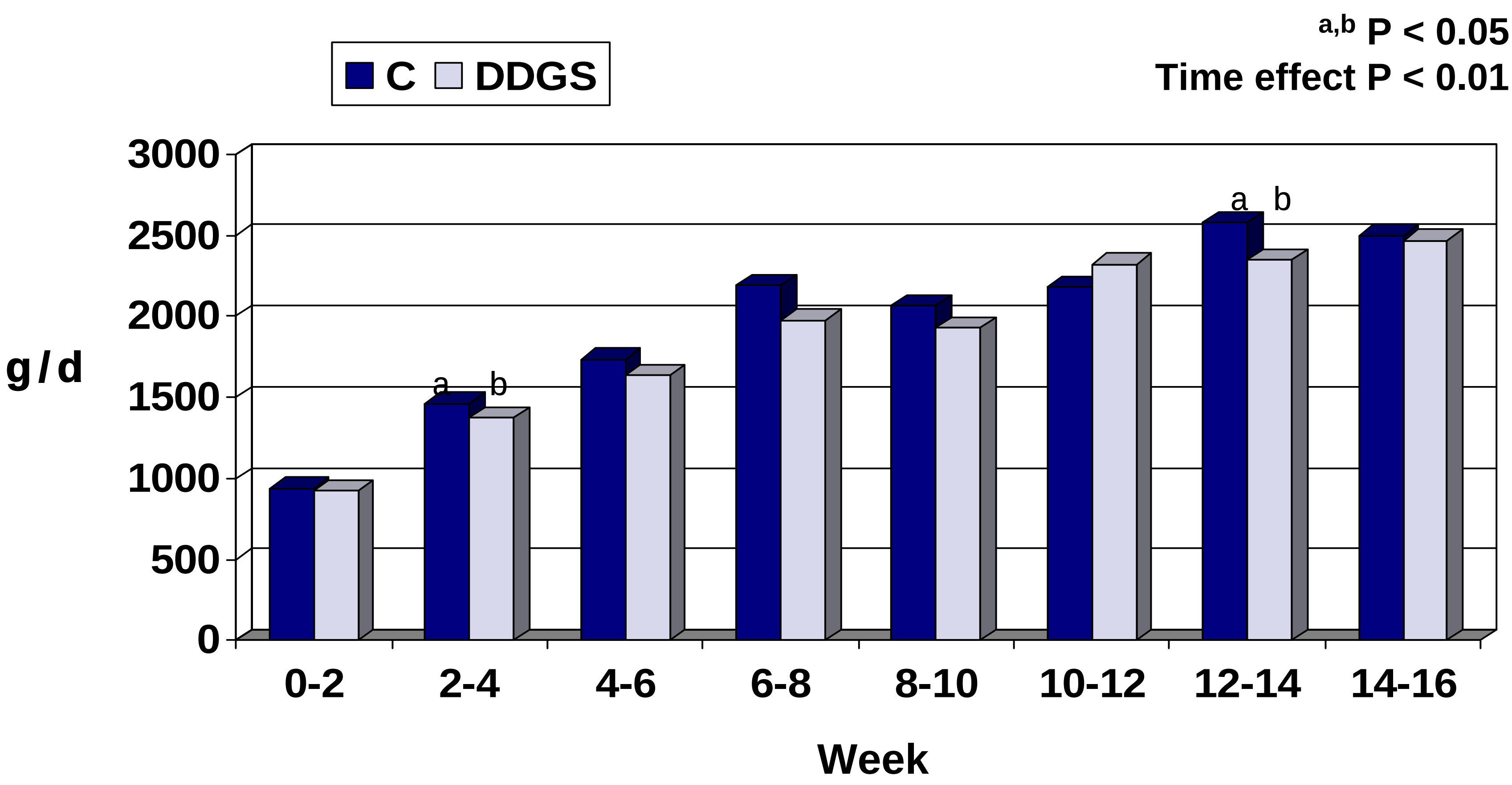


[a, b] Significantly different (P < .05)

Time effect (P < .01)

