Benefits and Limitations of Using DDGS in Swine Diets

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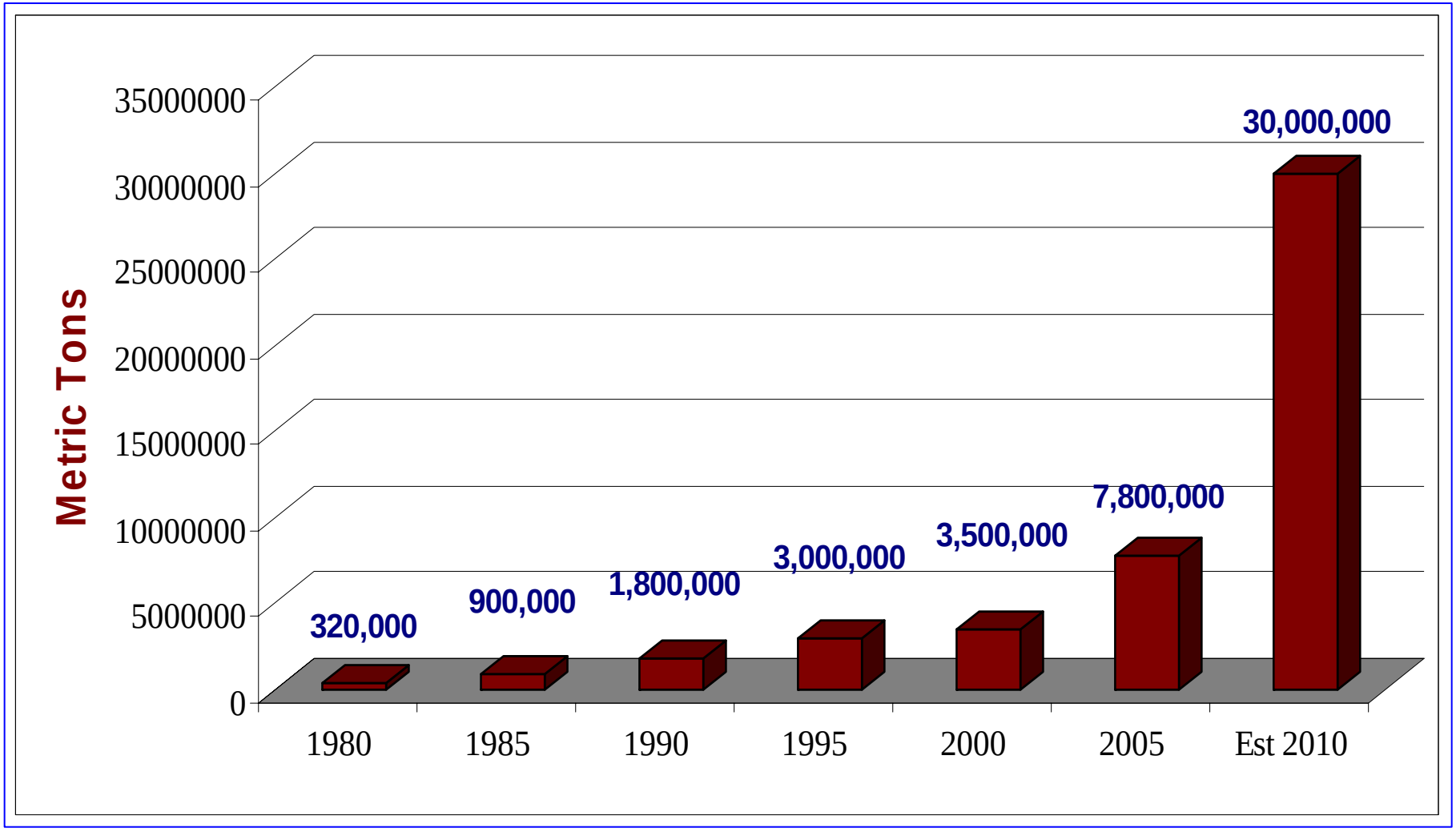
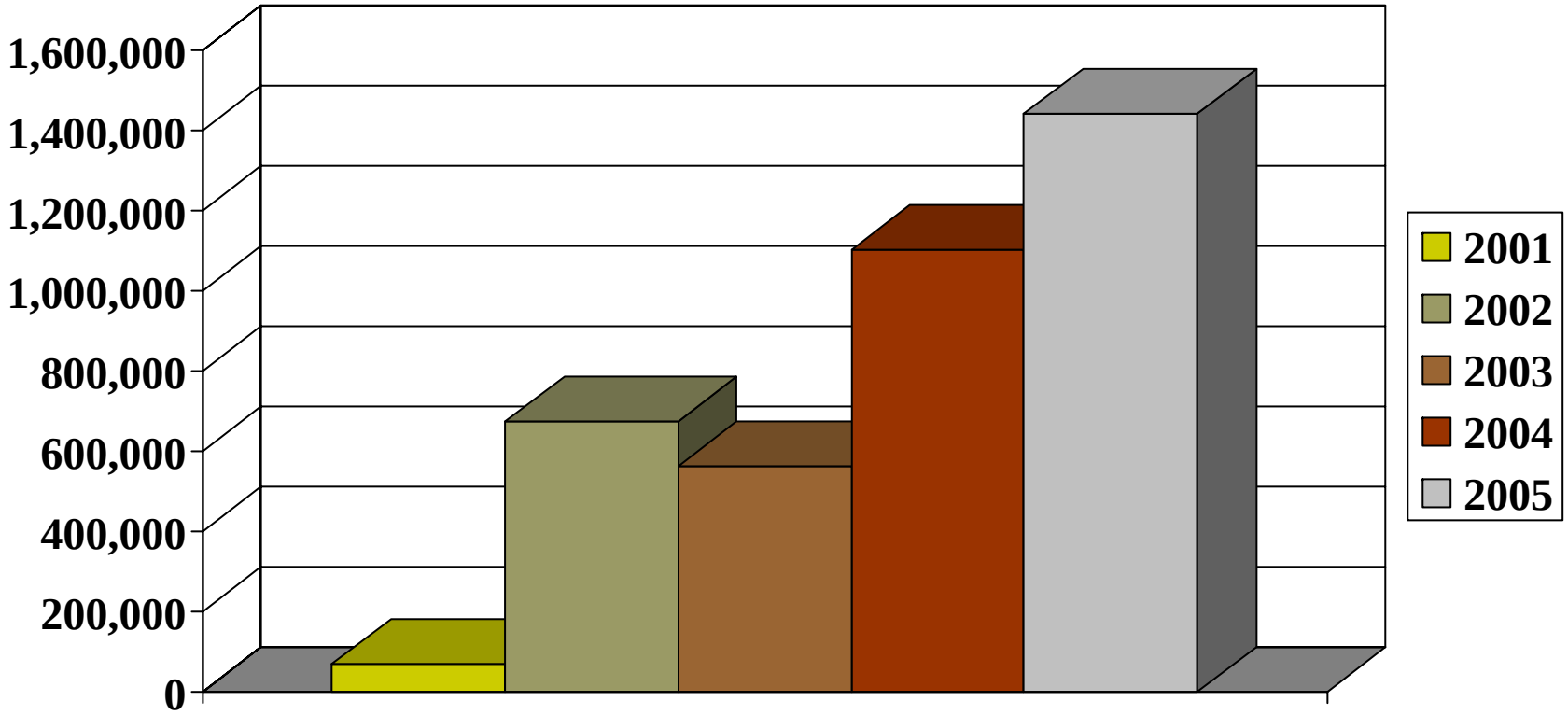
North American DDGS Production



Source: Sean Broderick, Commodity Specialists Company

Estimated DDGS Usage in U.S. Swine Feeds 2001-2005 (Metric Tonnes)



Current Commercial Dietary DDGS Inclusion Rates and Estimated Usage

- Grower-finisher diets ~85-90%
  - 10-15% dietary inclusion rates
- Sow diets ~5-10%
  - Gestation - up to 30% dietary inclusion
  - Lactation - 5-10% of the diet
- Late nursery diets < 5%
  - Added at 5-10% of the diet

Maximum Inclusion Rates of Golden High Quality DDGS in Swine Diets

(Based Upon University of Minnesota Performance Trials)

- Nursery pigs (> 7 kg)
  - Up to 25 %
- Grow-finish pigs
  - Up to 20% (higher levels may reduce pork fat quality)
- Gestating sows
  - Up to 50%
- Lactating sows
  - Up to 30%

Assumptions: no mycotoxins
formulate on a digestible amino acid and available phosphorus basis

Benefits and Limitations of Feeding DDGS Diets to Swine

Benefits

- Energy value = corn
- High available P
  - Reduce diet P supplementation
  - May reduce manure P excretion
- Partially replaces some corn, soybean meal, and dicalcium phosphate and reduces diet cost
- 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 when fed at high levels to sows
- Increases pig weight gain when fed to sows during lactation

