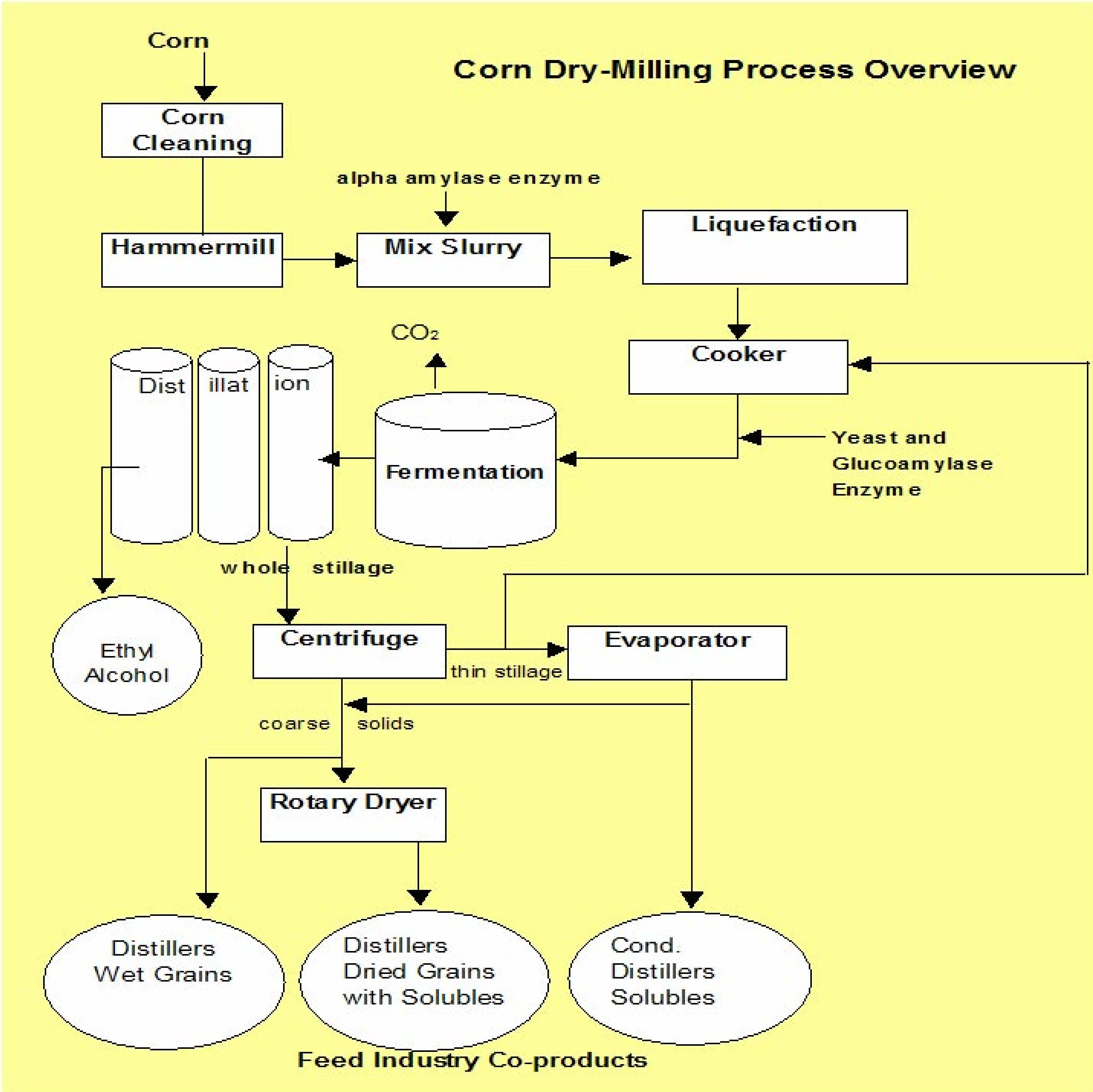
Use of High Quality U.S. Corn DDGS in Swine Feeds

Dr. Jerry Shurson
Professor
Dept. of Animal Science
University of Minnesota

Overview

- Dry-grind production of fuel ethanol and DDGS
- By-products of dry-grind ethanol production
- What is DDGS?
- Nutrient content and digestibility
- Recommended maximum inclusion rates of “new generation” DDGS in swine diets
- Nursery feeding trial results
- Grow-finish feeding trial results and effects of gut health
- Highlights of gestation-lactation feeding trial
- Effects of DDGS and phytase on reducing dietary inorganic P supplementation and manure P levels
- New spray dried corn distiller’s feed ingredients
- U of M DDGS web site


Corn Dry-Milling Process Overview
Corn
Corn Cleaning
Hammermill
alpha amylase enzyme
Mix Slurry
Liquefaction
Cooker
Yeast and Glucoamylase Enzyme
CO_2
Fermentation
Distillation
whole stillage
Ethyl Alcohol
Centrifuge
thin stillage
Evaporator
coarse solids
Rotary Dryer
Distillers Wet Grains
Distillers Dried Grains with Solubles
Cond. Distillers Solubles
Feed Industry Co-products

Dry-Grind Average Ethanol Yield Per Bushel of Corn (25.4 kg)

- Ethanol 10.2 liters
- DDGS 8.2 kg
- CO_2 8.2 kg

By-Products from Dry-Grind Ethanol Plants

- Distiller's grains
  - Wet – 30 to 35% DM
  - Dry – 90 to 92% DM
- Condensed distiller's solubles
  - Wet – 30 to 32% DM (variable)
  - Dry – 99% DM (new spray drying process developed at U of M)
- Distiller's dried grains with solubles
  - Wet – 30 to 35% DM
  - Dried – 88 to 90% DM (most common by-product)

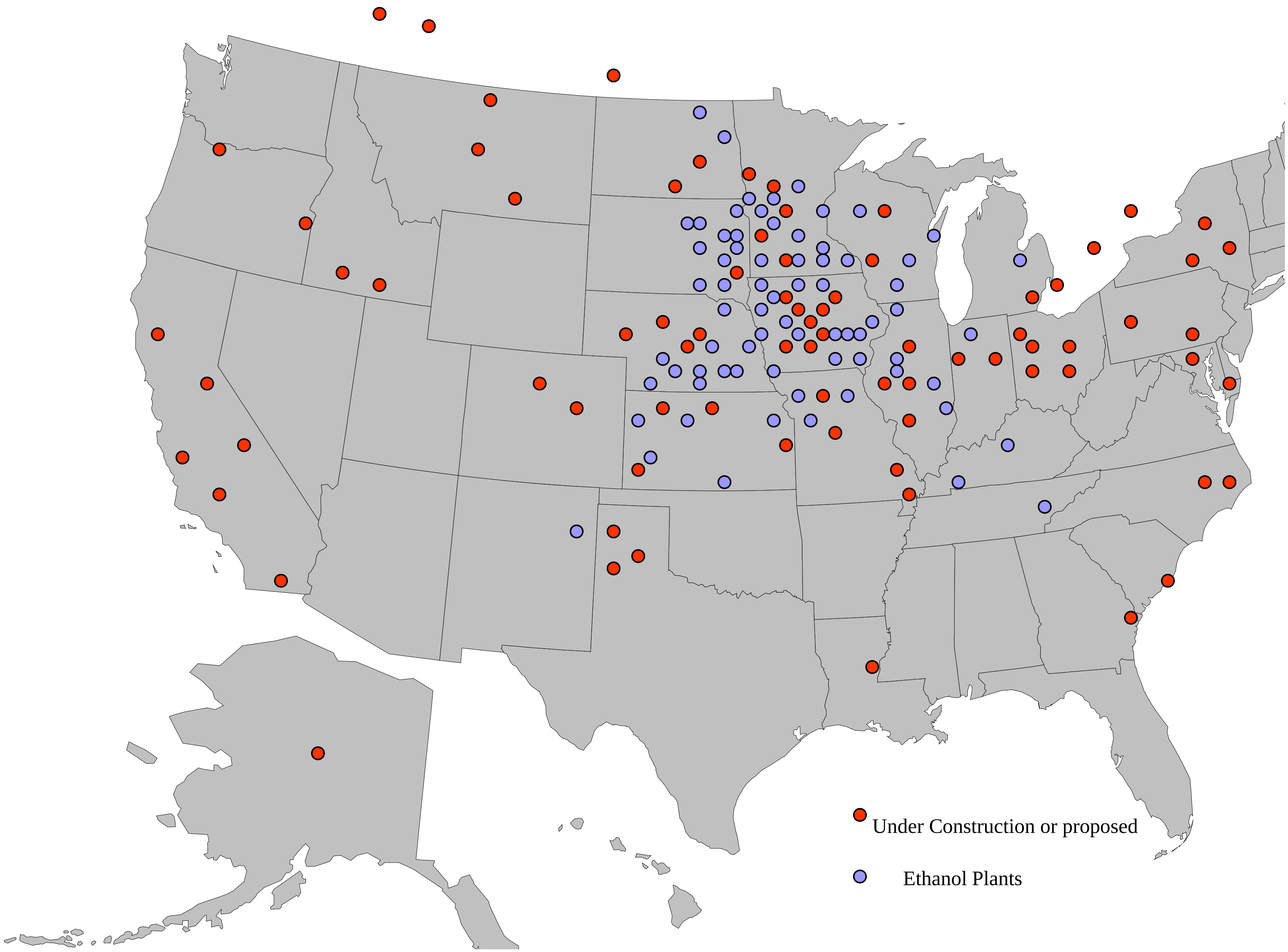
What is DDGS?

- By-product of the dry-grind ethanol industry
- Nutrient composition is **different** between dry-grind, wet-mill and beverage alcohol by-products
  - DDGS – fuel ethanol
  - DDGS - whiskey distilleries
  - Corn gluten feed – wet mill
  - Corn gluten meal – wet mill
  - Brewer's dried grains – beer manufacturing
- Nutrient content depends on the grain source used
  - **Corn DDGS - Midwestern US**
  - Wheat DDGS - Canada
  - Sorghum (milo) DDGS - Great Plains US
  - Barley DDGS

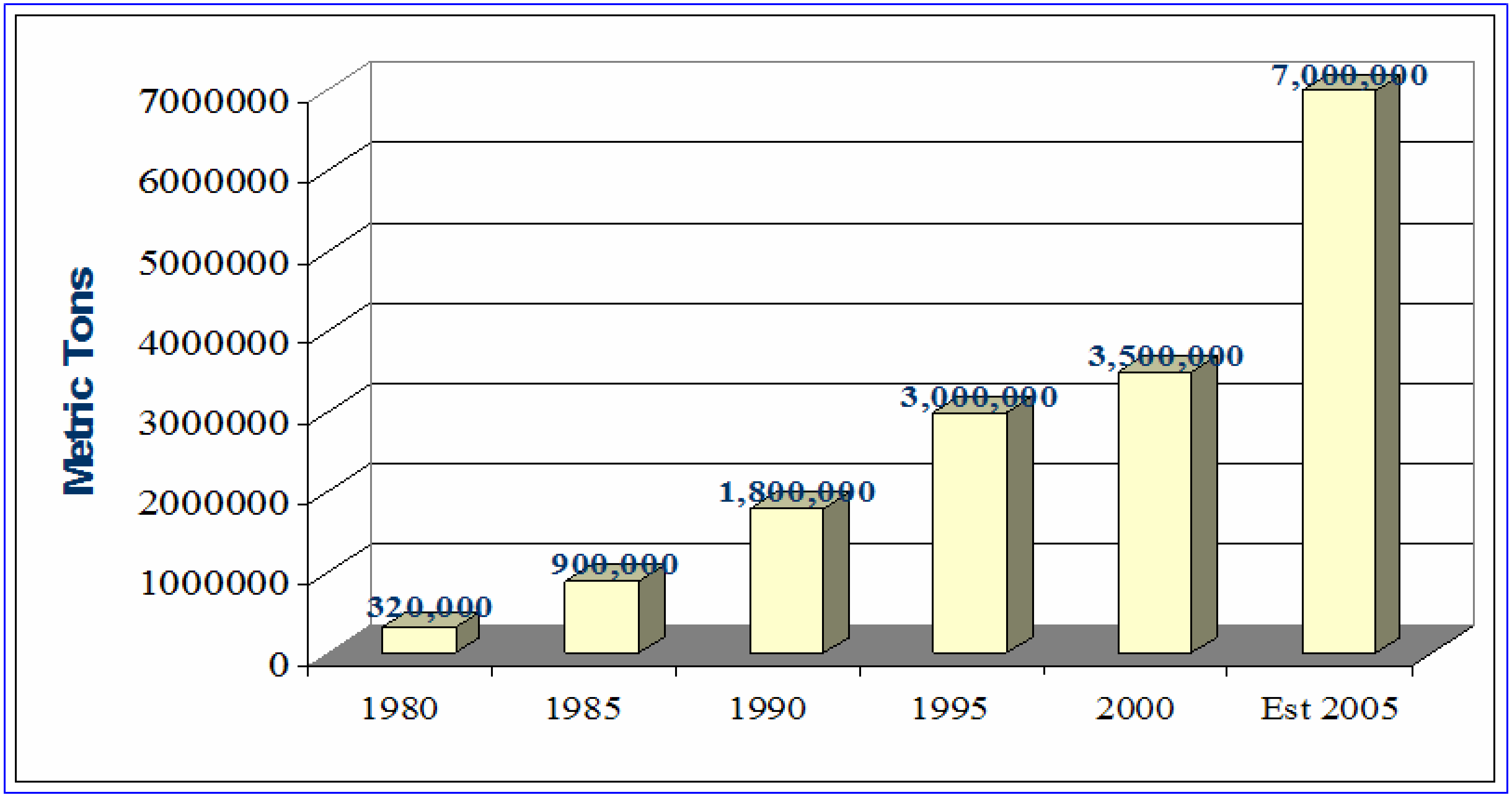
Comparison of Nutrient Composition (Dry Matter Basis) of High Quality Corn DDGS to Corn Gluten Feed, Corn Gluten Meal, Corn Germ Meal, and Brewer's Dried Grains