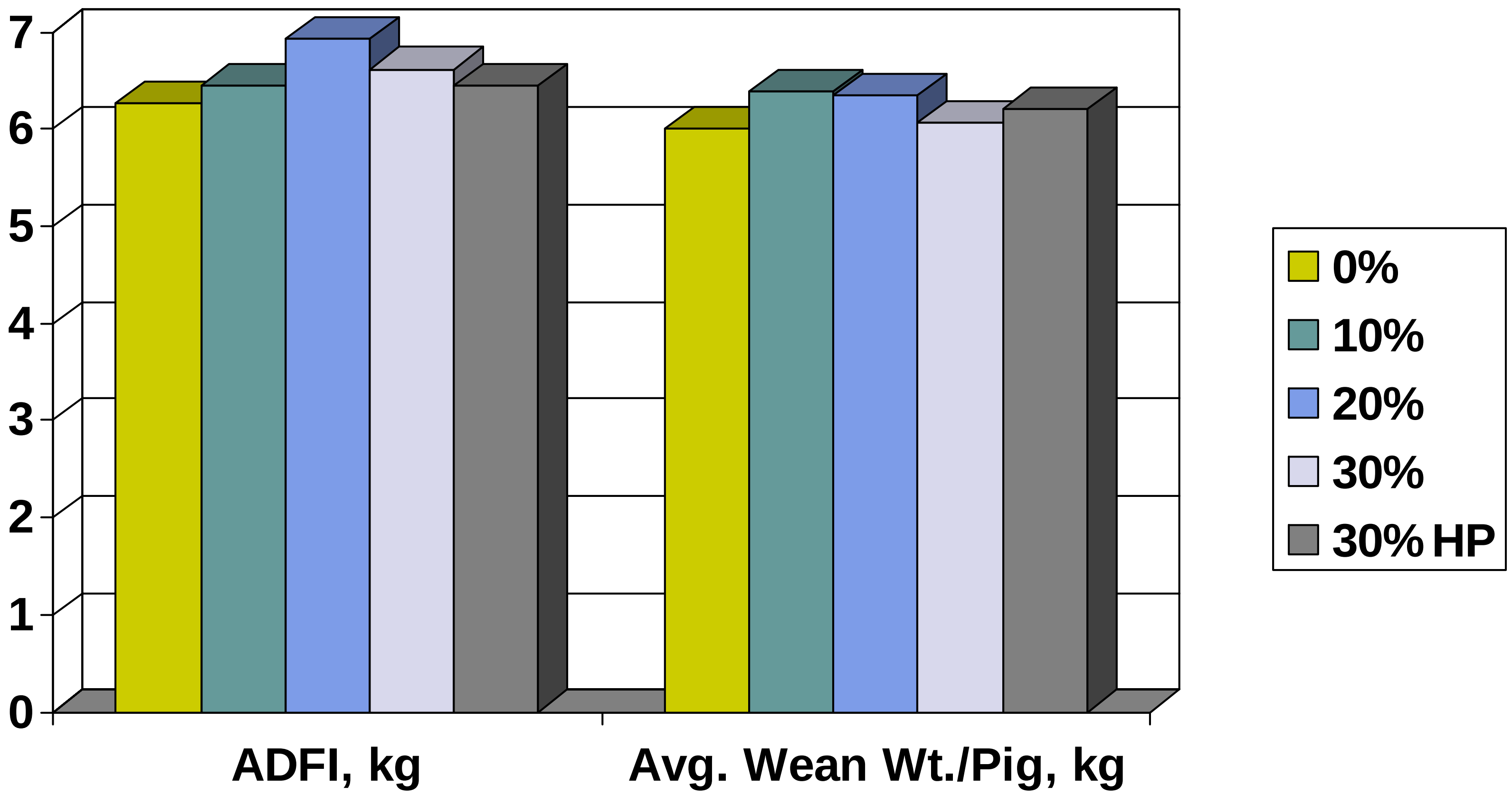
Spiehs et al. (2004)

Effect of Feeding a Diet Containing 50% DDGS on ADFI (g/d) of Growing-Finishing Pigs



Spiehs et al. (2004)

Effects of Feeding Increasing Levels of DDGS to Lactating Sows on Average Daily Feed Intake and Average Pig Weight at Weaning (Song et al. (2006), unpublished data)



Utilized 323 lactating sows (65 sows/dietary treatment)

Effect of DDGS Level on ADFI[a] of Grow-Finish Pigs

DDGS	0%	10%	20%	30%
Phase 1, lb[b]	3.34	3.29	3.20	3.03
Phase 2, lb[c]	5.04	5.02	4.84	4.65
Phase 3, lb[c]	5.84	5.83	5.60	5.57
Phase 4, lb	6.53	6.77	6.51	6.43
Phase 5, lb	7.35	7.29	7.27	7.08
Overall[b]	5.93	5.96	5.81	5.67

[a]Data are means of 48 individually penned pigs
[b]Linear effect of increasing DDGS in the diet ($P < 0.01$)
[c]Linear effect of increasing DDGS in the diet ($P < 0.05$)

Source: de Rodas (2005) LOL-Purina Feeds

Effect of Adding DDGS to Grow-Finish Diets on Pork Fat Quality

Fat Quality Characteristics of Market Pigs Fed Corn-Soy Diets Containing 0 to 30% DDGS