Limitations

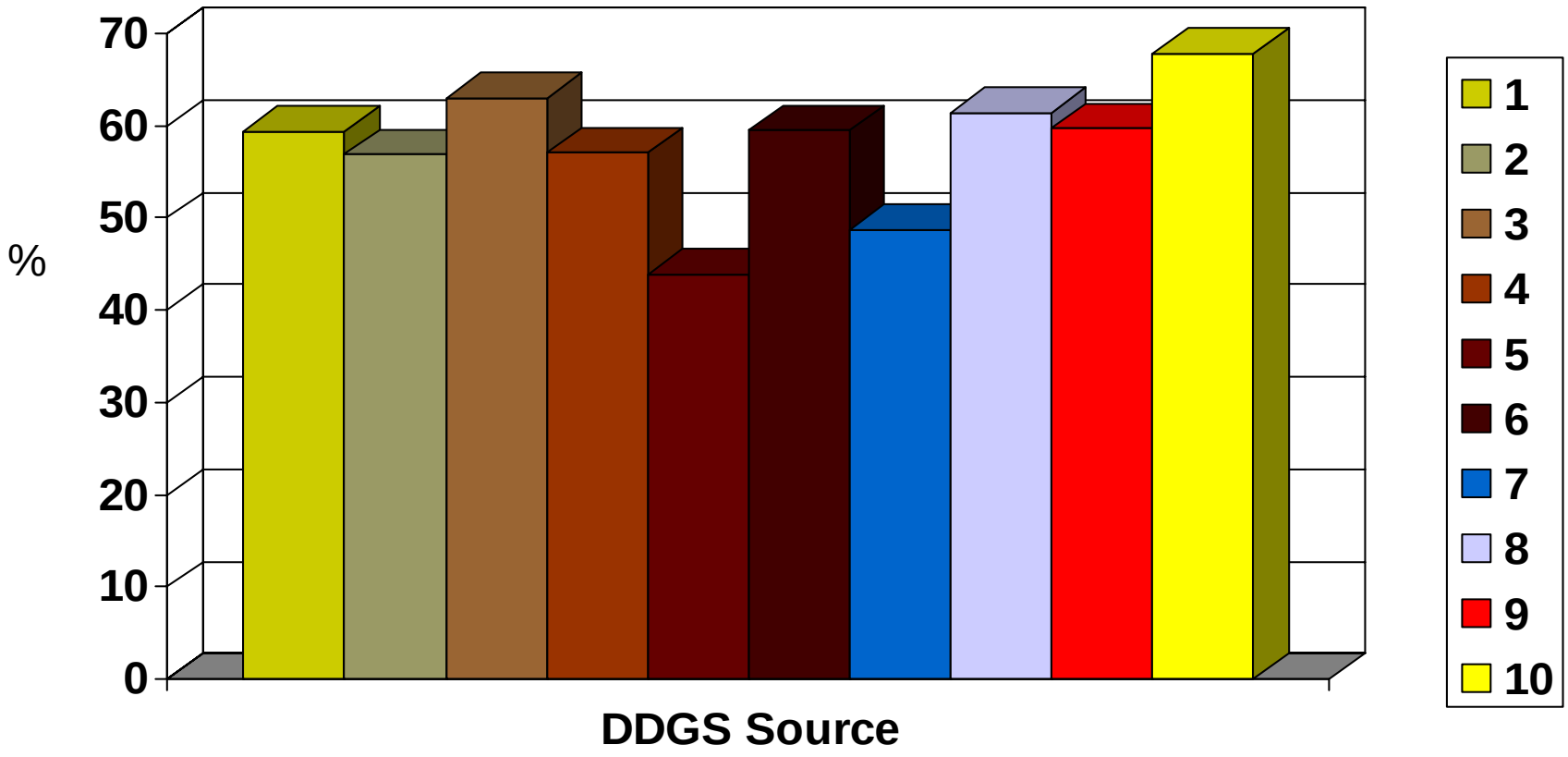
- Low protein (lysine) quality
  - add other supplements high in lysine and tryptophan
- Variability in nutrient content and digestibility among sources
- Manure N excretion increases
- Belly firmness and pork fat quality may be reduced when > 20% in the diet
- Fine particle size causes flowability problems in bins and feeders
- Difficult to pellet and maintain throughput of pellet mills
- Mycotoxin free grain should be used to produce ethanol and DDGS
- Short-term feed intake may be reduced when feeding high DDGS diets to sows

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

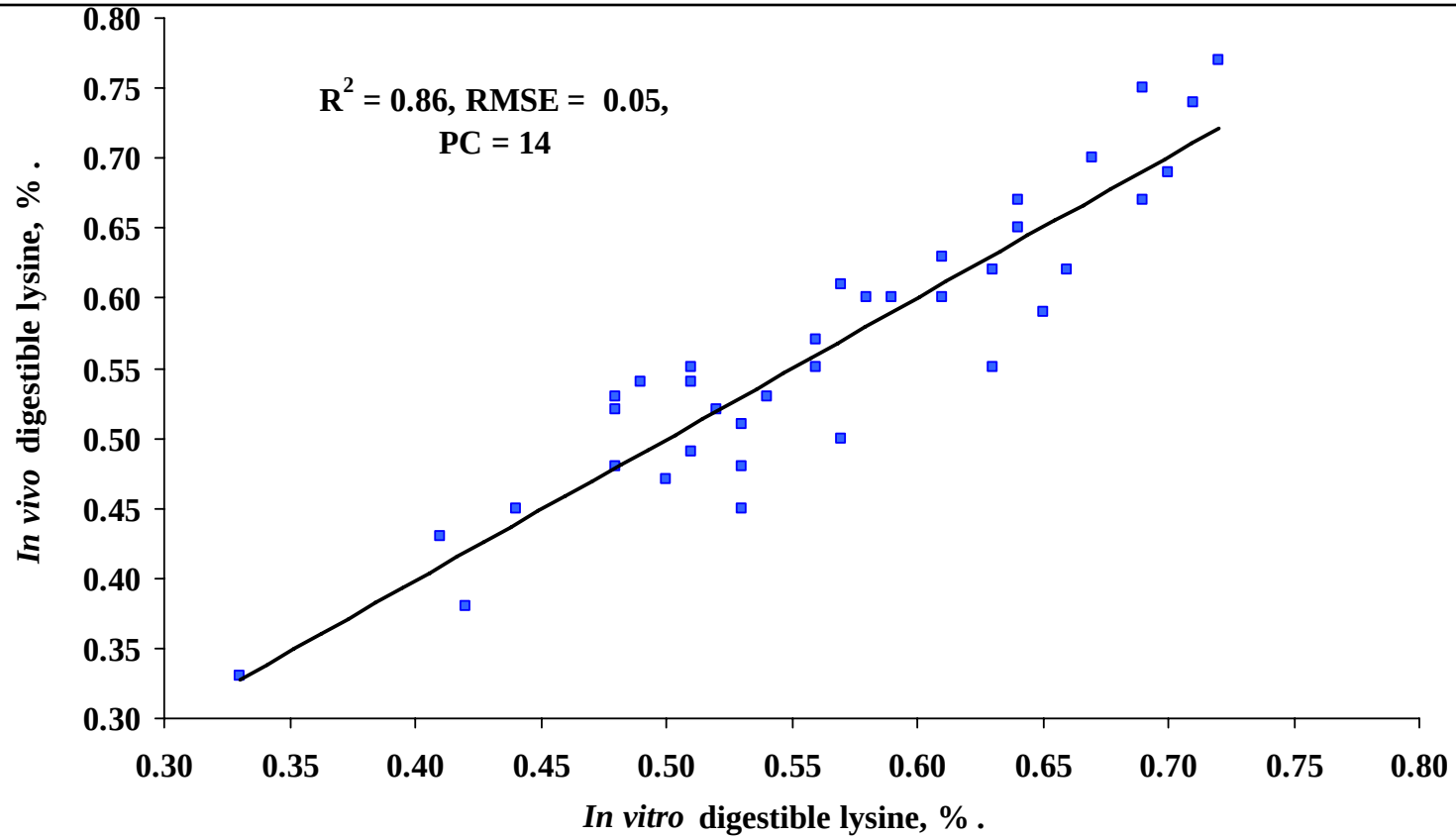
Averages, Coefficients of Variation, and Ranges of Selected Nutrients Among 32 U.S. DDGS Sources (100% Dry Matter Basis)

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

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

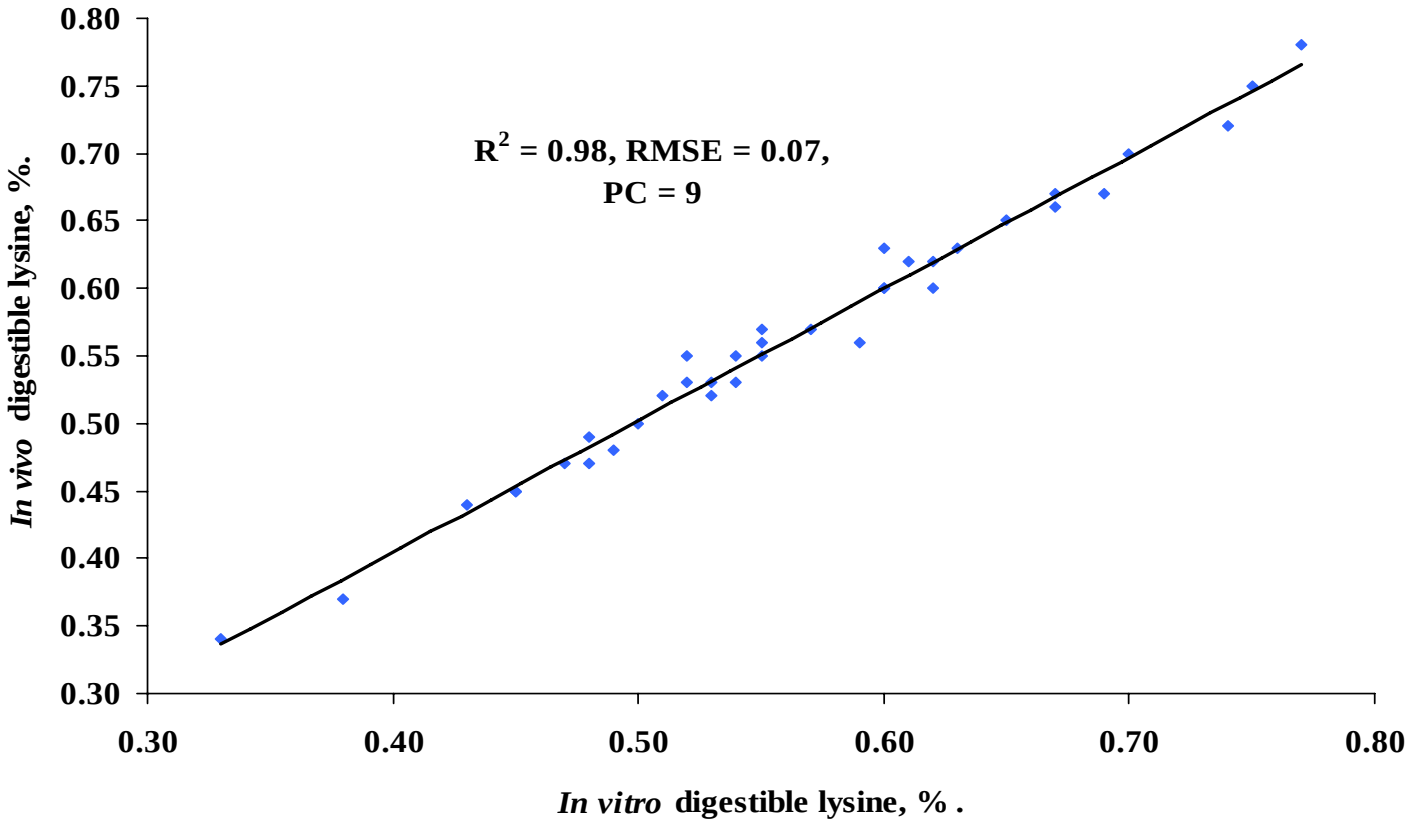


Prediction of Digestible Lysine from Optical Density (400 to 700 nm)