	"New Generation" Corn DDGS (UM)	Corn Gluten Feed (NRC)	Corn Gluten Meal (NRC)	Corn Germ Meal (Feedstuffs)	Brewer's Dried Grains (NRC)
Protein, %	30.6	23.9	66.9	22.2	28.8
Fat, %	*10.7*	3.3	3.2	1.1	7.9
NDF, %	43.6	37.0	9.7	No data	52.9
DE, kcal/kg	*4011*	3322	4694	No data	2283
ME, kcal/kg	*3827*	2894	4256	3222	2130
Lys, %	0.83	0.70	1.13	1.00	1.17
Met, %	0.55	0.39	1.59	0.67	0.49
Thr, %	1.13	0.82	2.31	1.22	1.03
Trp, %	0.24	0.08	0.34	0.22	0.28
Ca, %	0.06	0.24	0.06	0.33	0.35
Available P, %	*0.80*	0.54	0.08	0.17	0.21

Ethanol Plants in North America - June 16, 2004



U.S. DDGS Production



Source: Steve Markham – Commodity Specialists Company

Samples of High Quality DDGS DDGS from Various Ethanol Plants

VeraSun - Aurora, SD

CVEC - Benson, MN

Al-Corn - Claremont, MN

MGP – Lakota, IA

CMEC - Little Falls, MN

Agri-Energy - Luverne, MN

LSCP - Marcus, IA

DENCO – Morris, MN

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

Proximate Analysis of High Quality Corn DDGS (100% Dry Matter Basis)

Nutrient	“New Generation” DDGS
Dry matter, %	89.2
Crude protein, %	31.6
Crude fat, %	11.5
Crude fiber, %	6.2
Ash, %	7.8
NFE, %	42.8
ADF, %	11.2

Comparison of Swine DE and ME Estimates of DDGS (88% DM basis)

	DE, Mcal/kg	ME, Mcal/kg	NE, Mcal/kg
U of M – New Generation (1999)	3.49	3.37	No data
U of M – Old Generation (1999)[1]	3.41	3.10	No data
KSU – New Generation (2004)[2]	3.87	3.49 – 3.70	2.61
KSU – "Old Generation" (2004)[3]	3.73	3.13 – 3.59	2.45
Hanor-Hubbard-Ajinomoto (2004)[4]	No data	3.25	2.42
NRC (1998)	3.45	2.67	No data

[1] Calculated values
[2] Determined by growth and metabolism trials (source Dakota Gold)
[3] **Not DDGS** but corn gluten from a NE ethanol plant
[4] Determined by growth trials (source Dakota Gold)

Comparison of Amino Acid Composition of DDGS (88% dry matter basis)

	"New" DDGS	"Old" DDGS	DDGS (NRC, 1998)
Lysine, %	0.75 (17.3)	0.47 (26.5)	0.59
Methionine, %	0.63 (13.6)	0.44 (4.5)	0.48
Threonine, %	0.99 (6.4)	0.86 (7.3)	0.89
Tryptophan, %	0.22 (6.7)	0.17 (19.8)	0.24
Valine, %	1.32 (7.2)	1.22 (2.3)	1.23
Arginine, %	1.06 (9.1)	0.81 (18.7)	1.07
Histidine, %	0.67 (7.8)	0.54 (15.2)	0.65
Leucine, %	3.12 (6.4)	2.61 (12.4)	2.43
Isoleucine, %	0.99 (8.7)	0.88 (9.1)	0.98
Phenylalanine, %	1.29 (6.6)	1.12 (8.1)	1.27

Values in ( ) are CV's among plants

Comparison of Apparent Ileal Digestible Amino Acid Composition of DDGS for Swine
(88% dry matter basis)

	"New" DDGS	"Old" DDGS	DDGS (NRC, 1998)
Lysine, %	0.39	0.00	0.27
Methionine, %	0.28	0.21	0.34
Threonine, %	0.55	0.32	0.49
Tryptophan, %	0.13	0.13	0.12
Valine, %	0.81	0.45	0.77
Arginine, %	0.79	0.53	0.77
Histidine, %	0.45	0.26	0.40
Leucine, %	2.26	1.62	1.85
Isoleucine, %	0.63	0.37	0.64
Phenylalanine, %	0.78	0.60	0.96

Comparison of Phosphorus Level and Relative Availability of DDGS for Swine
(88% dry matter basis)

	"New" DDGS	"Old" DDGS	DDGS NRC (1998)	Corn NRC (1998)
Total P, %	0.78 Range 0.62-0.87	0.79	0.73	0.25
P Availability, %	90 Range 88-92	No data	77	14
Available P, %	0.70	No data	0.56	0.03

Physical Characteristics of Corn DDGS

- Bulk density
  - 35.7 ± 2.79 lbs/ft^3
  - Range 30.8 to 39.3 lbs/ft^3

- Particle size
  - 1282 ± 305 microns
  - Range 612 to 2125 microns

Quality Assessment of Corn DDGS

- NIR
- Smell
- Color
- Mycotoxins
- Fat stability

NIR Calibrations for DDGS

Nutrient	R	Rmsep, %	R^2	CV, %
Lysine	0.89	0.064	.79	16.2
Methionine	0.81	0.044	.66	14.2
Threonine	0.73	0.046	.53	6.2
Energy	0.87	37	.76	1.9

R = correlation between actual and predicted values
Rmsep = prediction error
R^2 = proportion of the total variation explained by calibrations
CV, % = coefficient of variation among DDGS samples

DDGS Color and Smell

- Color varies among sources
  - ranges from dark to golden
  - high quality corn DDGS is more golden and color is less variable
  - golden color is correlated with higher amino acid digestibility in swine and poultry
- Smell varies among sources
  - ranges from burnt or smoky to sweet and fermented
  - high quality DDGS has a sweet, fermented smell
  - smell may affect palatability

Mycotoxins

- Risk of mycotoxin contamination in high quality DDGS is very low
  - Poor quality corn = poor ethanol yields
  - Corn supplied to ethanol plants is produced locally
  - Corn produced in upper Midwest is has a low risk for mycotoxins
- Must use thin layer chromatography (TLC) or HPLC for testing mycotoxins in DDGS
  - ELISA and other methods result in false positives

Fat Stability of DDGS

- Limited data
- Mexico
  - DDGS monitored during transit and storage for 16 weeks in a commercial feed mill in Jalisco, Mexico
    - Temperature ranged from 2 to 28 degrees C
    - Average high temperature 25 degrees C
    - Average low temperature was 8.4 degrees C
  - No rancidity was detectable

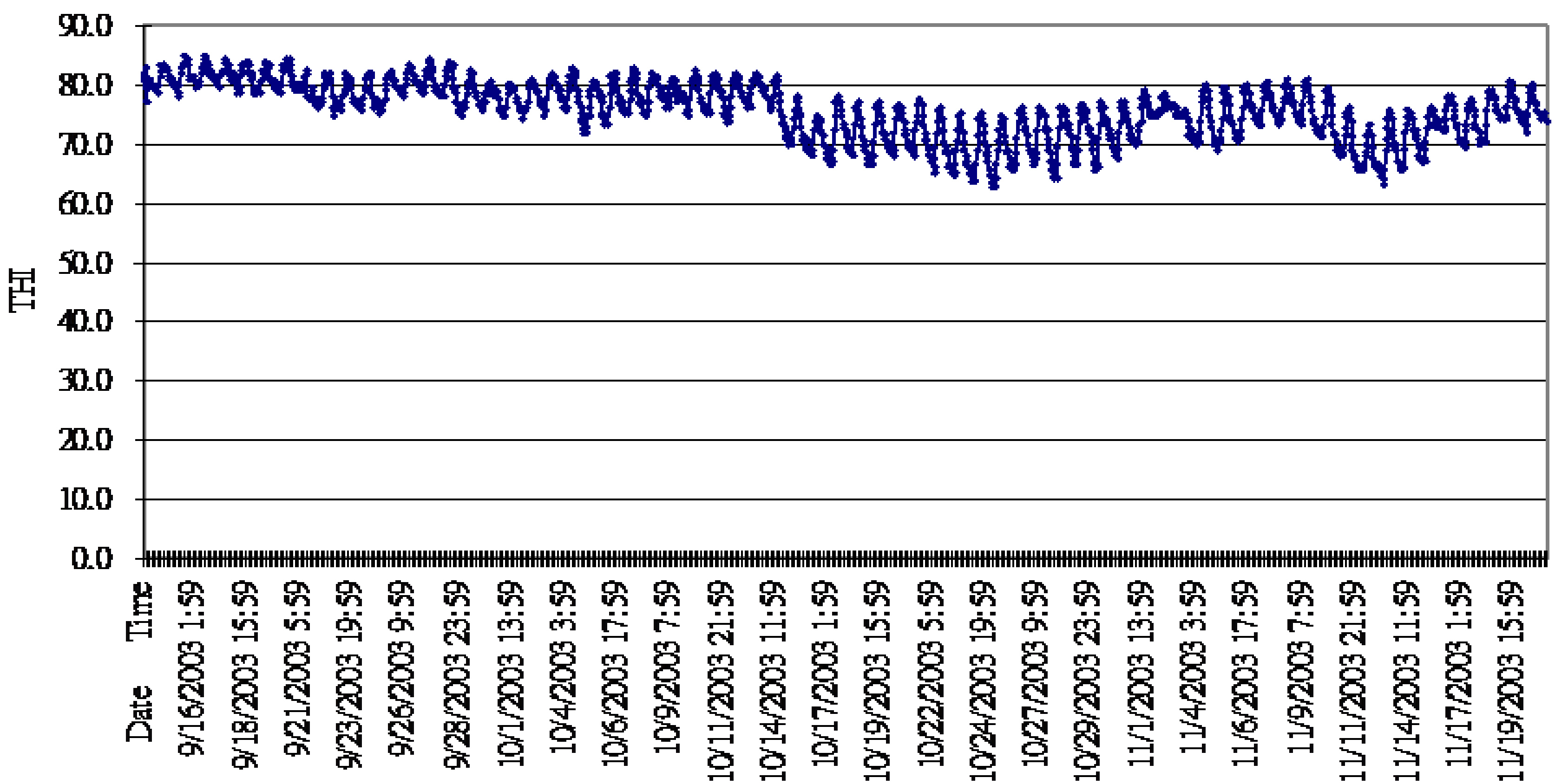
Fat Stability of DDGS in Taiwan

- Study conducted at Lin-Fong-Ying Dairy Farm
  - a commercial dairy farm located about 20 km south of the Tropic of Cancer
  - DDGS was shipped from Watertown, SD to Taiwan in a 40 ft. container
  - upon arrival in Taiwan, DDGS was re-packaged in 50 kg feed bags with a plastic lining
  - DDGS bags were stored in a covered steel pole barn for 10 weeks during the course of the dairy feeding trial

Dr. Yuan-Kuo Chen discussing DDGS sampling procedures from storage bags with his research assistant.