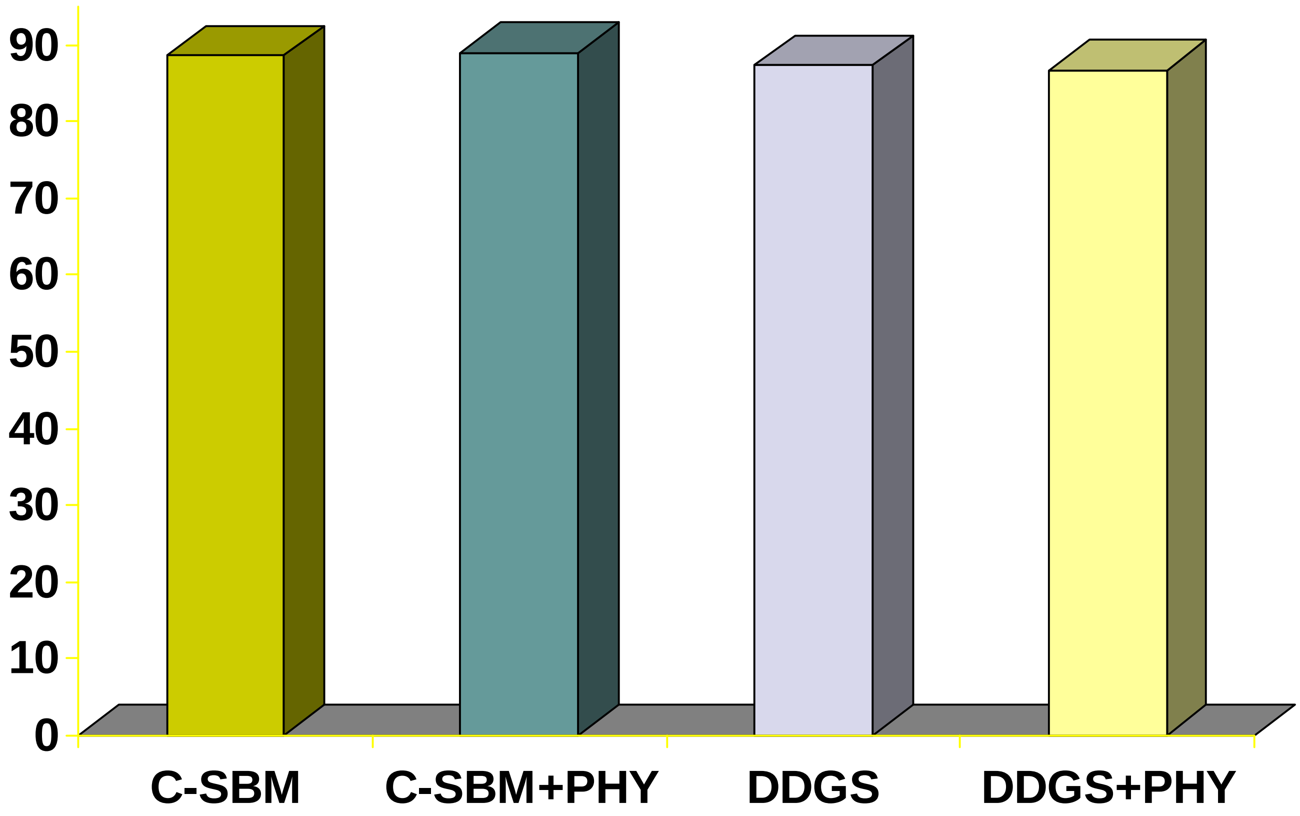
	0 %	10%	20%	30%
Belly thickness, cm	3.15[a]	3.00[a,b]	2.84[a,b]	2.71[b]
Belly firmness score, degrees	27.3[a]	24.4[a,b]	25.1[a,b]	21.3[b]
Adjusted belly firmness score, degrees	25.9[a]	23.8[a,b]	25.4[a,b]	22.4[b]
Iodine number	66.8[a]	68.6[b]	70.6[c]	72.0[c]

Means within a row lacking common superscripts differ (P < .05).

Source: Whitney et al. (2001)

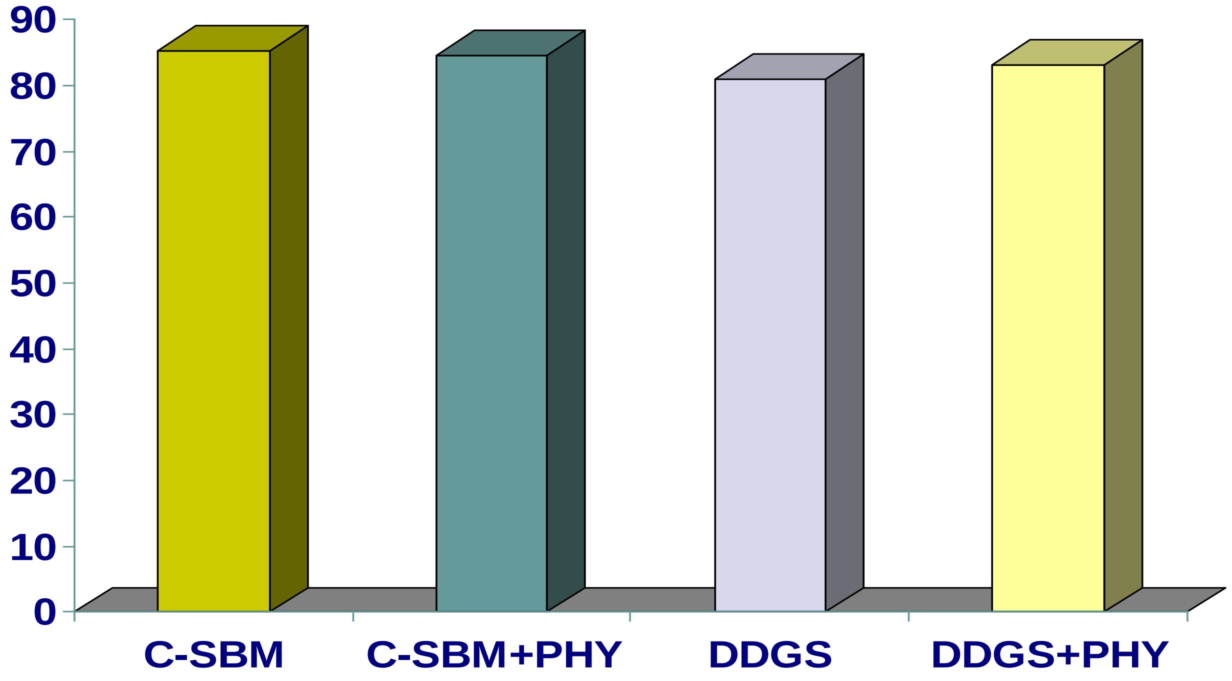
Effects of Feeding DDGS to Swine on Dry Matter Digestibility (Manure Volume)