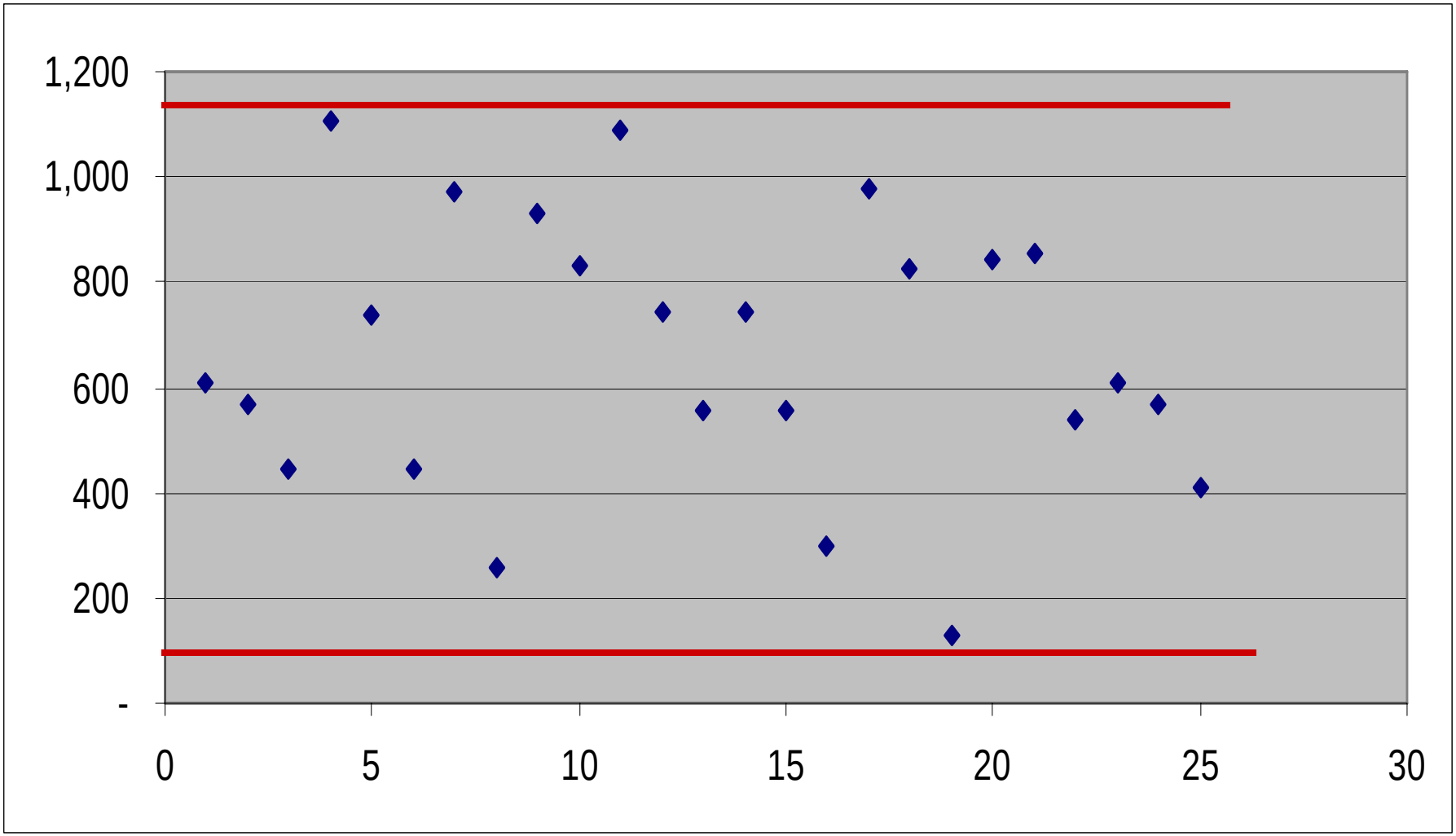


Urriola et al. (2006)

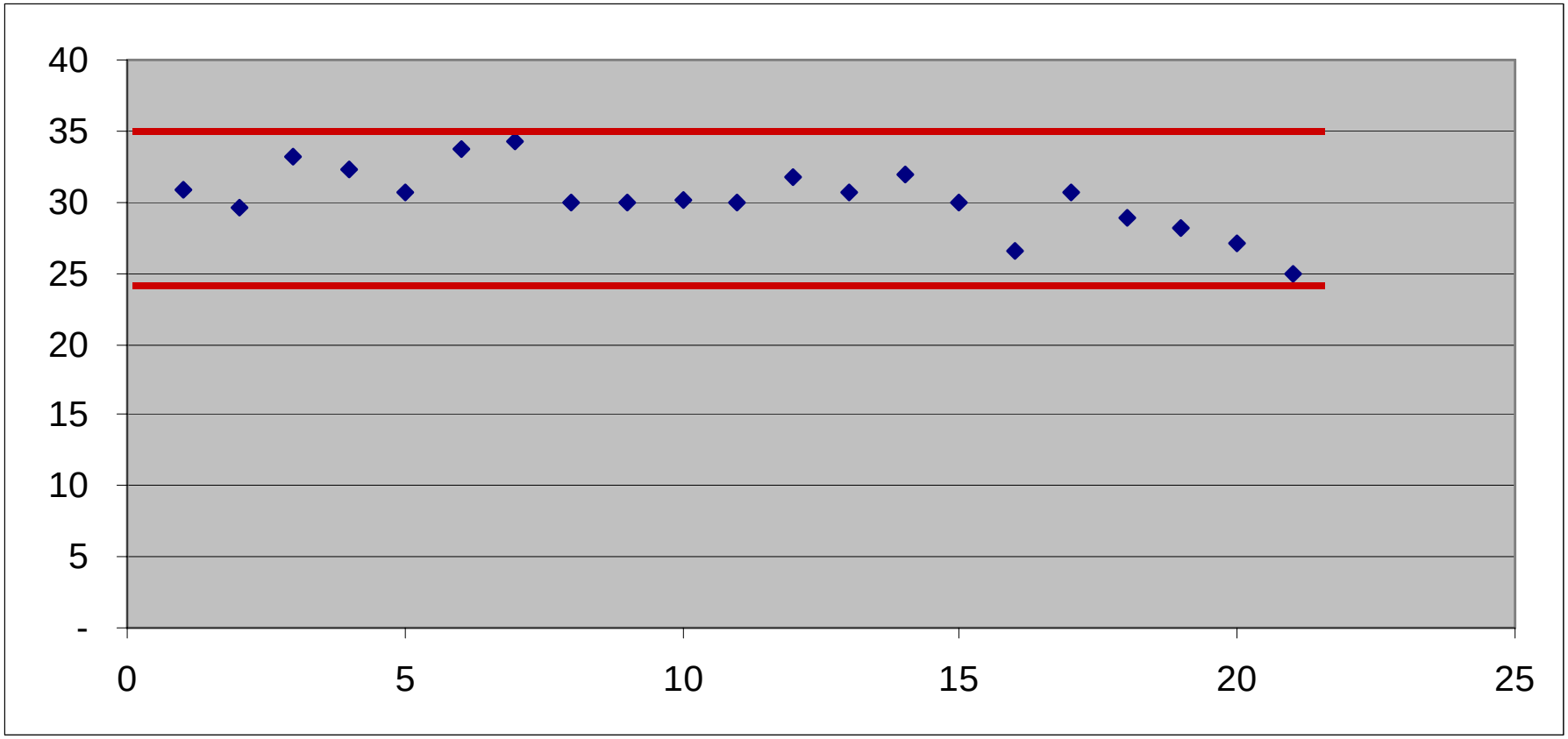
Prediction of Digestible Lysine in DDGS Using Front Face Fluorescence



Urriola et al. (2006)



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

Feeding High Quality DDGS to Weaned Pigs

Nursery Experiments

- Experiment 1
  - Pigs weaned at 19.0 ± 0.3 d of age
  - Weighed 7.10 ± 0.07 kg
- Experiment 2
  - Pigs weaned at 16.9 ± 0.4 d of age
  - Weighed 5.26 ± 0.07 kg
- Pigs were fed a commercial pelleted diet (d 0 to 3 postweaning)
- Phase II (d 4-17) and Phase III (d 18 – 35) diets were **formulated on a digestible amino acid basis.**
  - Diets contained 0, 5, 10, 15, 20, or 25% DDGS

Results

- Feeding Phase II and Phase III nursery diets containing up to 25% DDGS:
  - Had no effect on ADG, ADFI, F/G for pigs weaned at 19 d of age and weighing at least 15 lbs
  - Linearly reduced ADG and ADFI in Phase II but not Phase III for pigs weaned at 17 d of age and weighing 11.5 lbs.