Inside of the covered, steel pole barn used to store bags of DDGS and other forage and feed ingredients at LFY Dairy.

Temperature-Humidity-Index (THI) During the Taiwan DDGS Fat Stability Trial



Fat Stability of DDGS in Taiwan

Analysis	Week 1	Week 10
Peroxide value, mEq/kg	0.70	0.60
Free fatty acids, % as oleic	11.2	16.2

Peroxide values < 5 mEq/kg are considered acceptable for fat quality and there is no oxidative rancidity.

Why is there so much interest in feeding high quality DDGS to swine?

- Golden DDGS is high in digestible nutrients
- Economical partial replacement for:
  - corn
  - soybean meal
  - dicalcium phosphate
- Increasing production and supply
- Unique properties
  - reduce P excretion in manure
  - increase litter size weaned/sow
  - gut health benefits

Maximum Inclusion Rates of Golden 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 20%

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

Quick Calculation of Feed Cost Savings

Thumb rule:

Additions/1000 kg diet

+ 100 kg DDGS x ______ $/kg = $______
+ 1.5 kg limestone x ______ $/kg = $______
TOTAL ADDITIONS (A) $______

Subtractions/1000 kg diet

- 88.5 kg corn x ______ $/kg = $______
- 10 kg SBM (44%) x ______ $/kg = $______
- 3 kg dical. phos. x ______ $/kg = $______
TOTAL SUBTRACTIONS (S) $______

(S – A) = Feed cost savings/ton by adding 10% DDGS to the diet

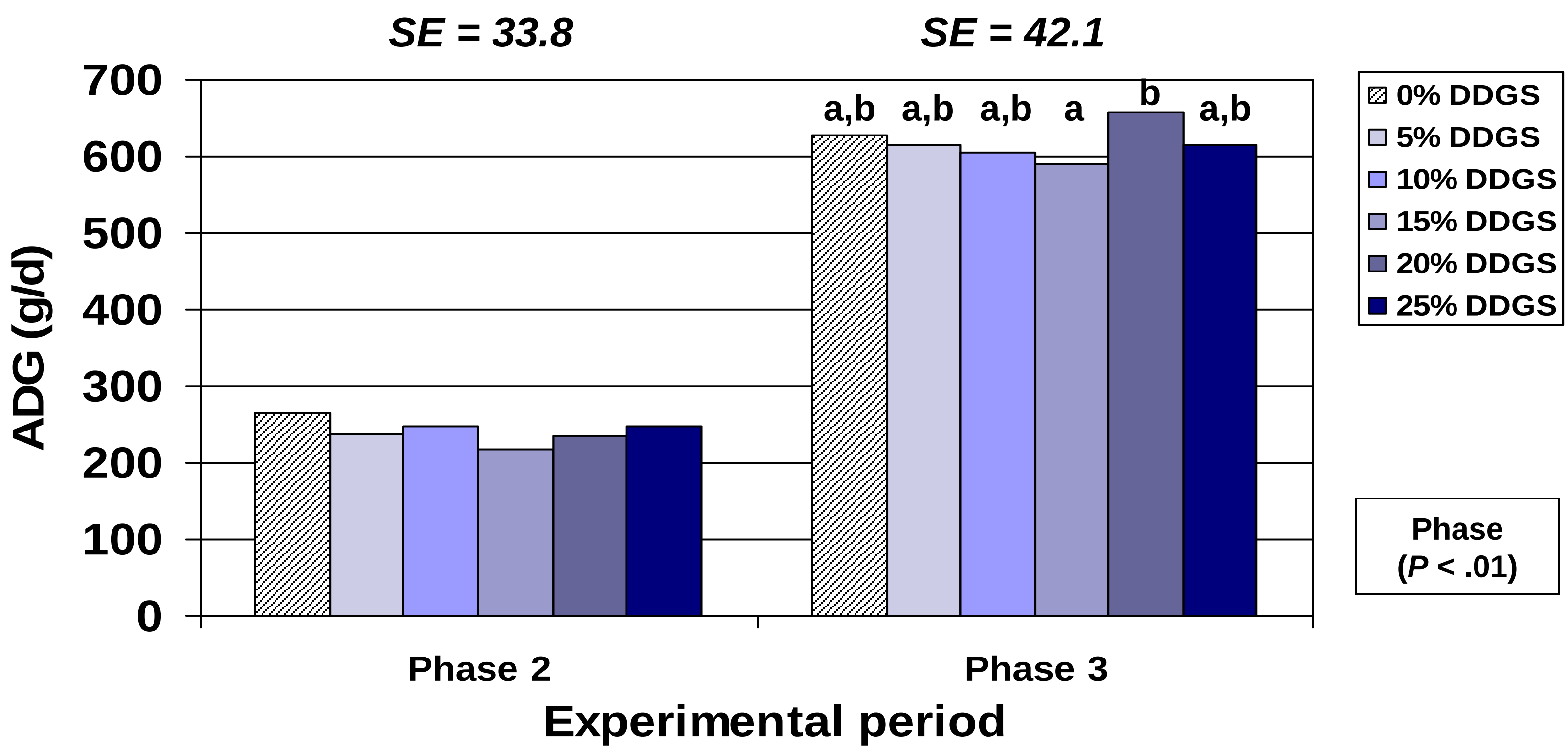
Feeding High Quality DDGS to Weaned Pigs

Materials and Methods – 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)

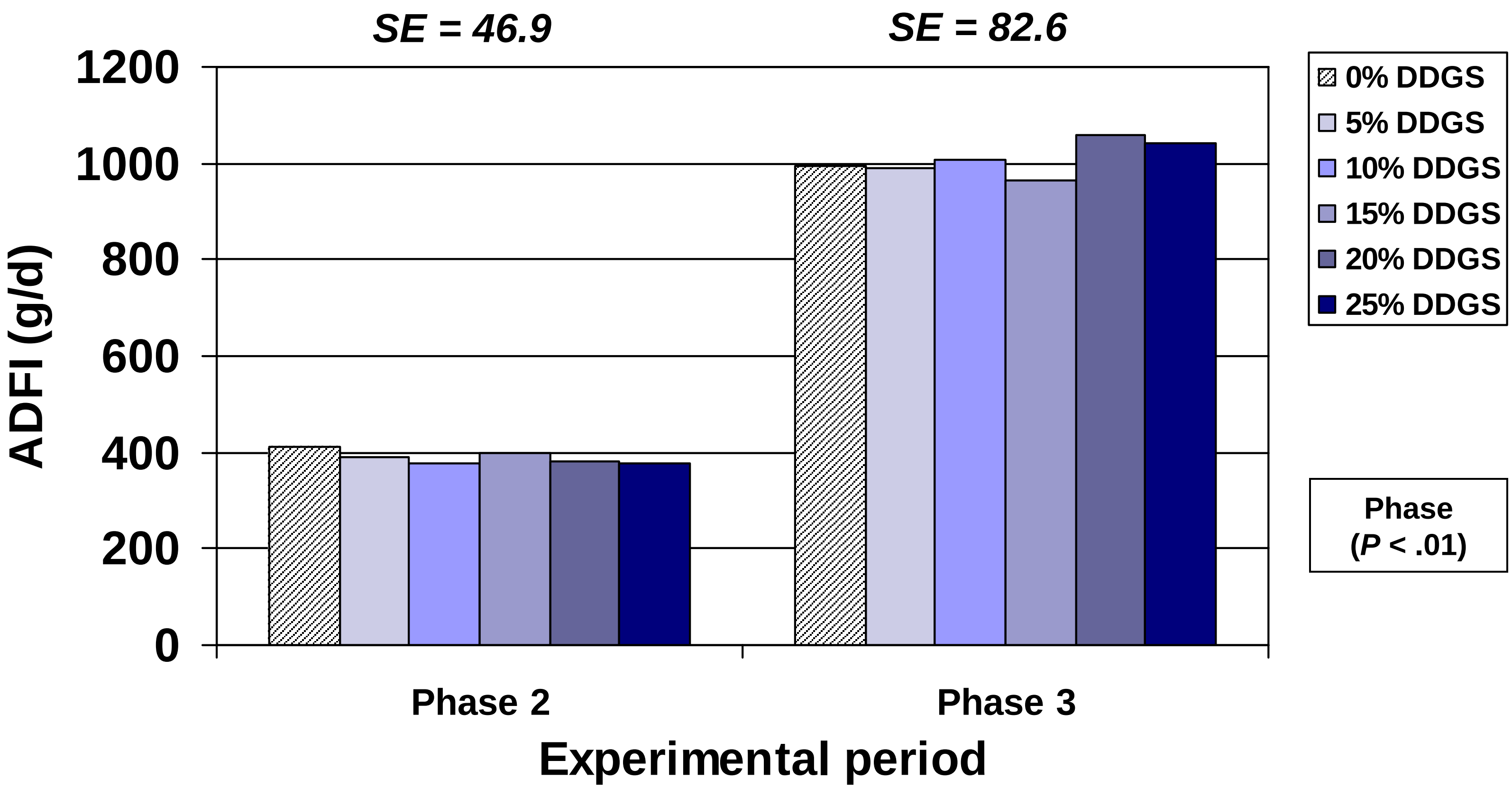
- Phase II (d 4-17) and Phase III (d 18 – 35) diets were **formulated on a digestible amino acid basis.**
  - Diets contained 0, 5, 10, 15, 20, or 25% DDGS

Effect of DDGS Level on Growth Rate (Experiment 1)

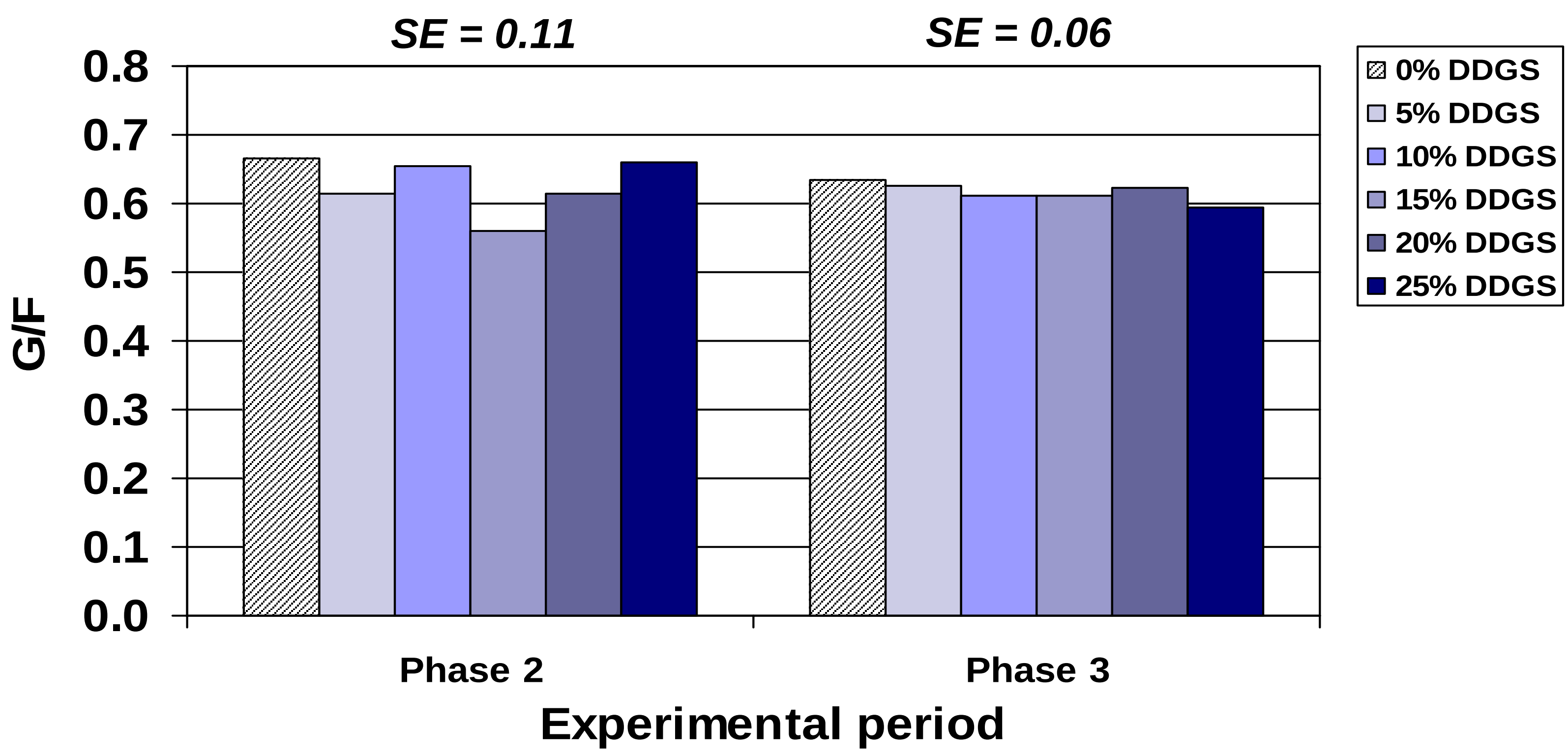


Means not sharing a common superscript letter are significantly different ($P < .05$)