Effect of Adding Phytase and/or 20 % DDGS to Corn-SBM Diets on DM Digestibility in G-F Pigs



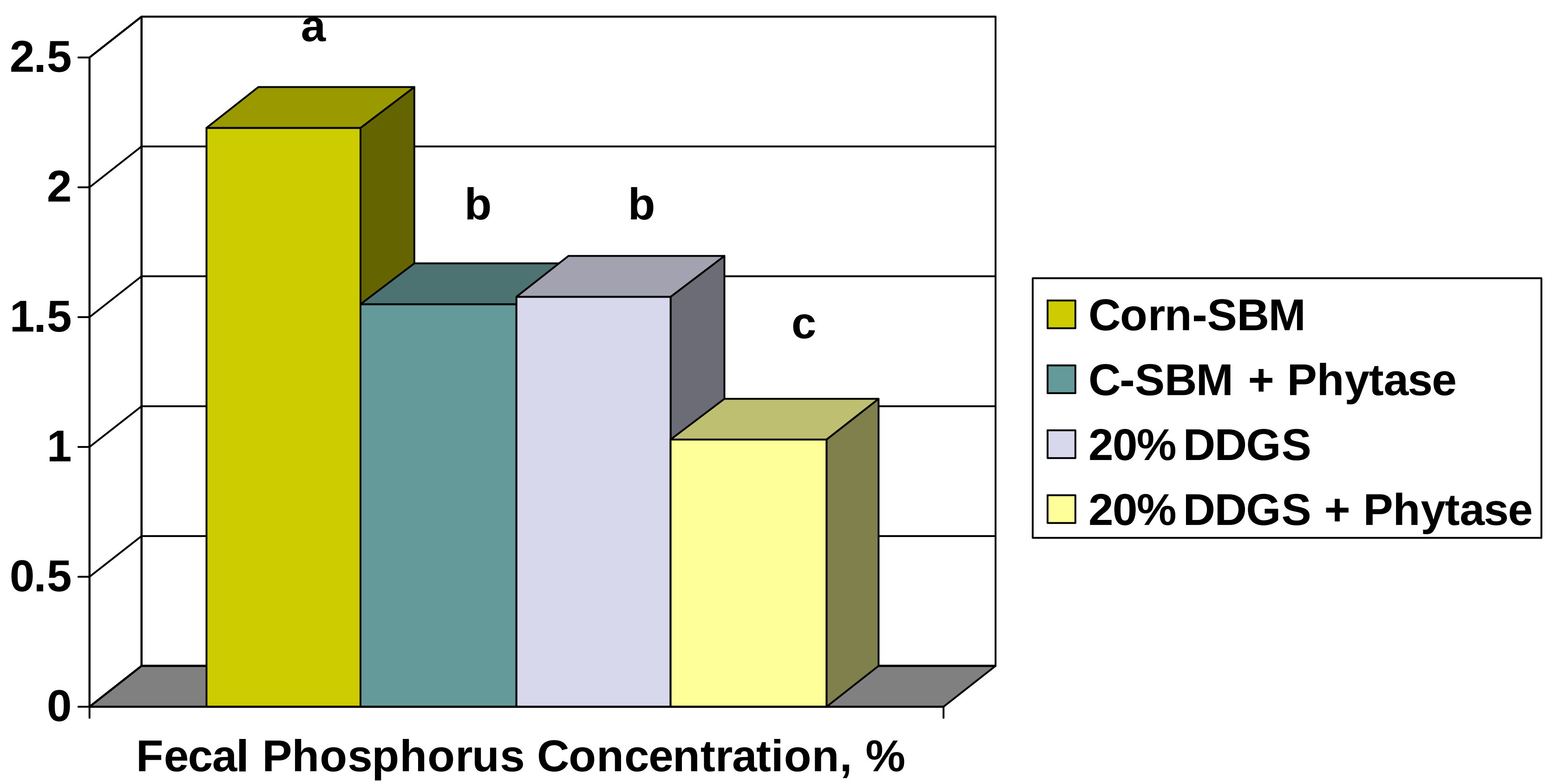
Xu et al. (2006)

Effect of Adding Phytase and/or 20% DDGS to Corn-SBM Diets on Dry Matter Digestibility in Nursery Pigs