Effects of Feeding DDGS to Grow-Finish Pigs on Growth Performance, Carcass, and Pork Quality

Take Home Messages from 4 Experiments

- Diets containing 10% DDGS will provide the same ADG as pigs fed typical corn-SBM diets
  - Diets formulated on a total lysine basis
  - Diets formulated on a digestible amino acid basis
- If >10% DDGS is added to G-F diets, diets should be formulated on a digestible amino acid basis to achieve good performance.
- Feed intake may decline with increasing levels of DDGS in the diet
  - Unclear why different studies show different feed intake responses
  - Diets containing >10% DDGS may result in improved feed efficiency

Take Home Messages from 4 Experiments

- Carcass yield is slightly linearly reduced with increasing dietary DDGS levels
  - No difference in % lean
  - No difference in backfat
  - May be due to increased viscera weight from increased dietary fiber?
- Backfat thickness is unaffected, and may be slightly reduced, with increasing dietary levels of DDGS
- Bellies will be less firm as higher dietary levels of DDGS are fed
- Belly thickness may or may not be affected by increasing dietary DDGS levels
- No concern about reduced shelf life and fat oxidation in loins under typical retail storage conditions for at least 28 days.
- Muscle quality and eating characteristics of loins and bacon are unaffected by feeding diets containing increasing levels of DDGS

Fat Quality Characteristics of Market Pigs Fed Corn-Soy Diets Containing 0, 10, 20, and 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]

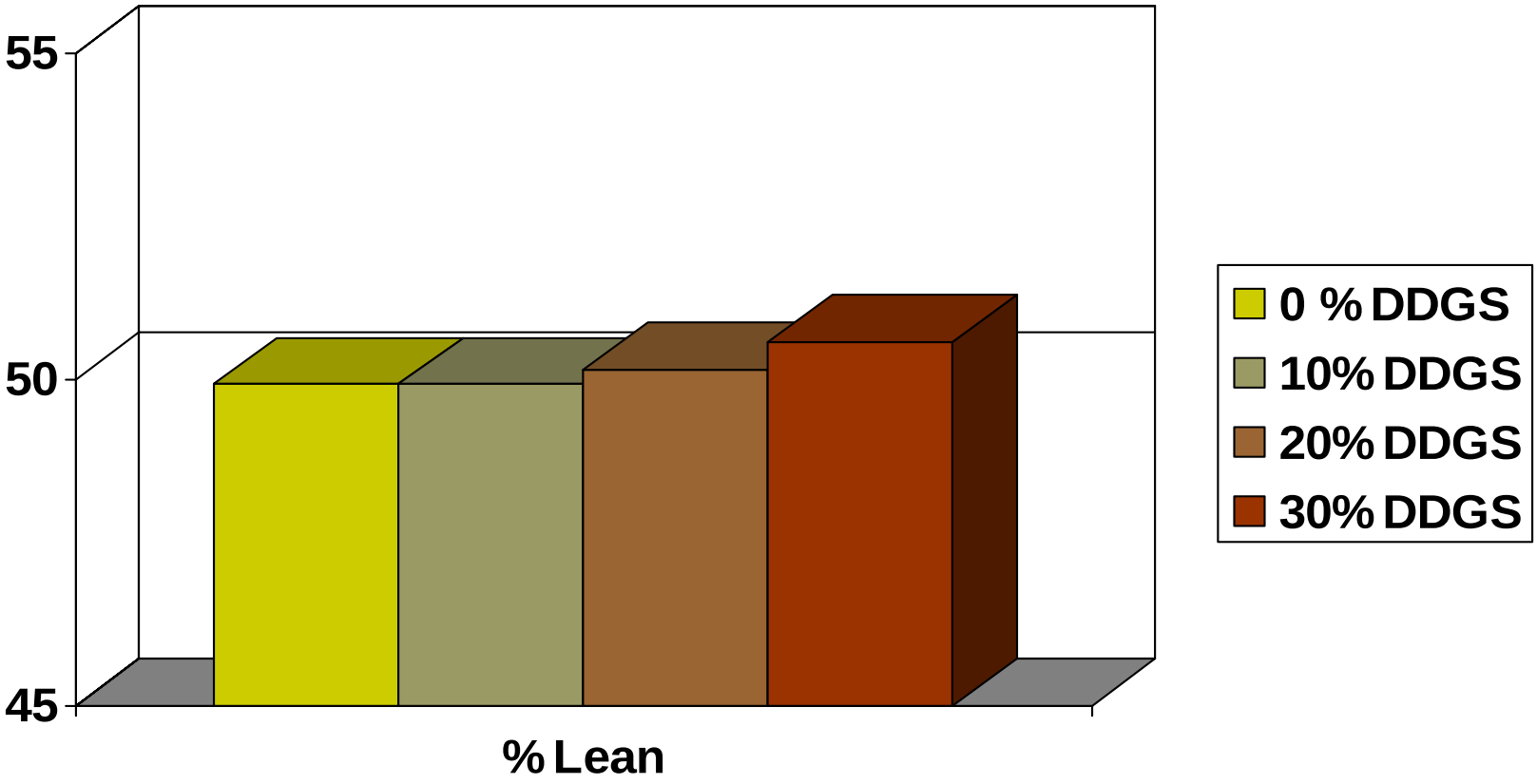
Means within a row lacking common superscripts differ (P < .05).

Effect of Formulating G-F Diets on a Digestible Amino Acid Basis, with Increasing Levels of DDGS, on Overall Growth Performance

	0% DDGS	10% DDGS	20% DDGS	30% DDGS
Initial wt., lbs	49.7	50.3	49.7	49.7
Final wt., lbs	252	253	251	250
ADG, lbs	2.00	2.00	1.99	1.99
ADFI, lbs	5.76	5.58	5.55	5.45
F/G	2.88	2.80	2.79	2.75

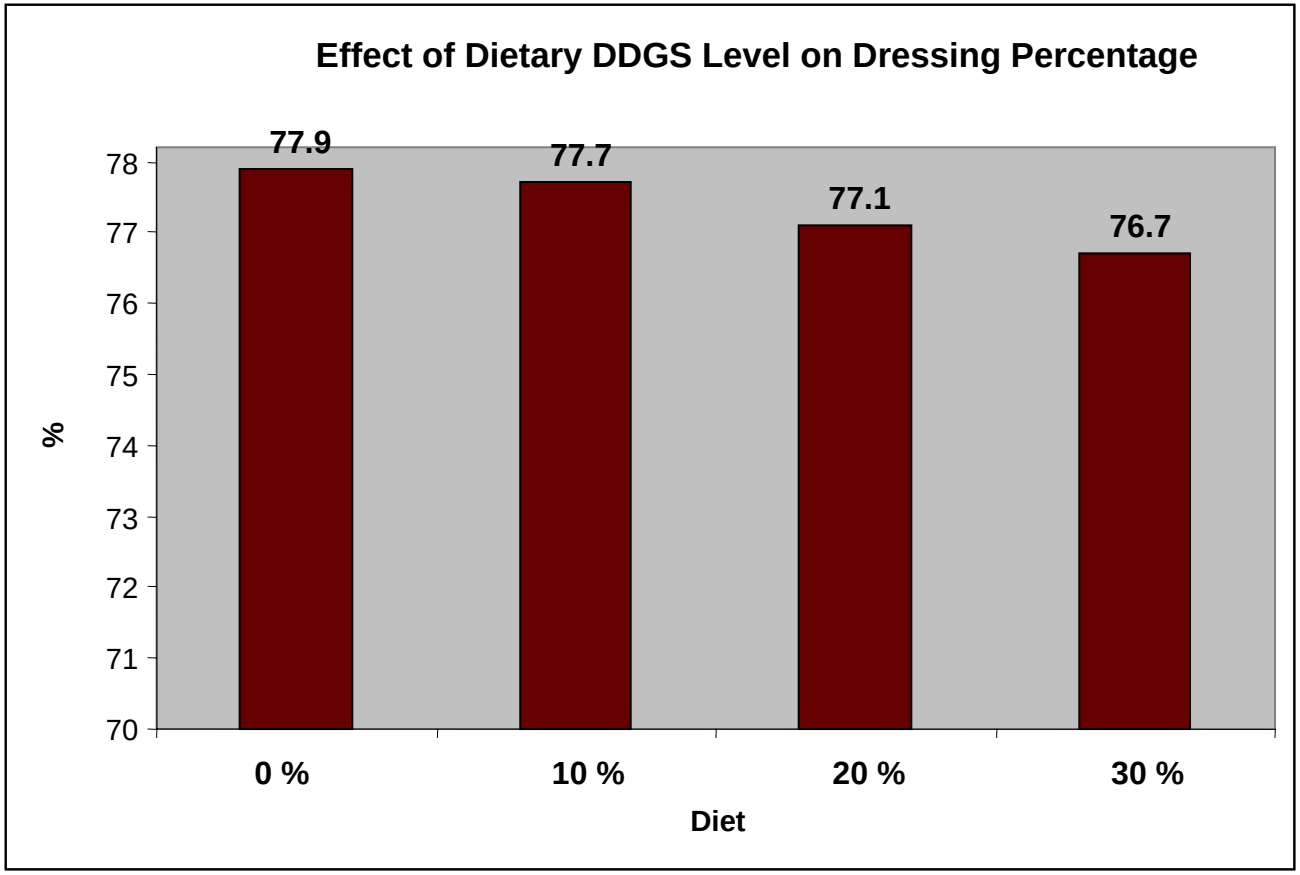
Xu et al. (2006) unpublished
Data from 32 pens, 8 pens/treatment

Effects of Dietary DDGS Level on % Carcass Lean



Xu et al. (2006) unpublished
30% DDGS tended to be higher than 0% DDGS (P = 0.11)