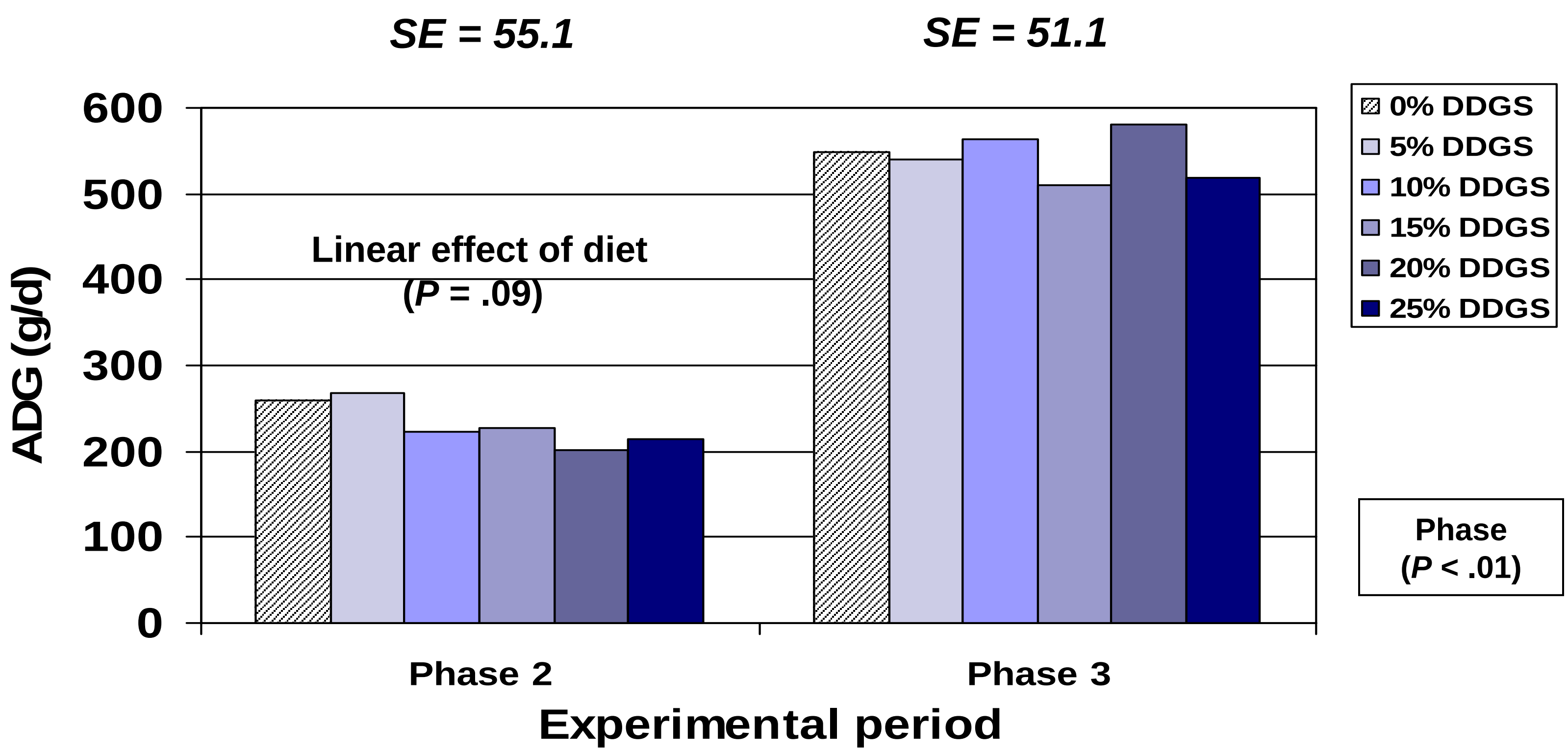
Effect of DDGS Level on ADFI (Experiment 1)



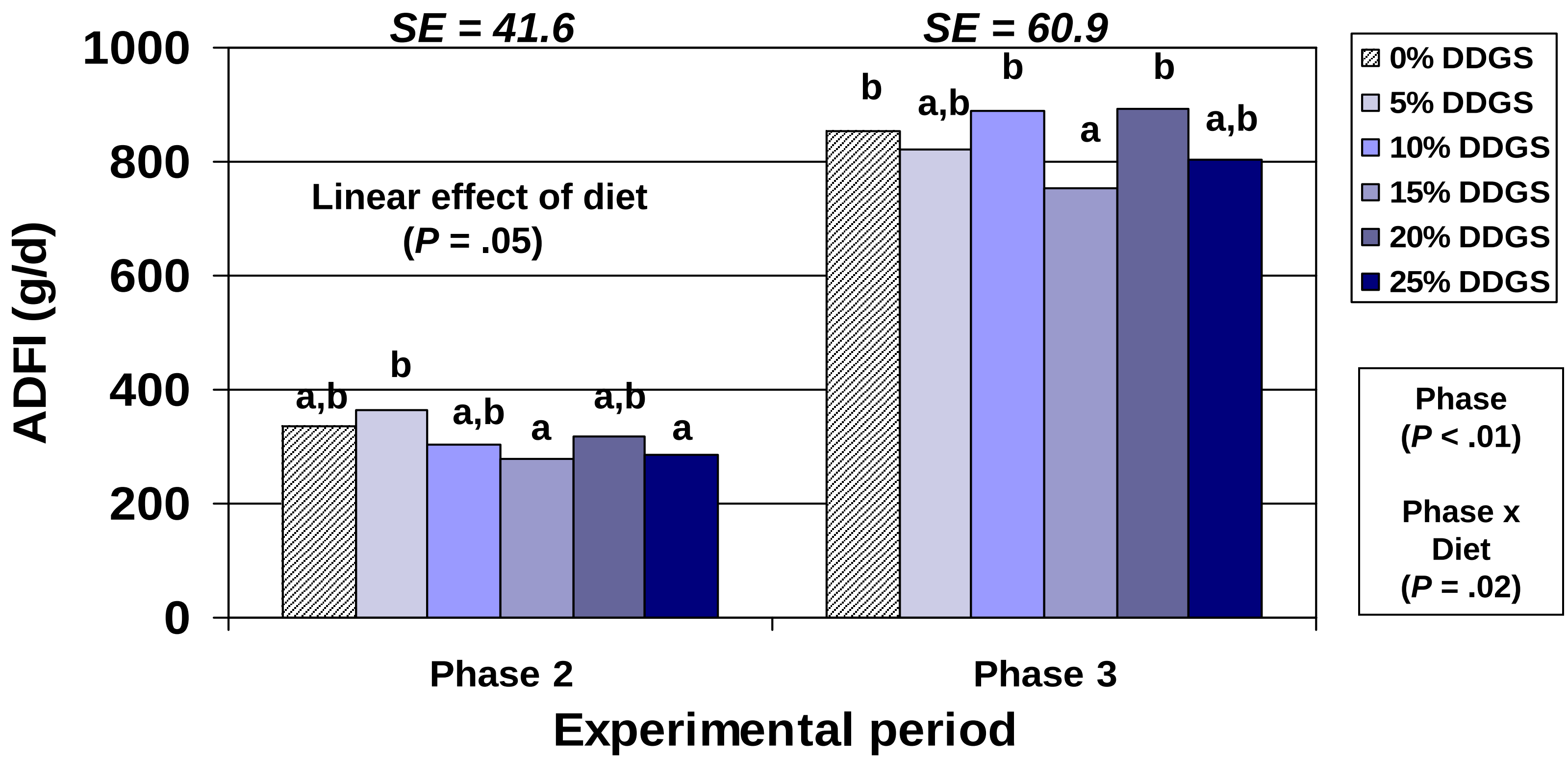
Effect of DDGS Level on Gain/Feed (Experiment 1)



Effect of DDGS Level on Growth Rate (Experiment 2)

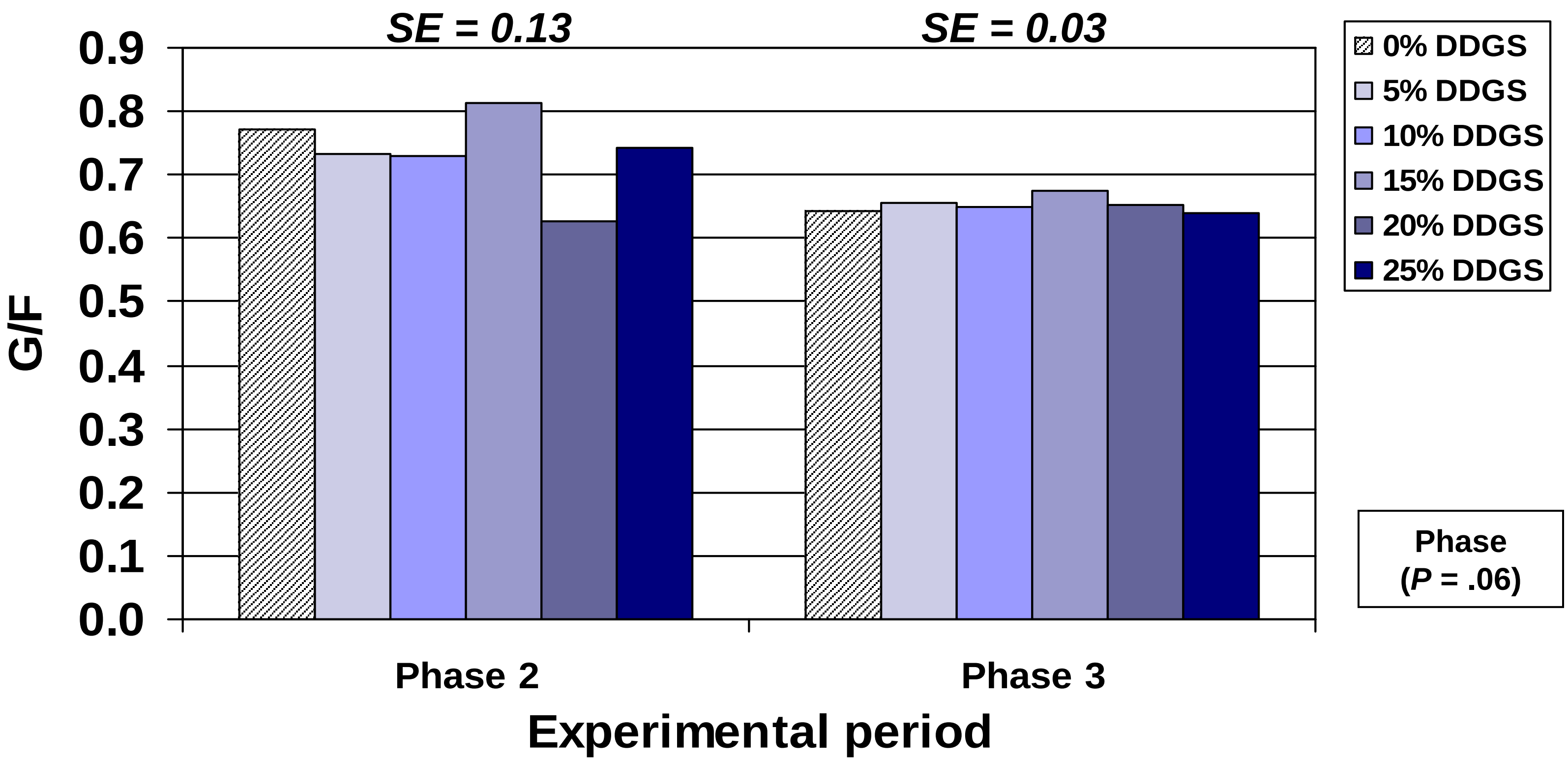


Effect of DDGS Level on Feed Intake (Experiment 2)