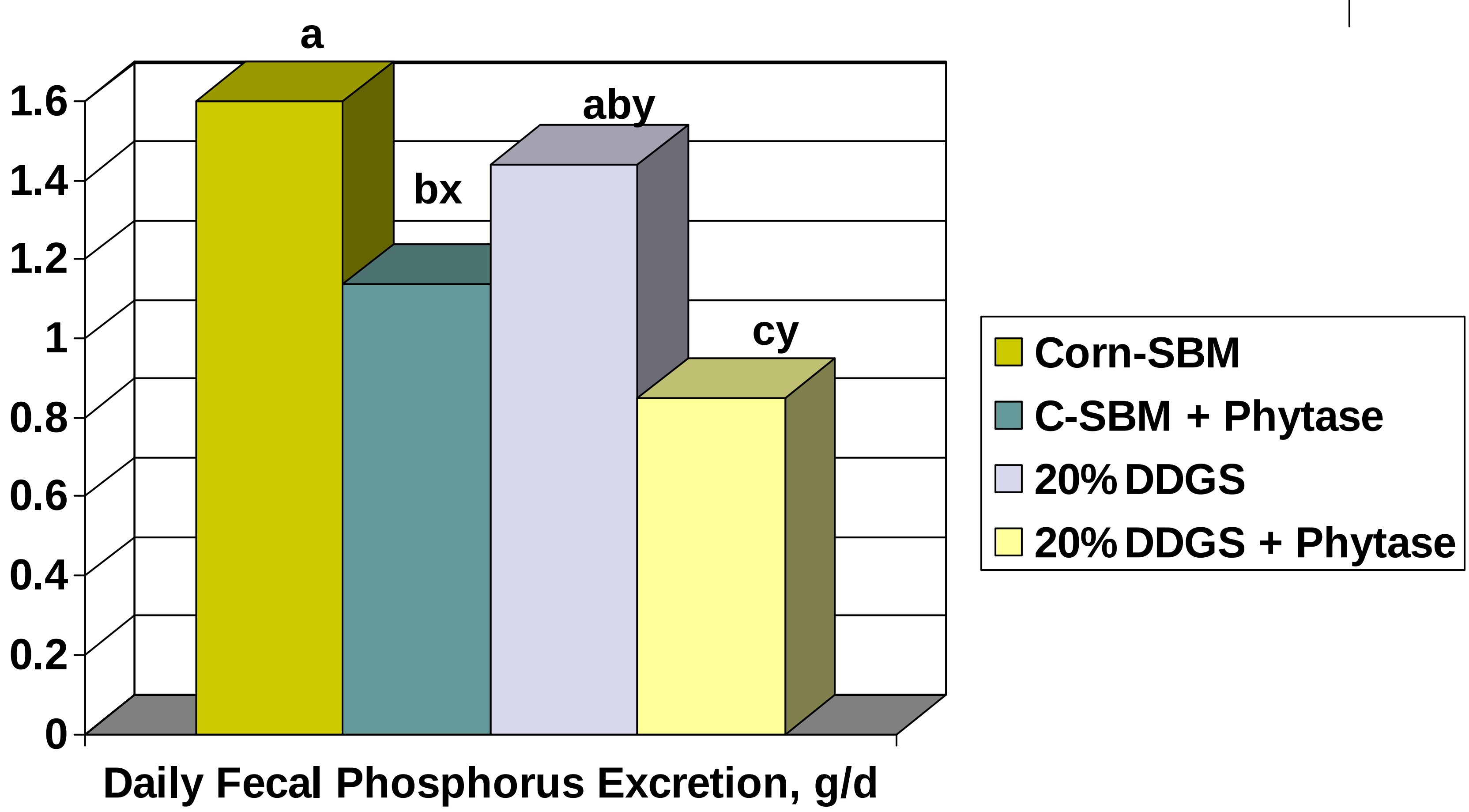
DDGS reduced DM digestibility 3.3% (P = .01)

Effect of Feeding Corn-SBM Diets With or Without 20% DDGS or Phytase on Fecal Phosphorus Concentration (%)