Adding DDGS to Grower-Finisher Diets Slightly Reduces Carcass Yield



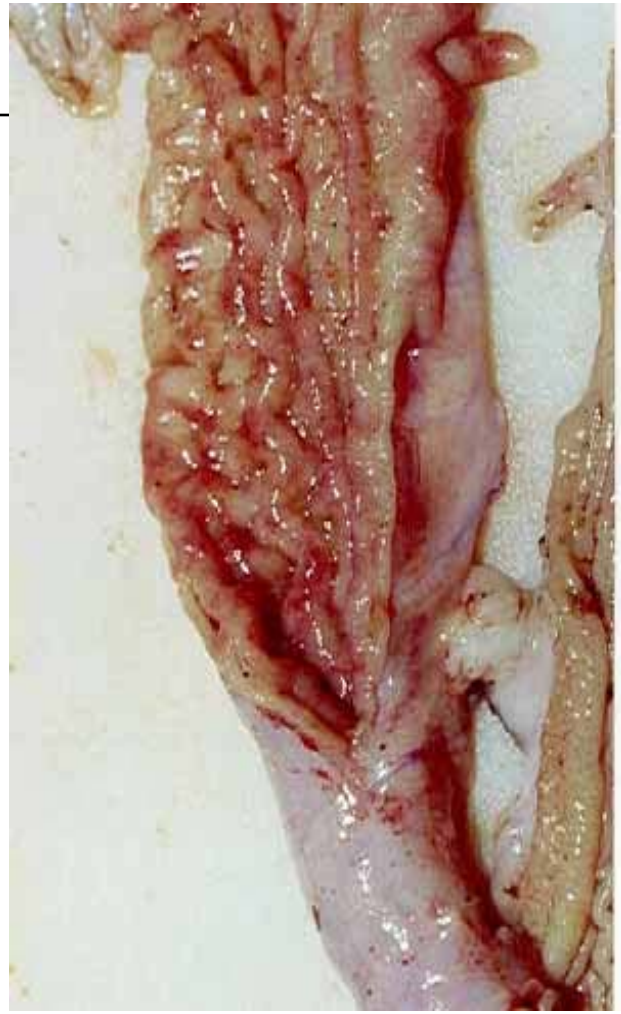
Xu et al. (2006) unpublished
Linear effect ($P < 0.01$)

Unique, Value-Added Attributes of DDGS Have Been Identified

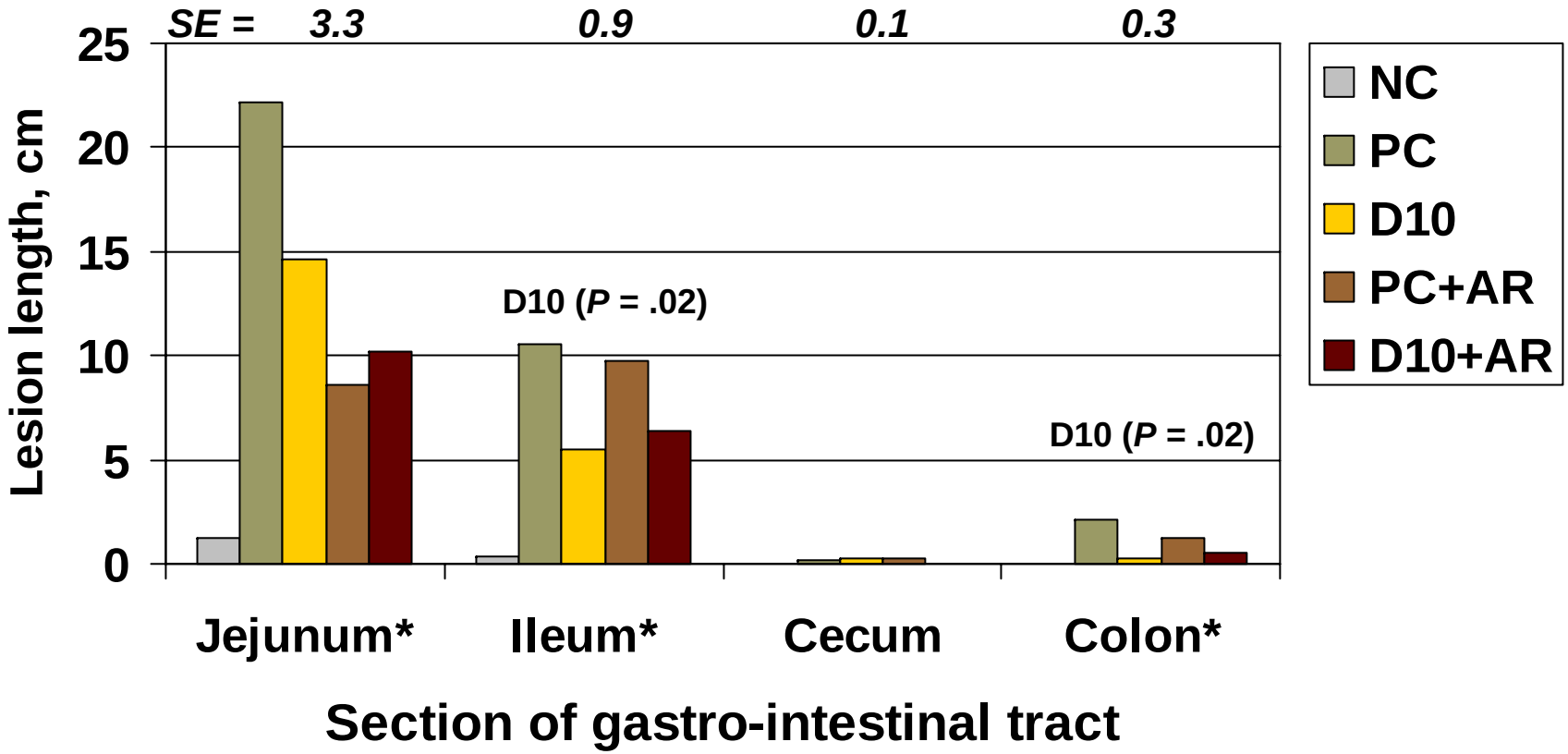
- DDGS may improve gut health related to *Lawsonia intracellularis*
- Phytase and DDGS can reduce manure P excretion
- Feeding high levels of DDGS to sows may improve litter size weaned and pig weaning weights