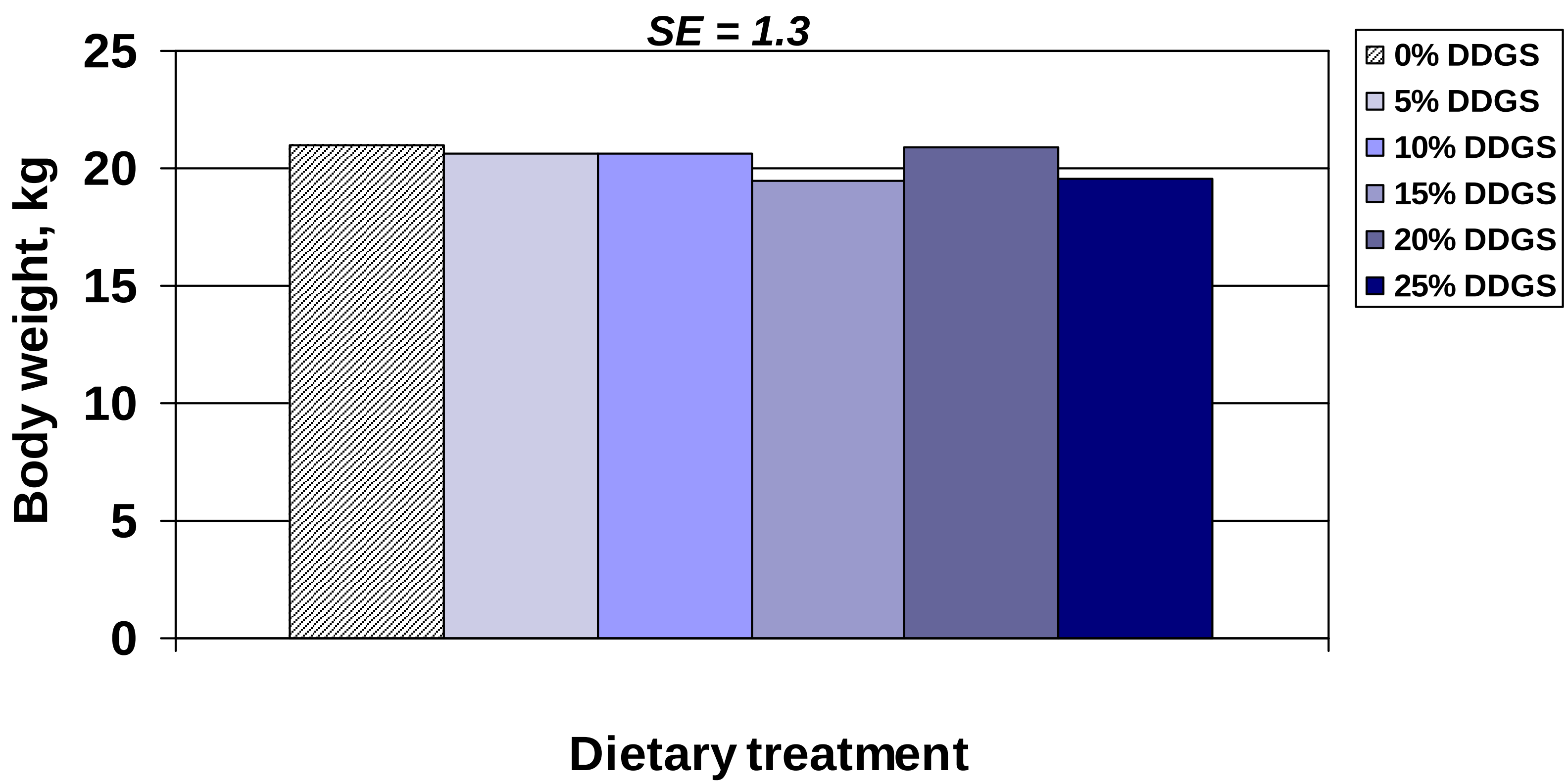


Means not sharing a common superscript letter are significantly different ($P < .05$)

Effect of DDGS Level on Gain/Feed (Experiment 2)



Effect of DDGS Level on Final BW (Experiment 2)

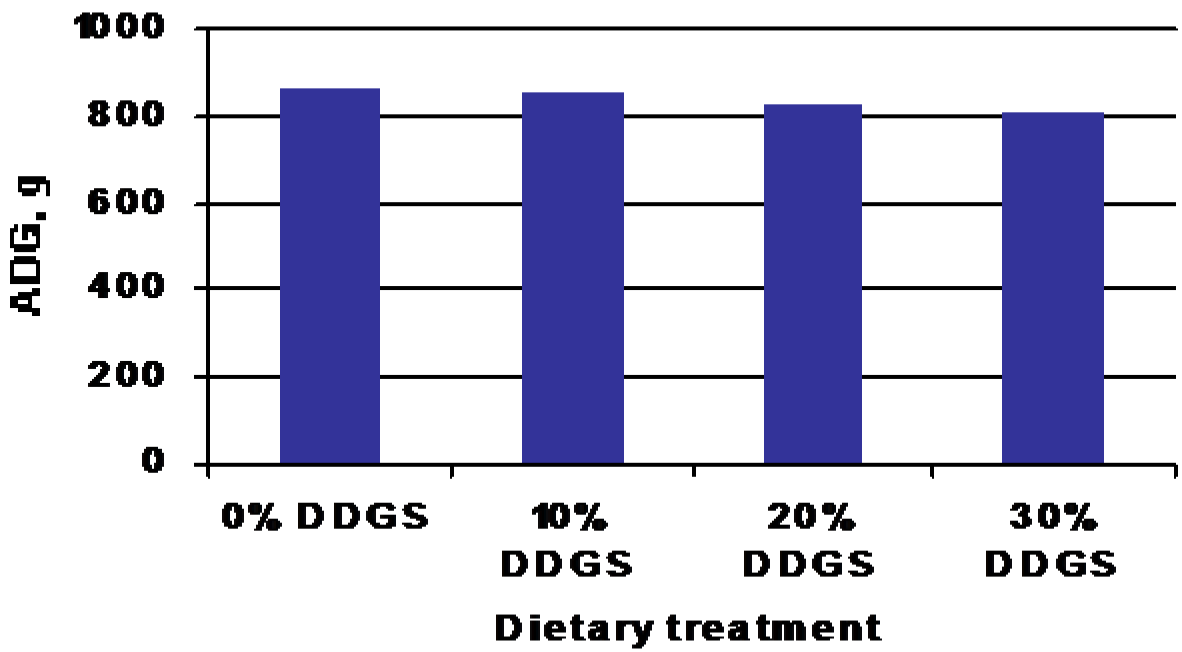


Feeding High Quality DDGS to Grow-Finish Pigs

Materials and Methods

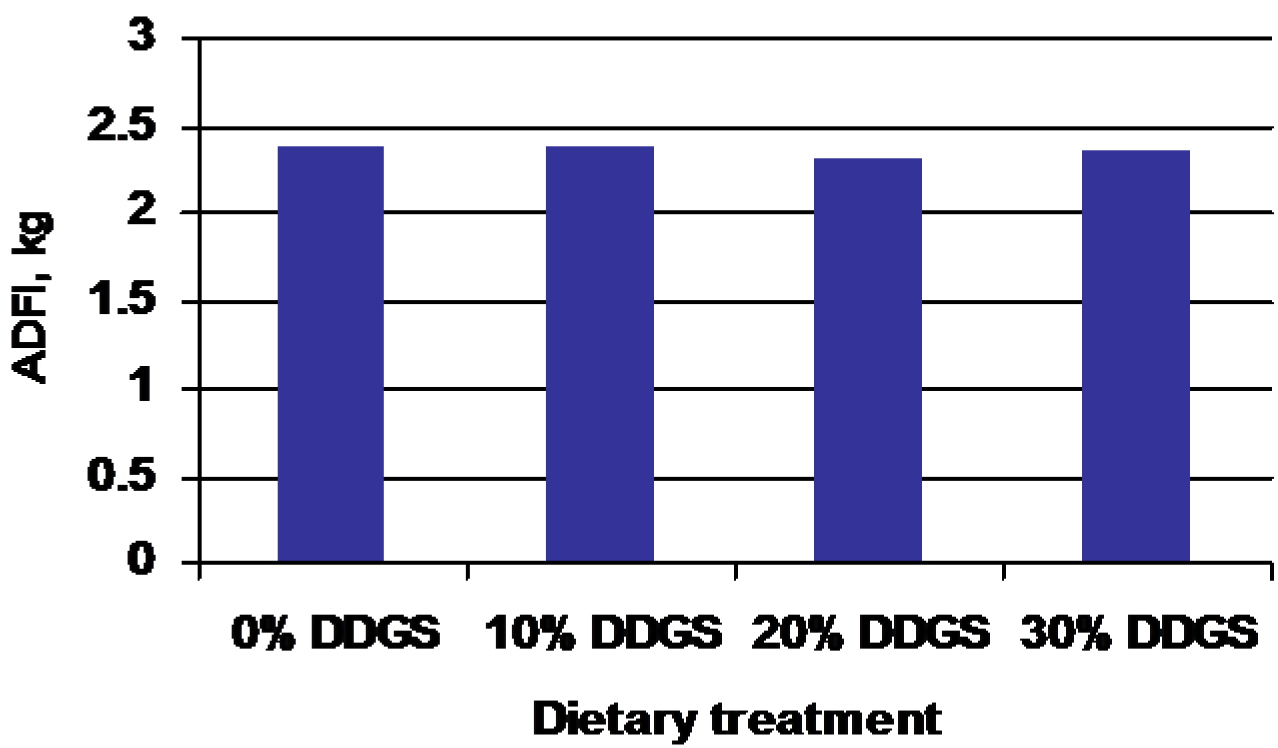
- 240 crossbred pigs (approx. 28.3 kg BW)
  - Grow-finish facilities at WCROC – Morris, MN
  - Blocked by weight, gender and litter
  - Blocks randomly assigned to 1 of 4 diet sequences
    - 5-phase feeding program
  - 0, 10, 20, or 30% DDGS diets **formulated on total lysine basis**
  - 24 pens, 10 pigs/pen, 6 replications/trt

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



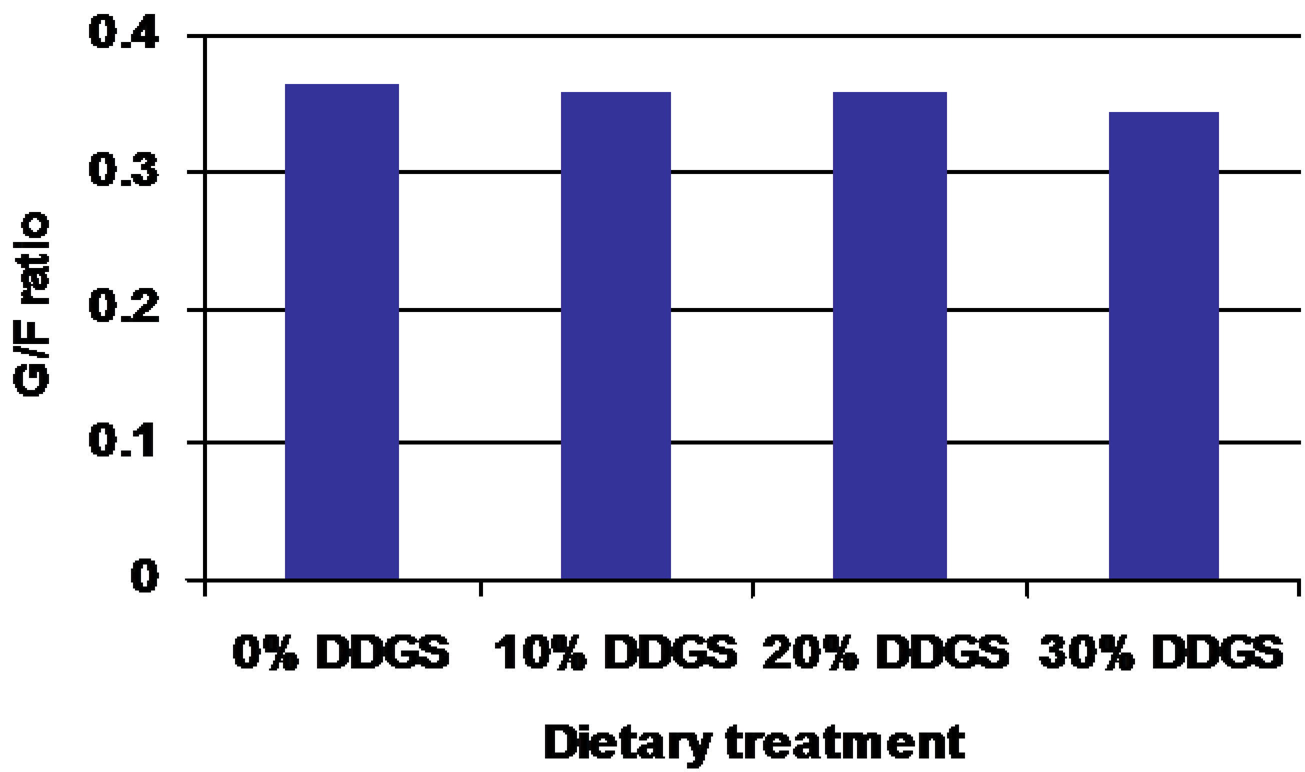
0 % and 10 % DDGS > 20% and 30% DDGS (P < .10)