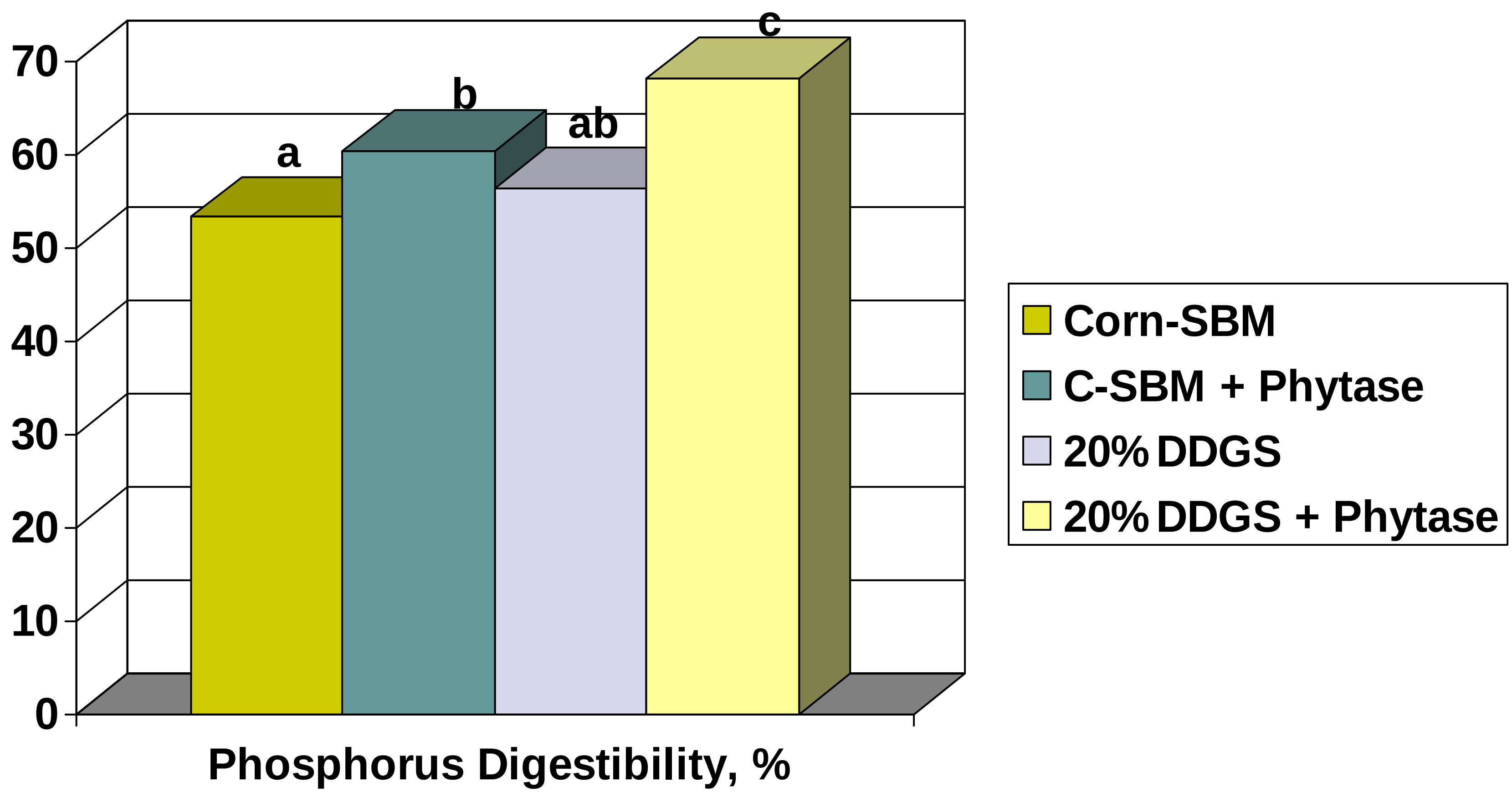
a,b Means with different superscripts are significantly different (P < .05).

Effect of Feeding Corn-SBM Diets With or Without 20% DDGS or Phytase on Daily Fecal Phosphorus Excretion (g/d)



a,b,c Means with different superscripts are significantly different (P < .05).
x,y Means with different superscripts are significantly different (P < .15).

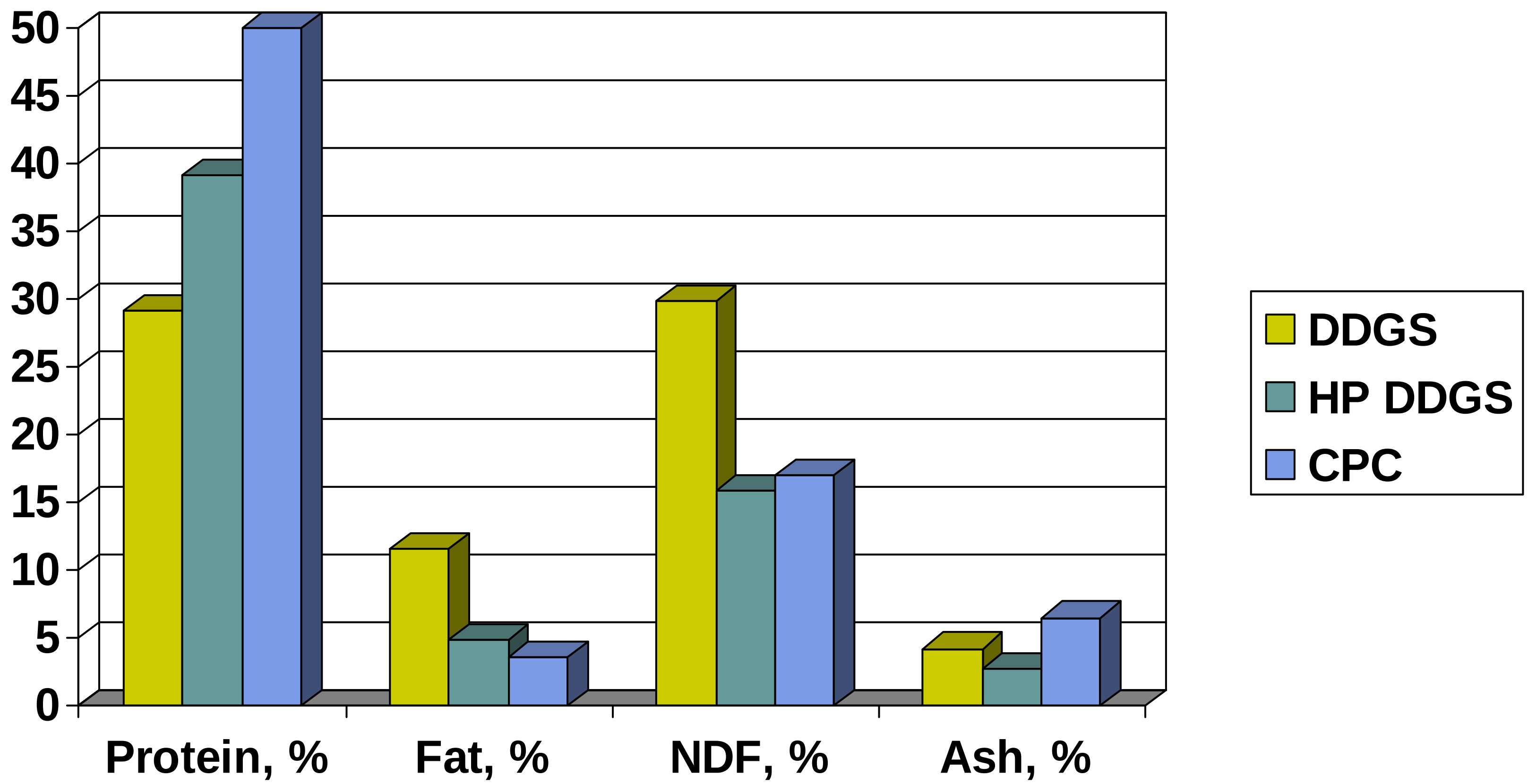
Effect of Feeding Corn-SBM Diets With or Without 20% DDGS or Phytase on Phosphorus Digestibility (%)