Healthy

Ileitis

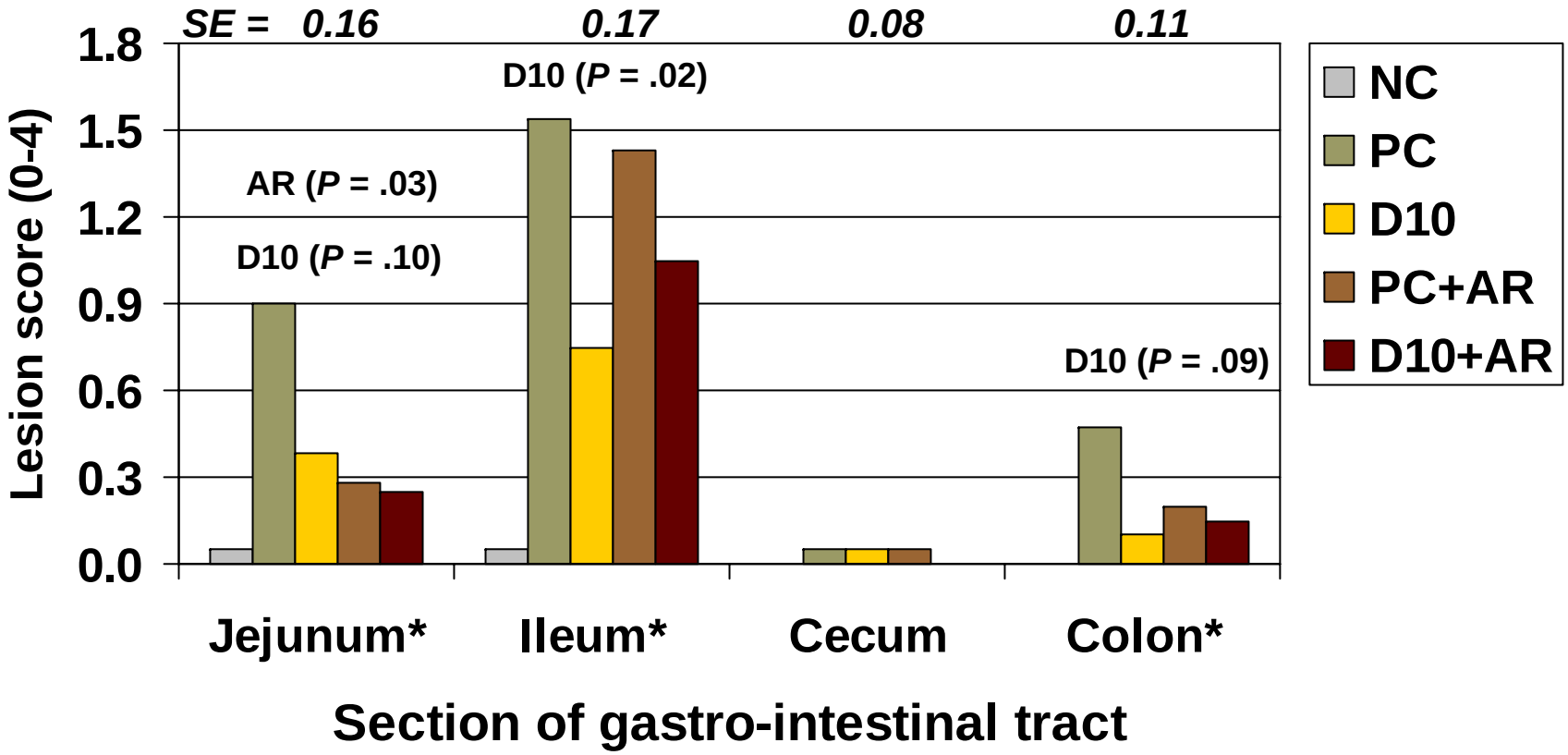


Effect of Dietary Treatment on Lesion Length (21 d Post-Challenge) Experiment 2



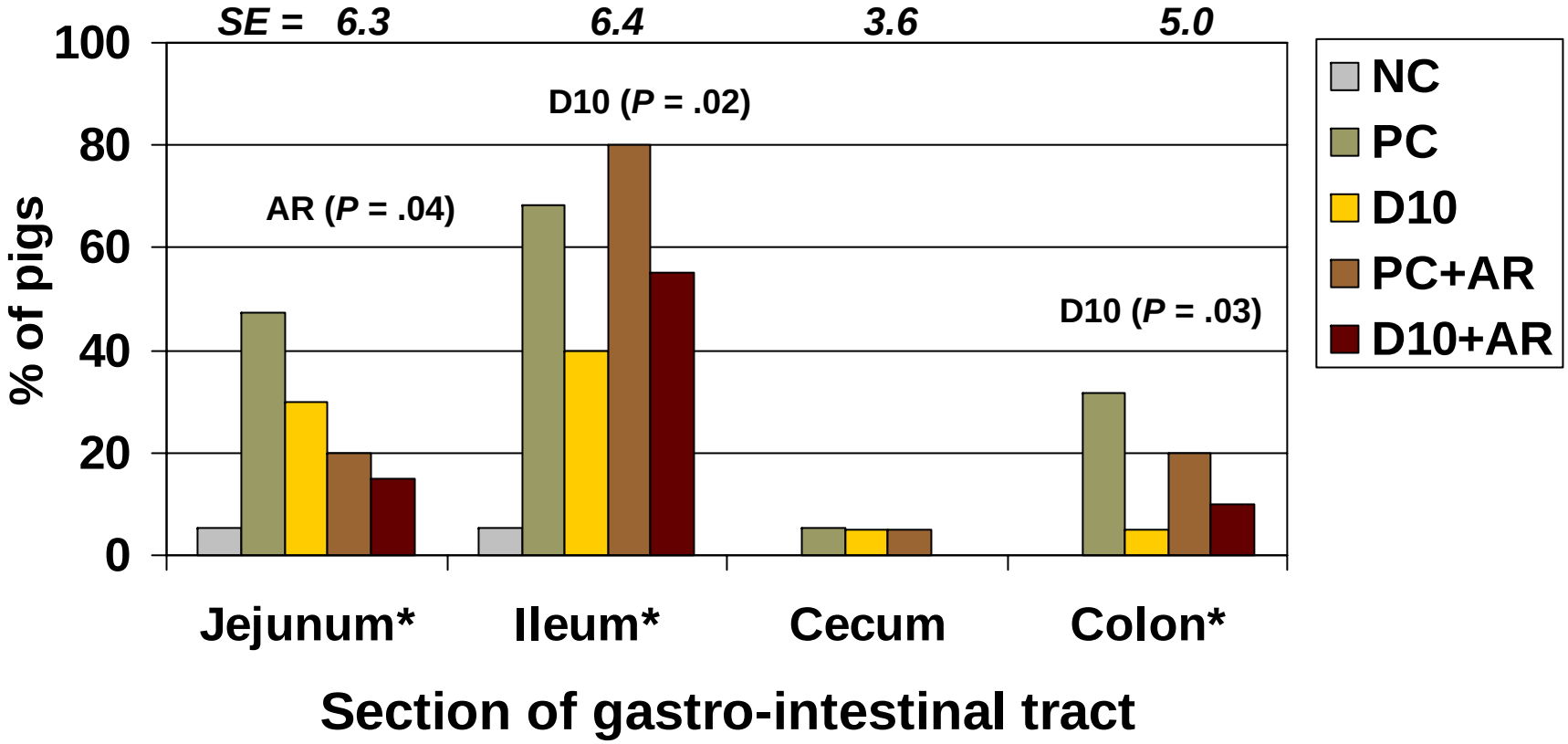
* Effect of disease challenge ($P < .01$).

Effect of Dietary Treatment on Lesion Severity (21 d Post-Challenge) Experiment 2



* Effect of disease challenge ($P < .01$).

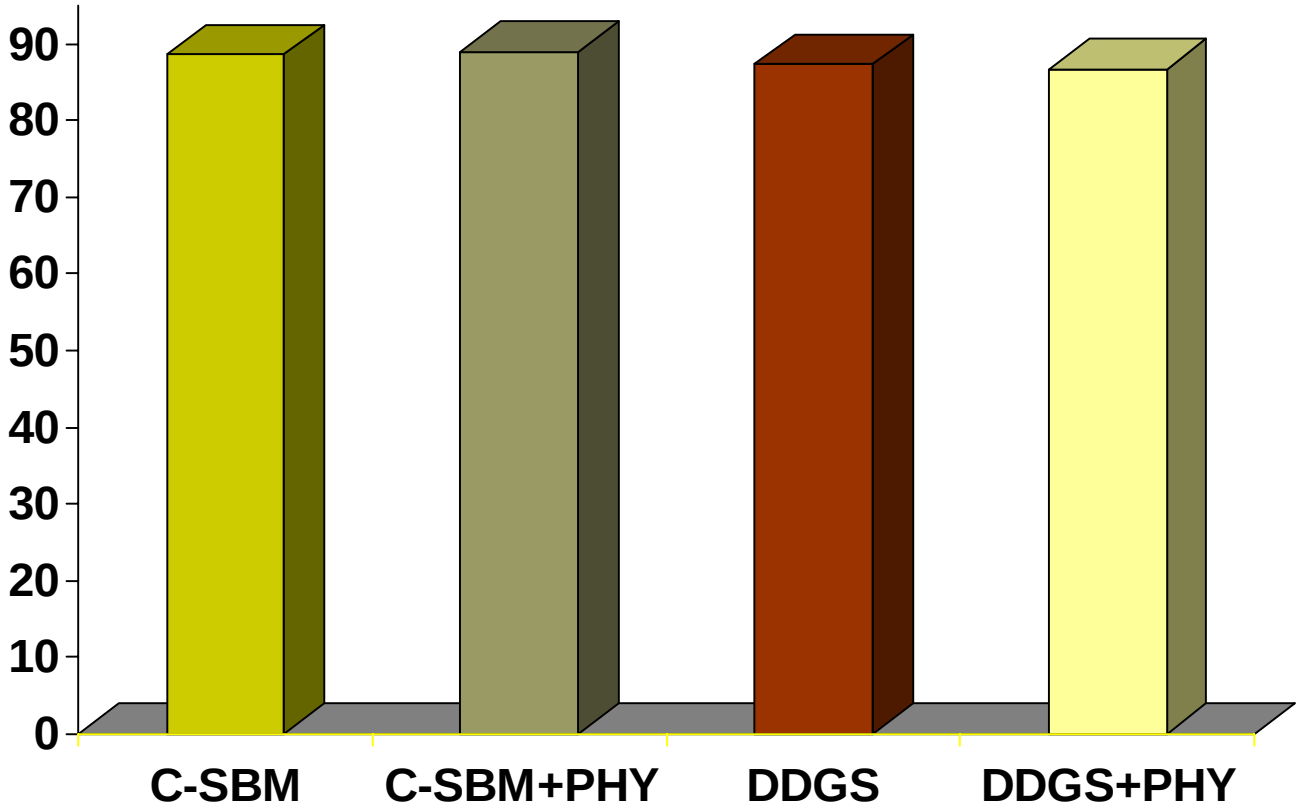
Effect of Dietary Treatment on Lesion Prevalence (21 d Post-Challenge) Experiment 2



* Effect of disease challenge ($P < .01$).

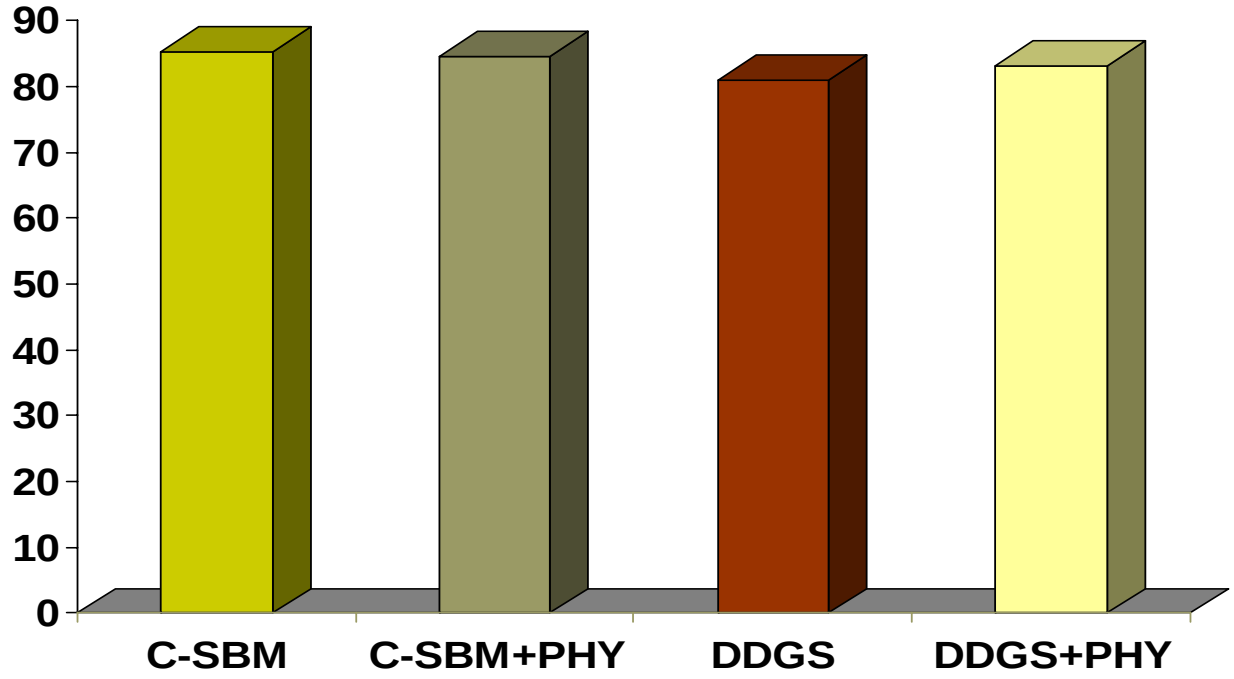
Effects of Feeding DDGS to Swine on Dry Matter Digestibility (Manure Volume)