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



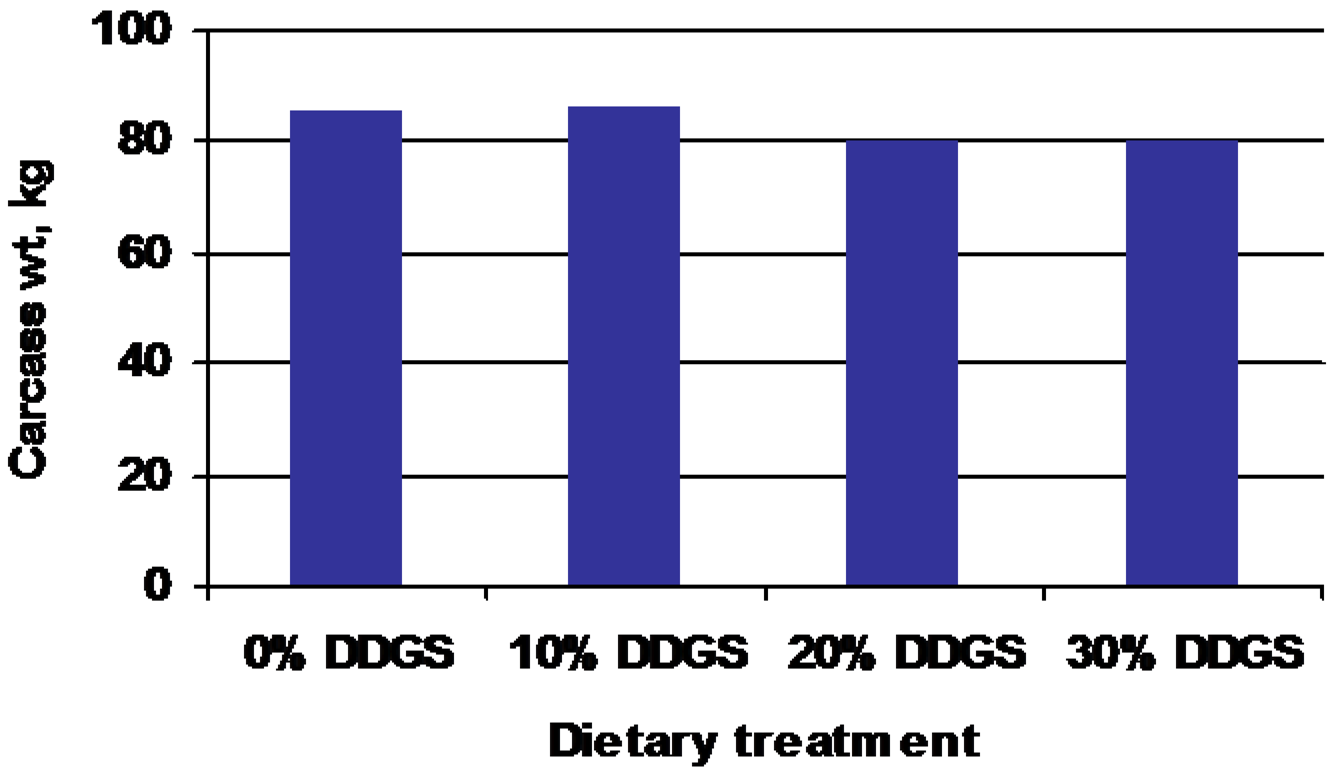
No significant differences among dietary treatments

Effect of Dietary DDGS Level on Overall G/F of Grow-Finish Pigs



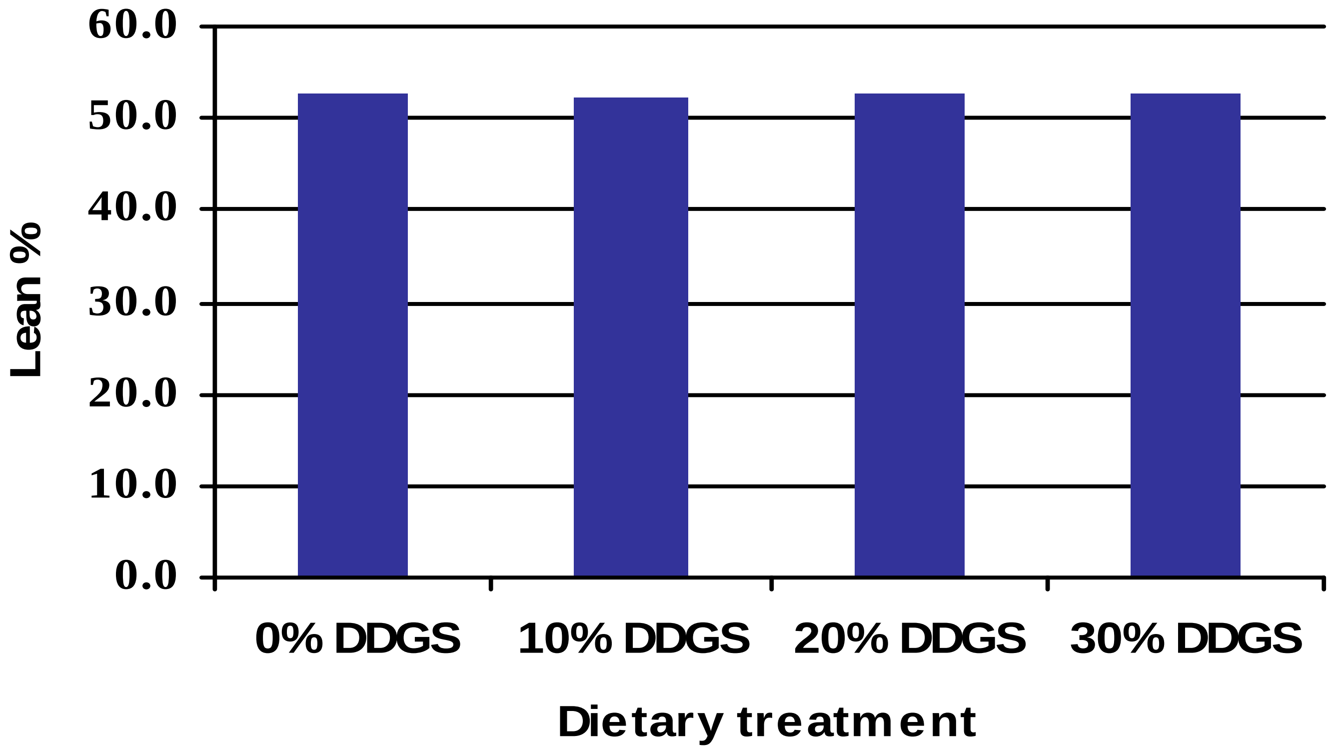
0 %, 10 % and 20% DDGS > 30% DDGS (P < .10)

Effect of Dietary DDGS Level on Carcass Weight



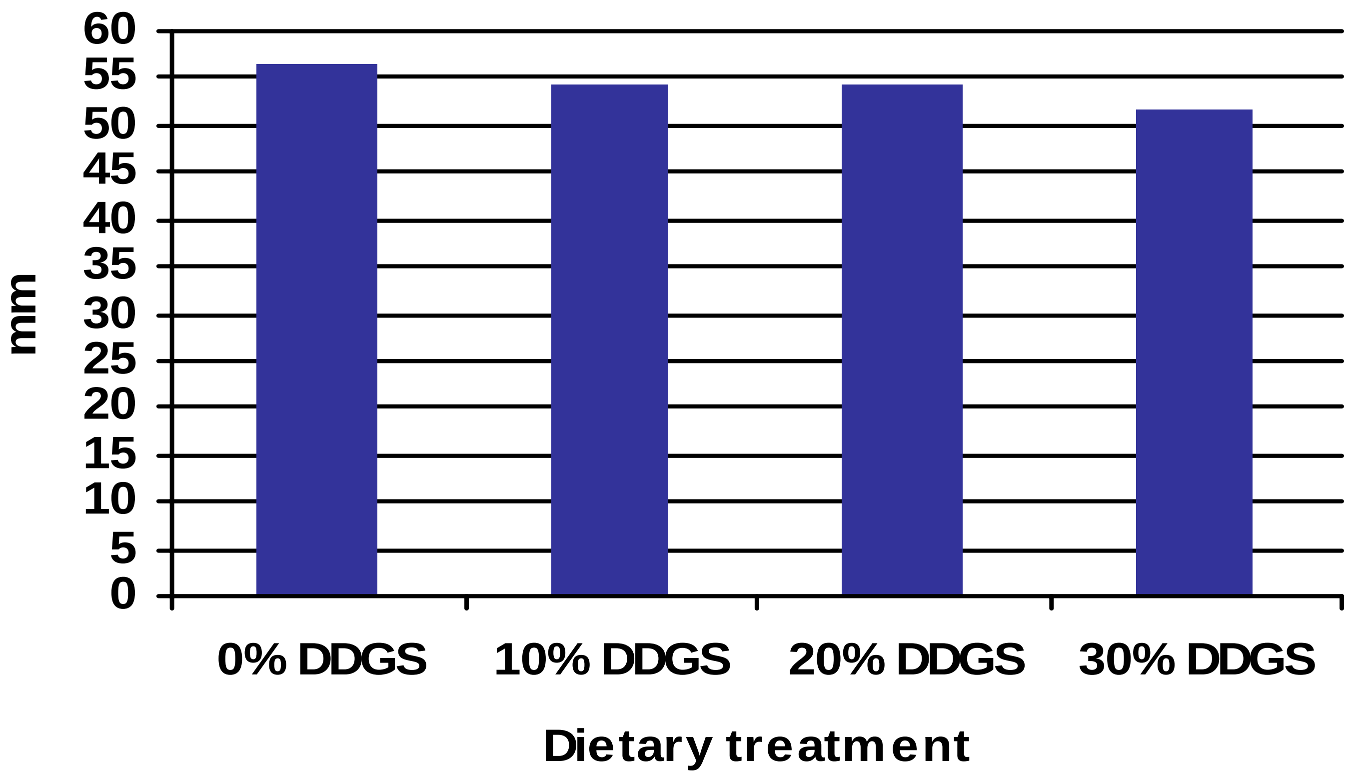
0 % and 10 % DDGS > 20% and 30% DDGS (P < .01)