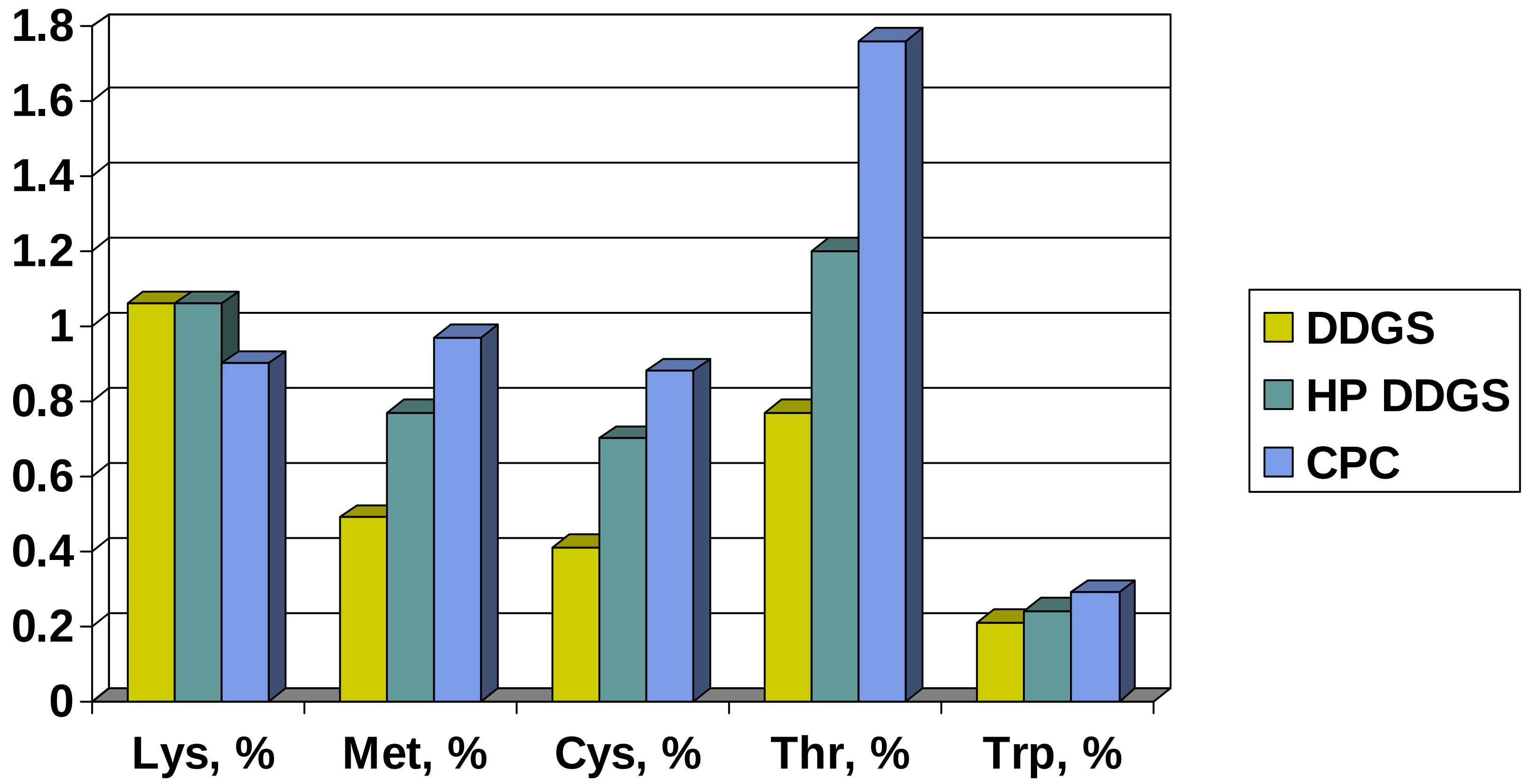
a,b Means with different superscripts are significantly different (P < .05).