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



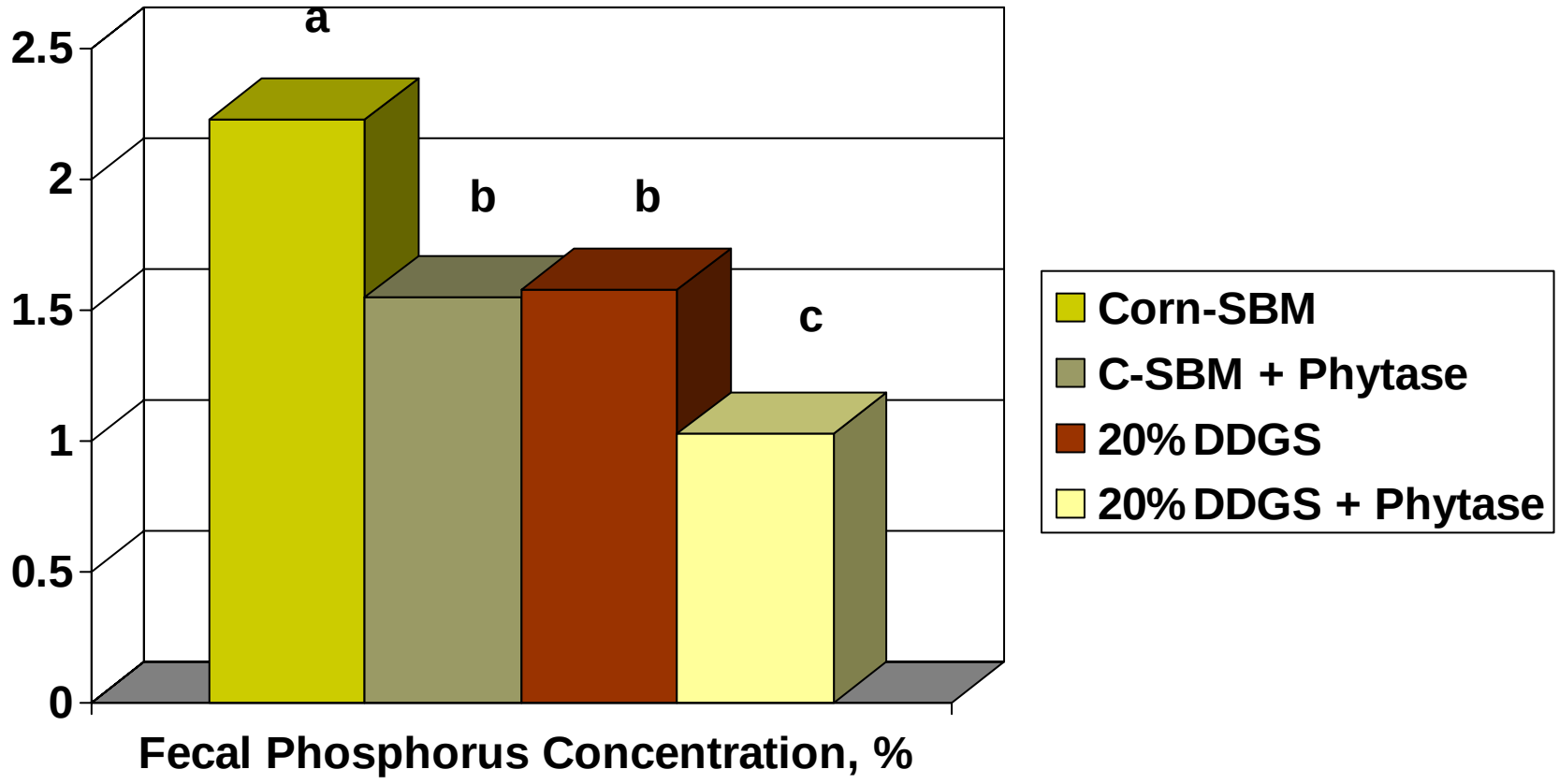
Xu et al. (2006)

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



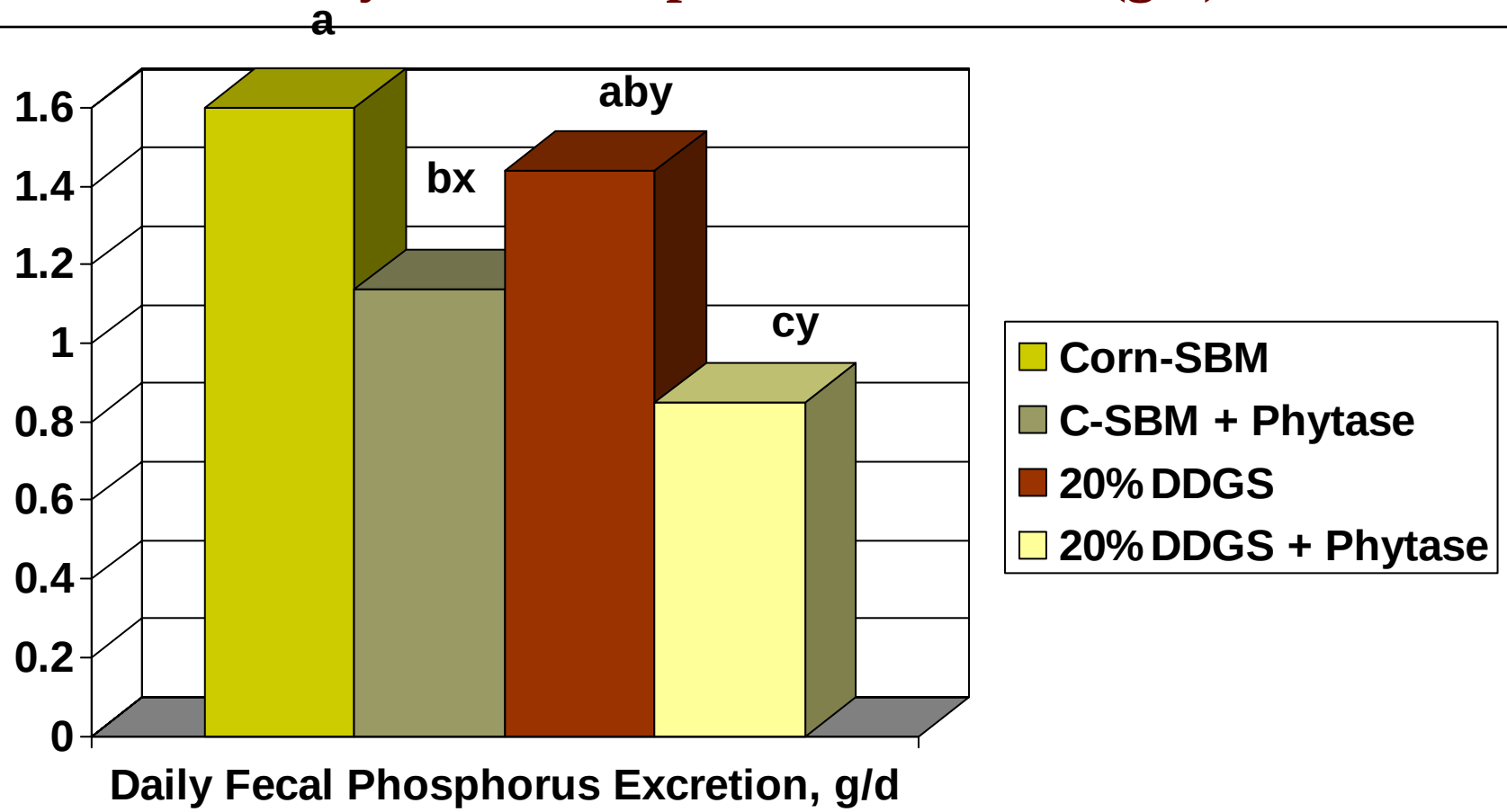
DDGS reduced DM digestibility 3.3% (P = .01)

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



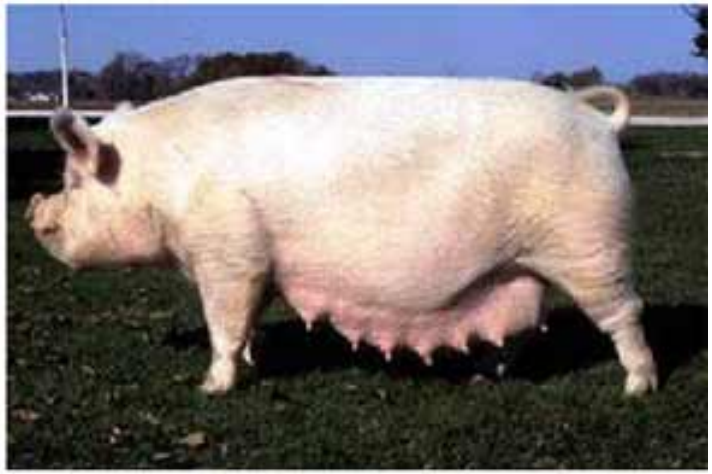
a,b Means with different superscripts are significantly different (P < .05).