Effect of Dietary DDGS Level on % Carcass Lean



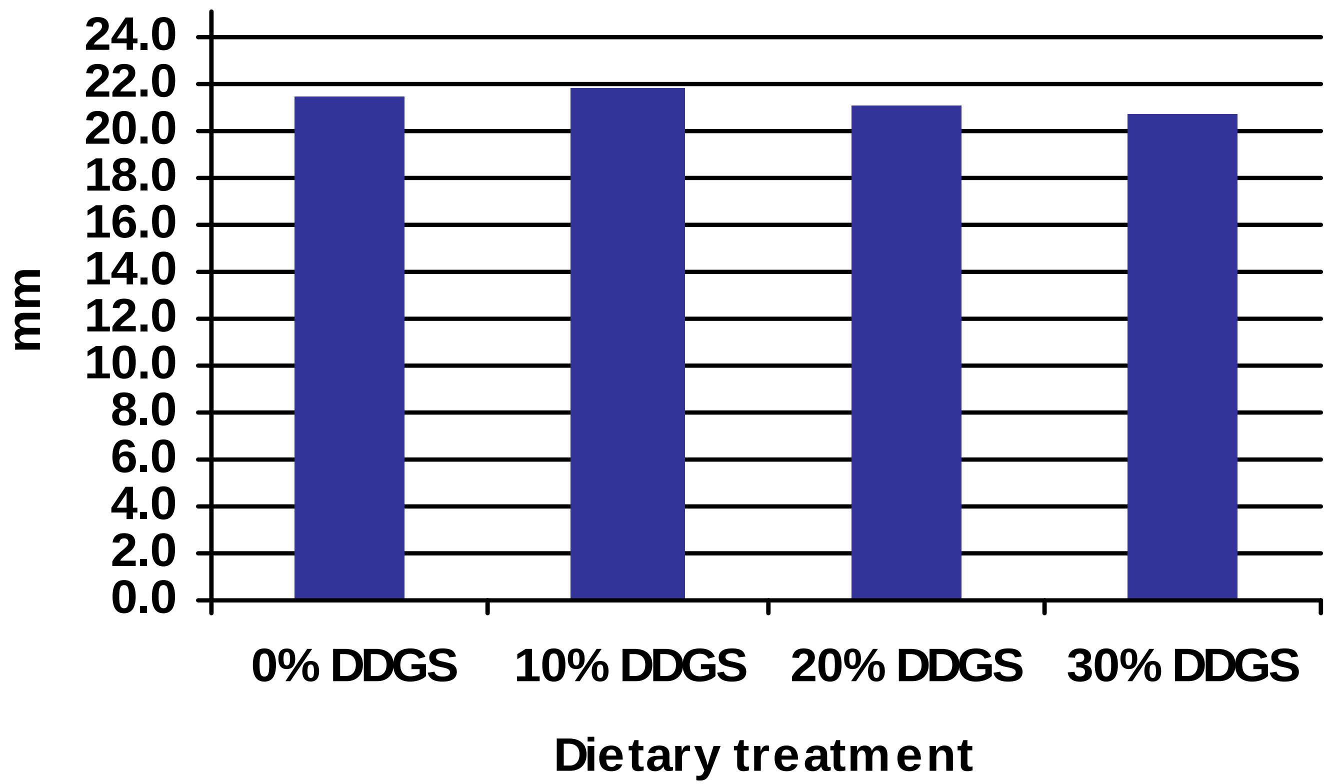
No significant differences among dietary treatments

Effect of Dietary DDGS Level on Carcass Loin Depth



Linear decrease with increasing dietary level of DDGS (P < .02)

Effect of Dietary DDGS Level on Carcass Backfat Depth



No significant differences among dietary treatments

Muscle Quality Characteristics from G-F Pigs Fed Diets Containing 0, 10, 20, and 30% DDGS

Trait	0 %	10 %	20 %	30 %	RMSE
L*[a]	54.3	55.1	55.8	55.5	2.9
Color score[b]	3.2	3.2	3.1	3.1	0.8
Firmness score[c]	2.2	2.0	2.1	2.1	0.5
Marbling score[d]	1.9	1.9	1.7	1.9	0.6
Ultimate pH	5.6	5.6	5.6	5.6	0.2
11-d purge loss, %	2.1[f]	2.4[fg]	2.8[g]	2.5[fg]	1.2
24-h drip loss	0.7	0.7	0.7	0.7	0.2
Cooking loss, %	18.7	18.5	18.3	18.8	2.6
Total moisture loss[e], %	21.4	21.5	21.8	22.1	3.1
Warner-Bratzler sheer force, kg	3.4	3.4	3.3	3.3	0.5

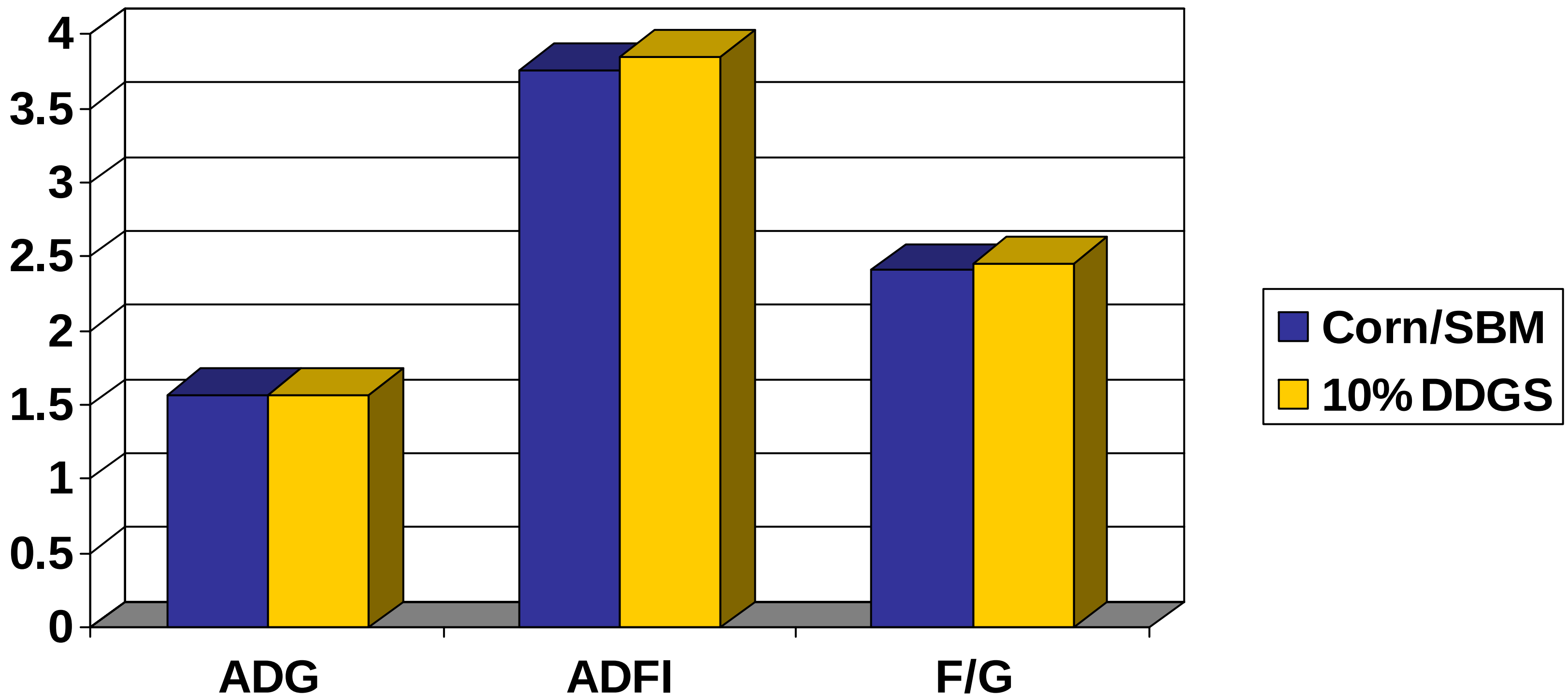
[a] 0 = black, 100 = white
[b] 1=pale pinkish gray/white; 2=grayish pink; 3=reddish pink; 4=dark reddish pink; 5=purplish red; 6=dark purplish red
[c] 1 = soft, 2 = firm, 3 = very firm
[d] Visual scale approximates % intramuscular fat content (NPPC, 1999)
[e] Total moisture loss = 11-d purge loss + 24-h drip loss + cooking loss

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 ($P < .05$).

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

Typical Grow-Finish Pig Performance in a 1000 Head Commercial Finishing Barn

Grow-Finish Pigs Fed Diets Containing DDGS

	No DDGS	10% DDGS
Pigs in	993	988
Pigs Out	979	971
Daily Gain, lb	1.63	1.62
Feed:Gain	2.75	2.74
Feed cost, $/hd	$32.69	$32.53

Source: Land O'Lakes Farmland Feed

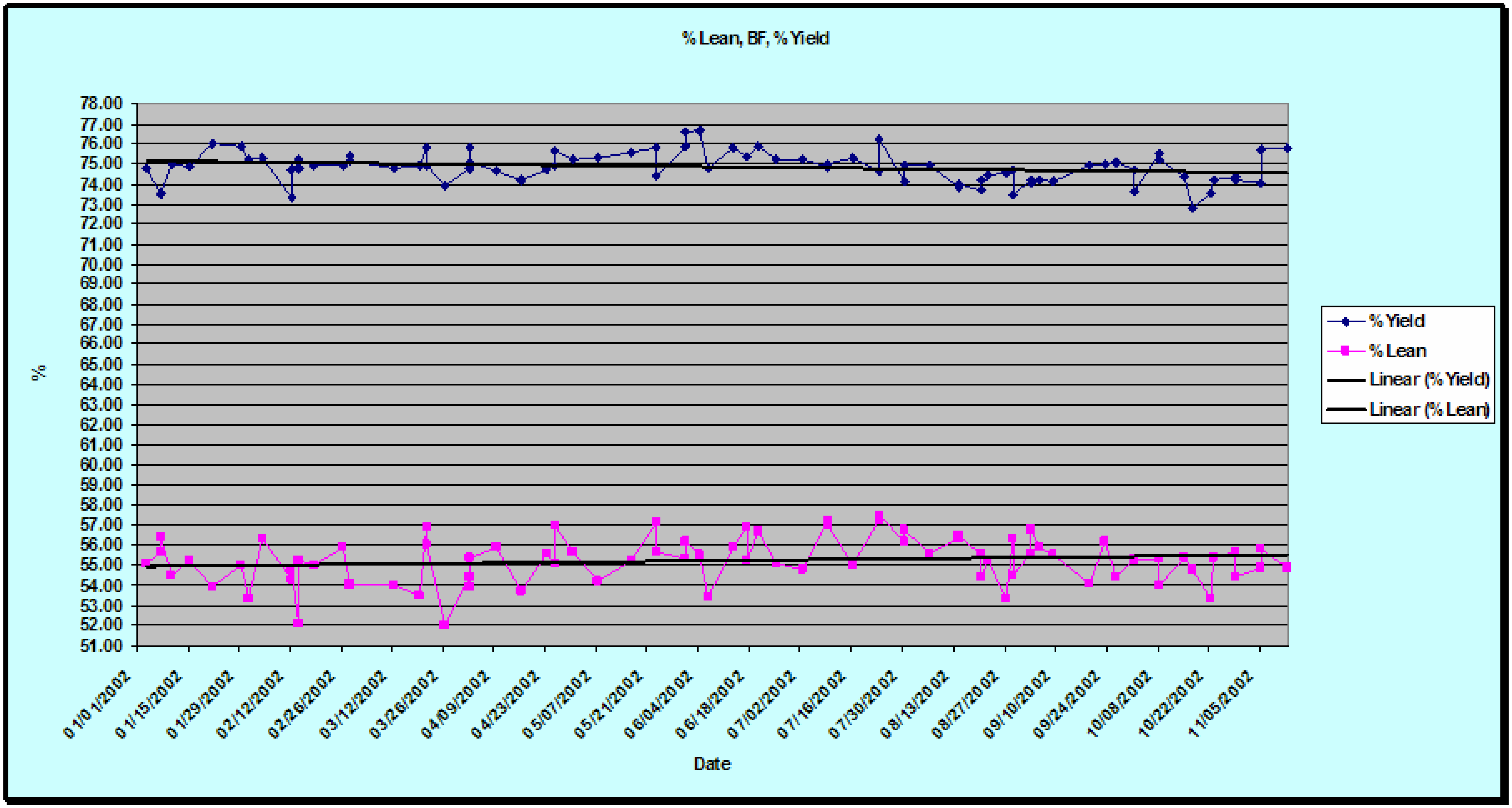
Actual Close-Outs on Commercial Swine Finishing Operations

	# in	# out	Wt in	Wt out	DL	ADG	F/G	ADC	Days
Farm 1:									
Averages			58.7	253.0	3.35	1.71	2.79	4.79	113
Total head	24,676	23,852							
Farm 2:									
Averages			47.2	265.2	2.88	1.75	2.86	5.00	124
Total head	8,798	8,545							
Farm 3:									
Averages			51.5	259.2	2.33	1.74	2.76	4.82	119
Total head	13,887	13,563							

Source: Land O'Lakes Farmland Feed

Carcass Yield and % Lean of Pigs Fed 10% DDGS Diets on a Commercial Swine Operation in 2002

(10% DDGS was added to diets mid-year)



Source: Land O' Lakes

Does Feeding DDGS Improve Gut Health?

What is Ileitis?