The Value of New Distiller's By-Products

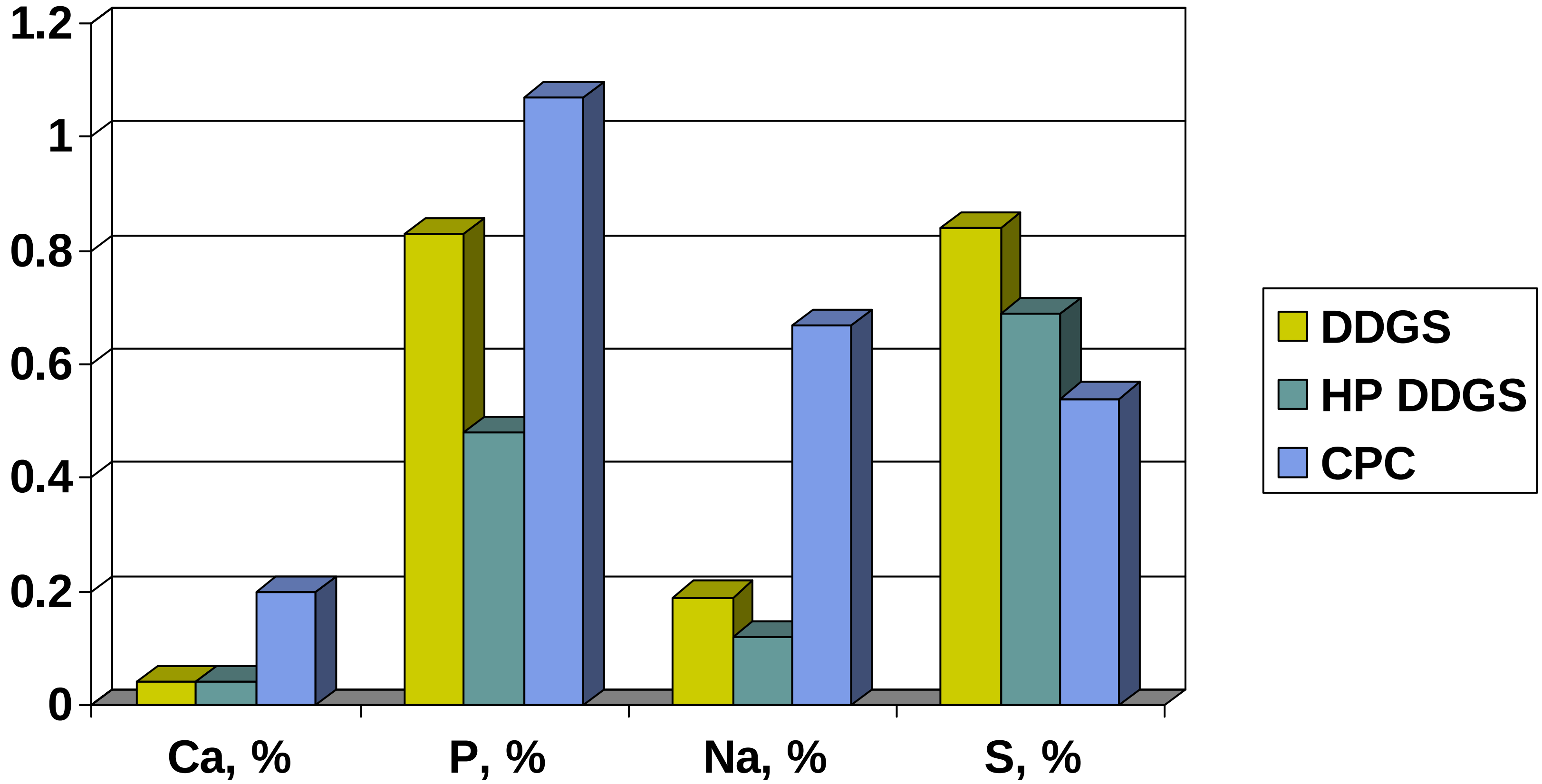
Comparison of Nutrient Content of Dakota Gold DDGS with High Protein Dakota Gold and Corn Protein Concentrate (100% DM Basis)



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



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



Opportunity Costs of High Protein Corn By-Products in Swine Diets

	DDGS Spec. 1	DDGS Spec. 2	HP DDGS	CPC
Swine	$80.00	$78.00	$51.00	$61.60

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

- 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 DDGS 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 in Monogastric Diets

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

- Request evidence of mycotoxin screening procedures and quality control procedures 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