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

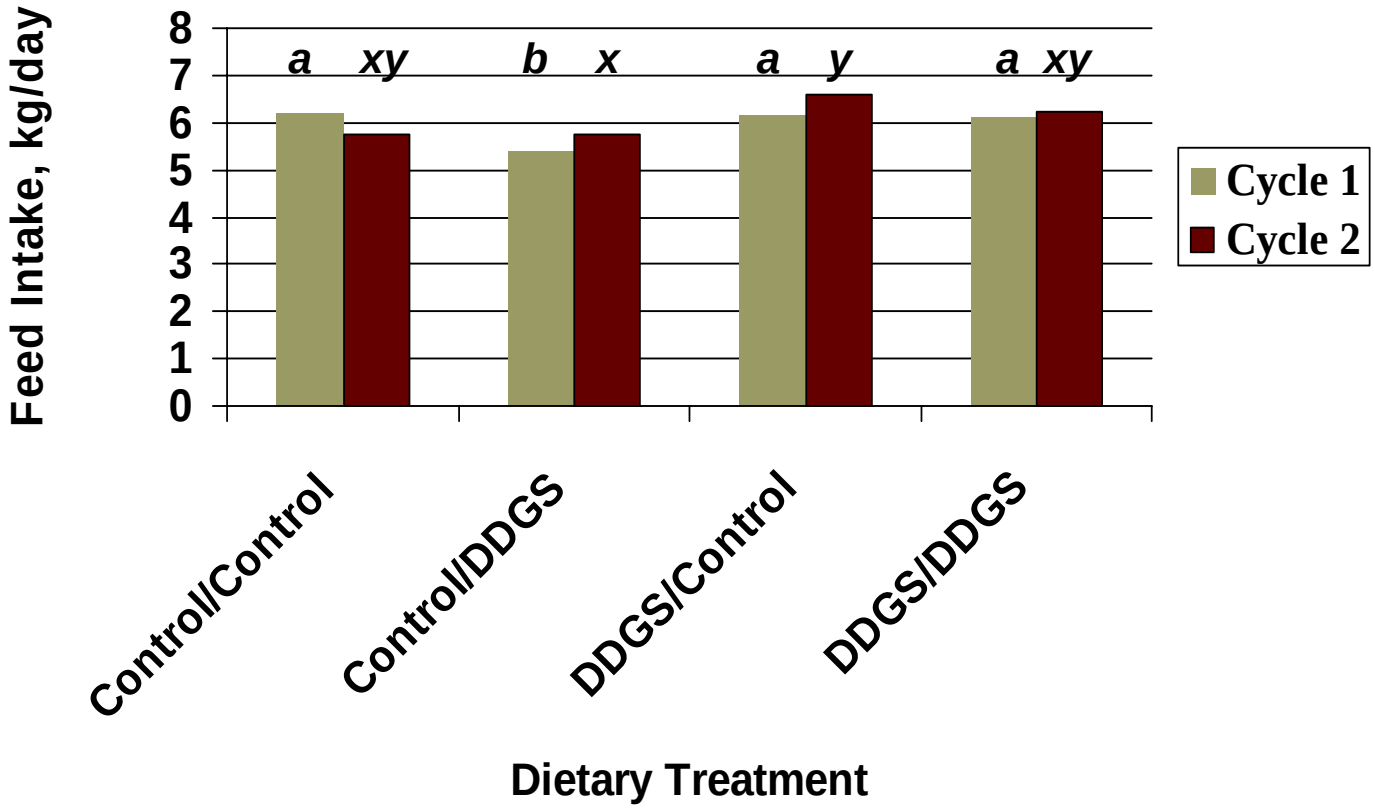


a,b,c Means with different superscripts are significantly different (P < .05).
x,y Means with different superscripts are significantly different (P < .15).

Feeding High Quality DDGS to Sows

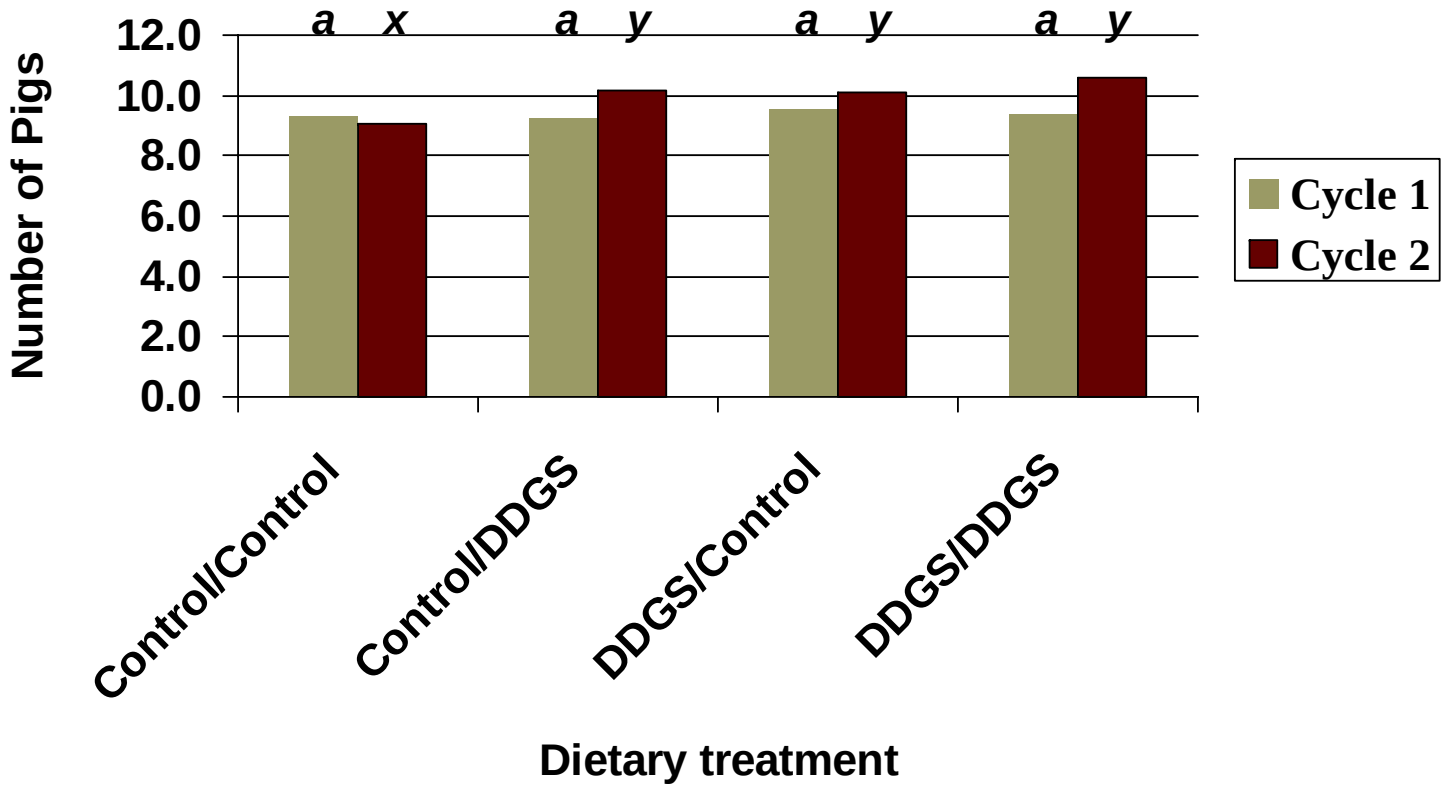


Effect of Feeding 0 and 50% DDGS Gestation Diets and 0 and 20% DDGS Lactation Diets on Sow Lactation ADFI



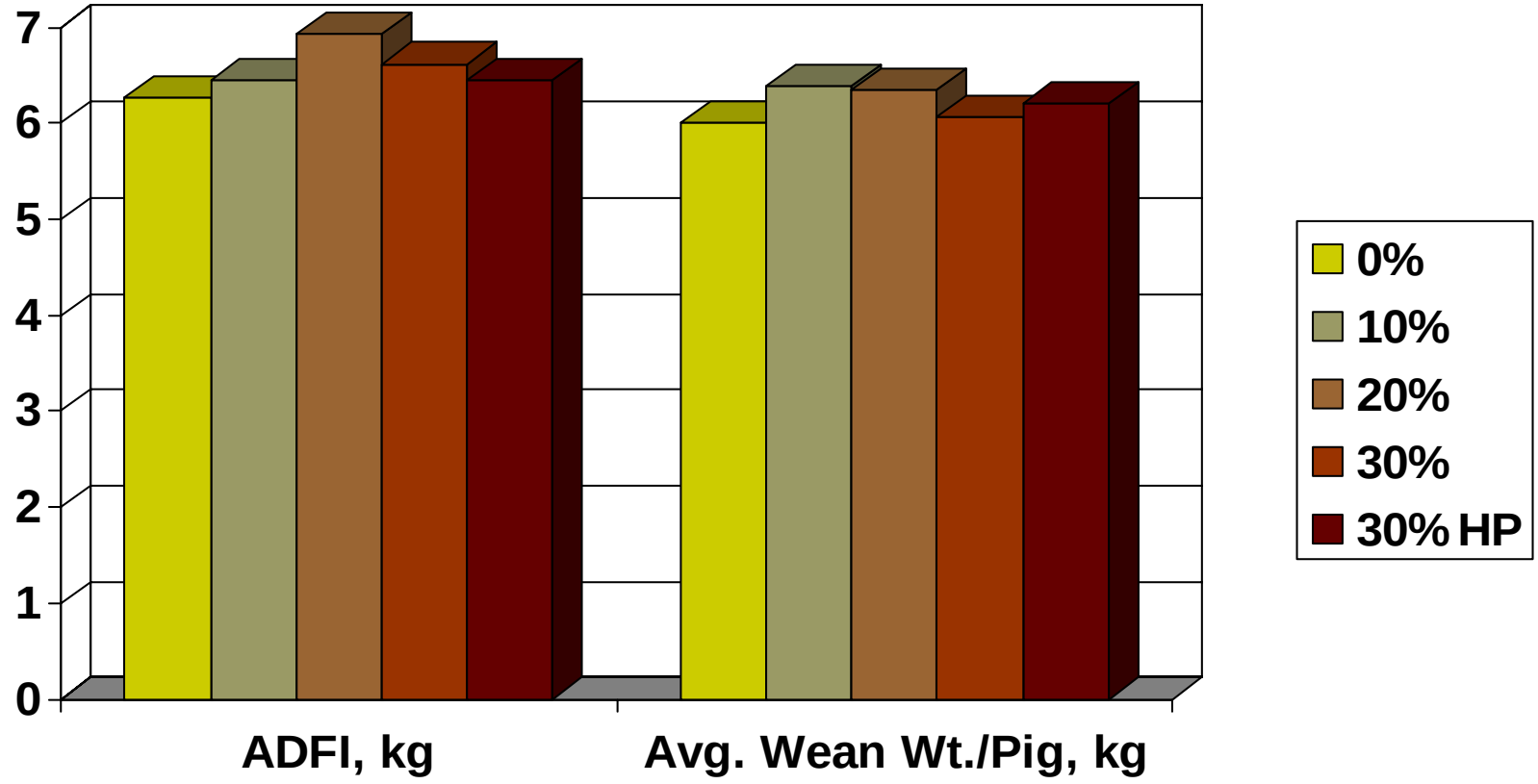
[a,b,x,y] Different superscripts indicate significant difference (P < .10).

Effect of Feeding 0 or 50% DDGS Gestation Diets and 0 or 20% DDGS Lactation Diets on Pigs Weaned/Litter



[a,b,x,y] Different superscripts indicate significant difference (P < .10).

Effects of Feeding Increasing Levels of DDGS to Lactating Sows on Average Daily Feed Intake and Average Pig Weight at Weaning



Utilized 323 lactating sows (65 sows/dietary treatment)
Song et al. (2006), unpublished

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