- Porcine Proliferative Enteropathy
- Caused by *Lawsonia intracellularis*
  - Present in 96% of U.S. swine herds (Bane et al., 1997)
    - 28% of pigs affected (NAHMS, 2000)
  - Can be shed in infected pigs for up to 10 weeks
- Animals are infected by oral contact with feces from animals shedding the bacteria
- 7-10 days after infection:
  - Lesions of the intestinal wall begin to form
  - Lesions maximized around 21 days post-infection

Clinical Forms of Ileitis

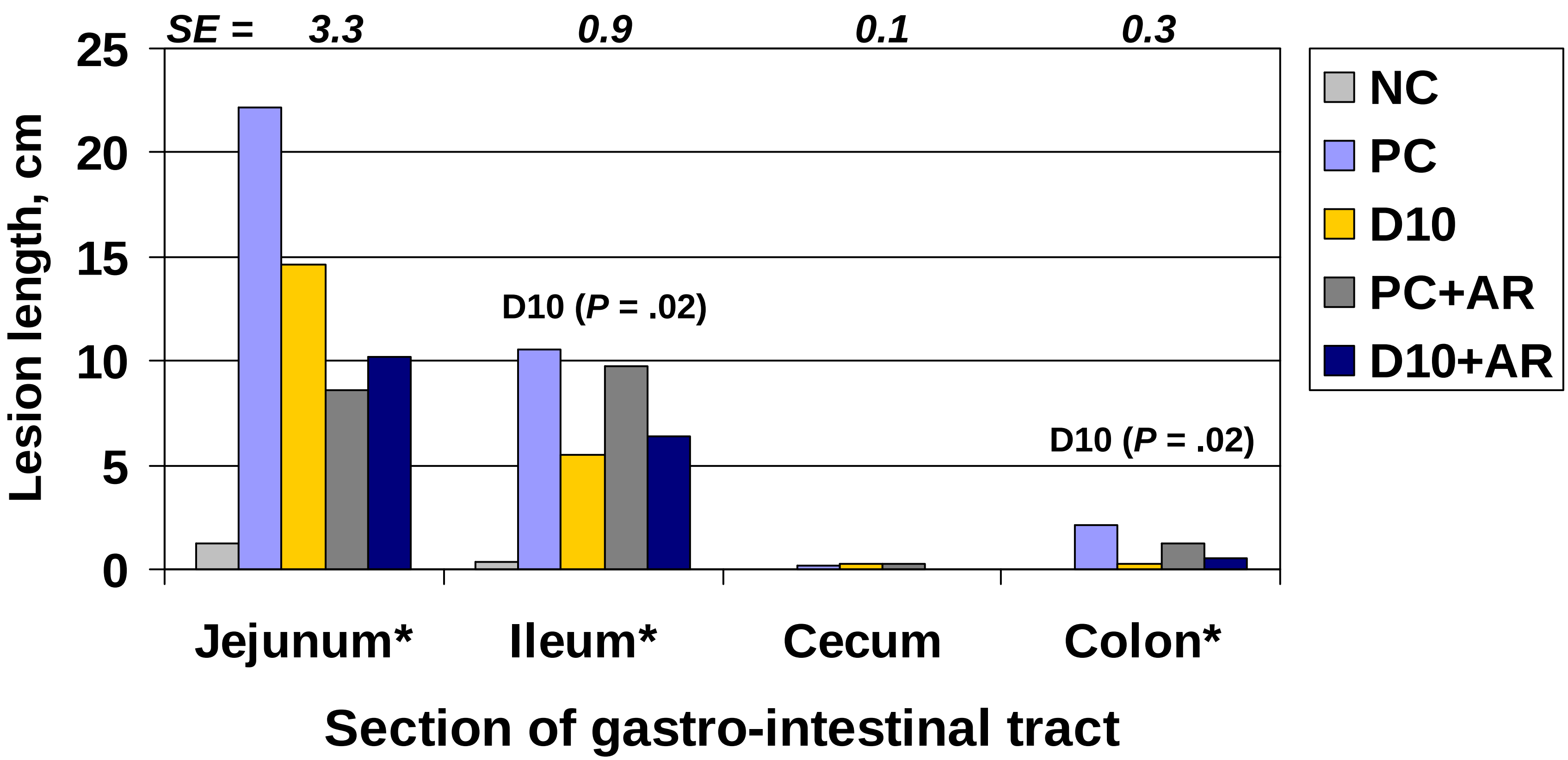
- Porcine Intestinal Adenomatosis (PIA)
  - Chronic form
  - Seen in growing pigs (6 - 20 weeks of age)
  - Decreased feed intake, lethargic

- Porcine Hemorrhagic Enteropathy (PHE)
  - Acute form, affects heavier pigs
    - Greatest frequency appears to be from 65 – 110 kg pigs
  - Massive intestinal hemorrhaging, bloody diarrhea, increase in mortality

Healthy

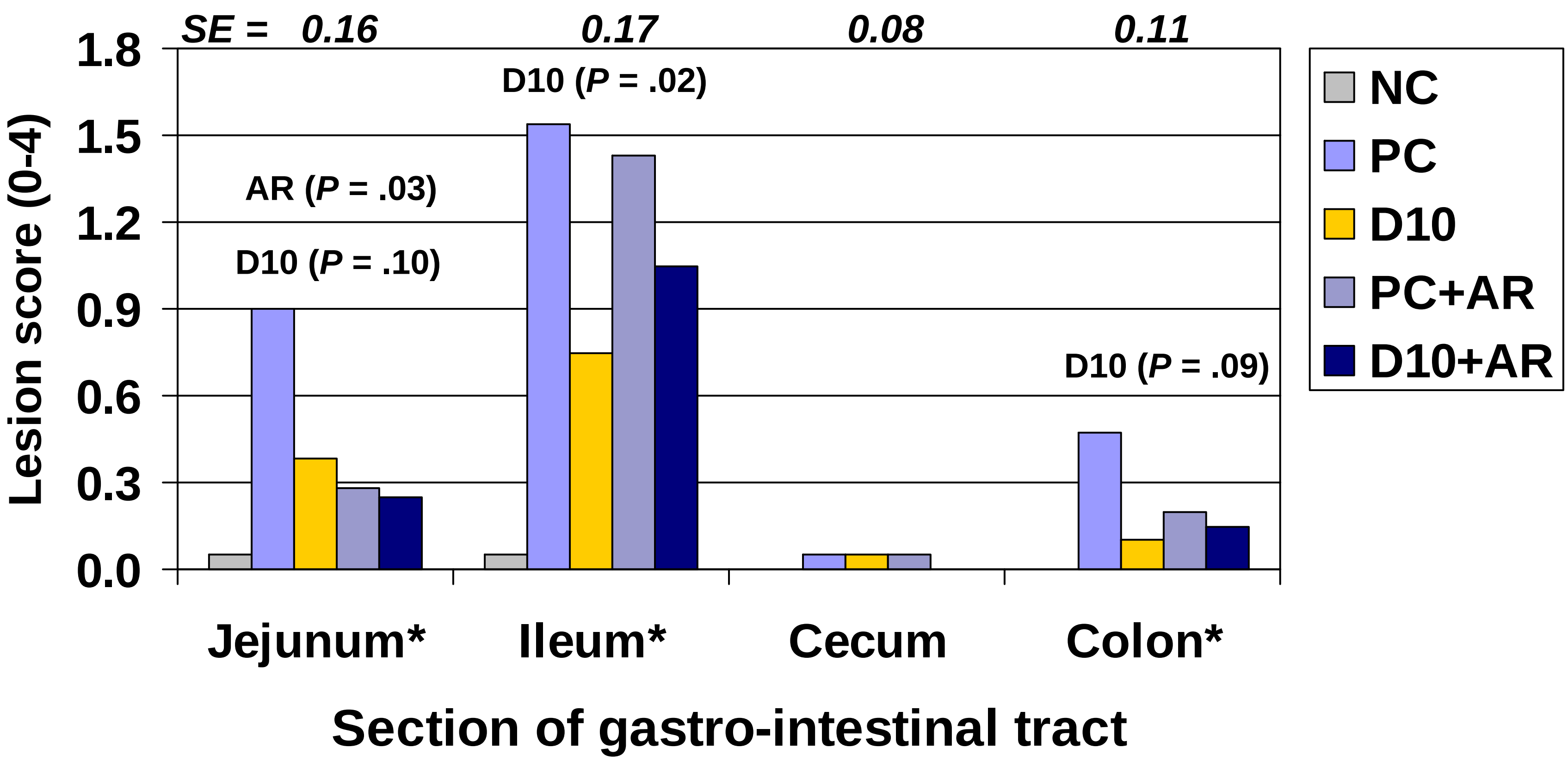
Ileitis

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



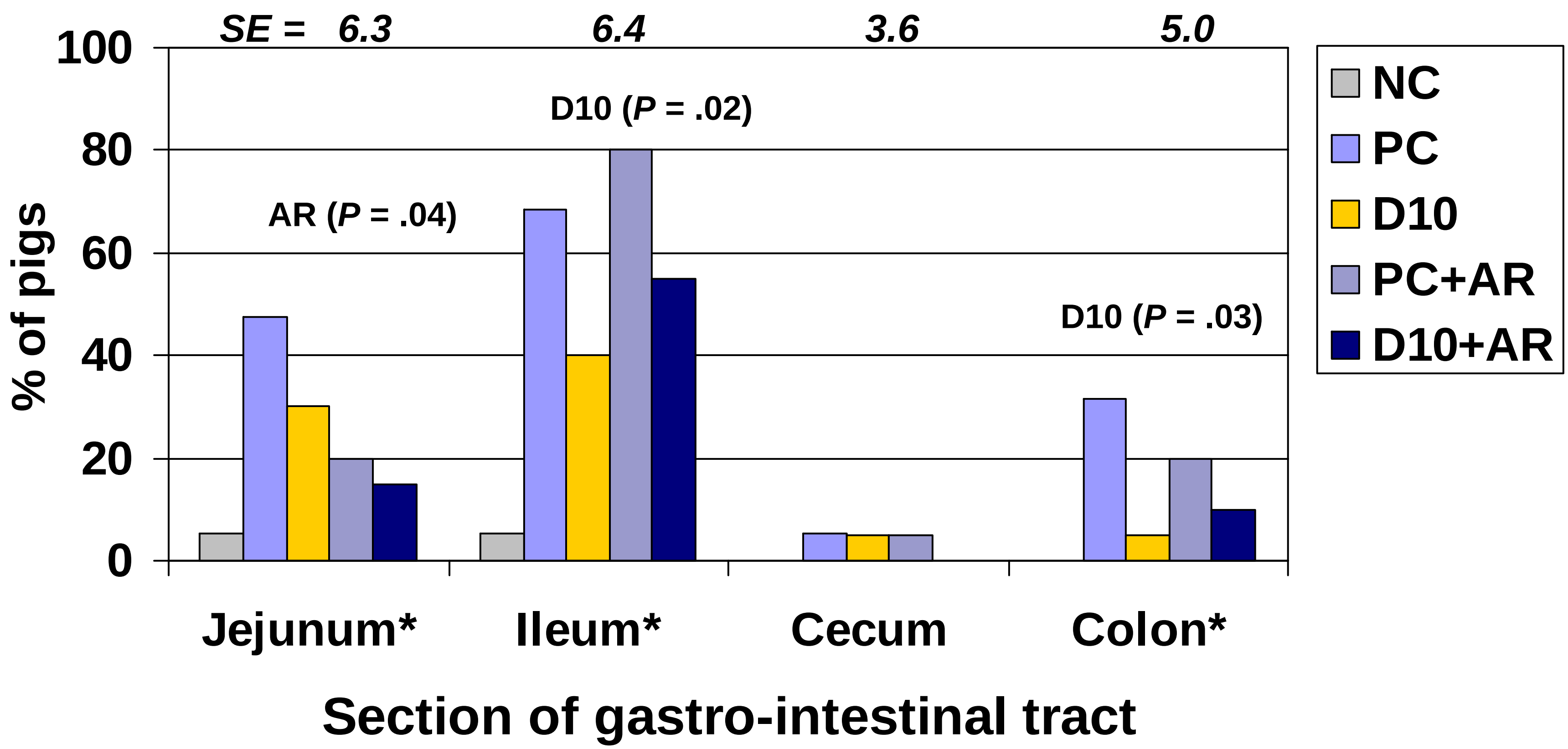
* Effect of disease challenge (P < .01).

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



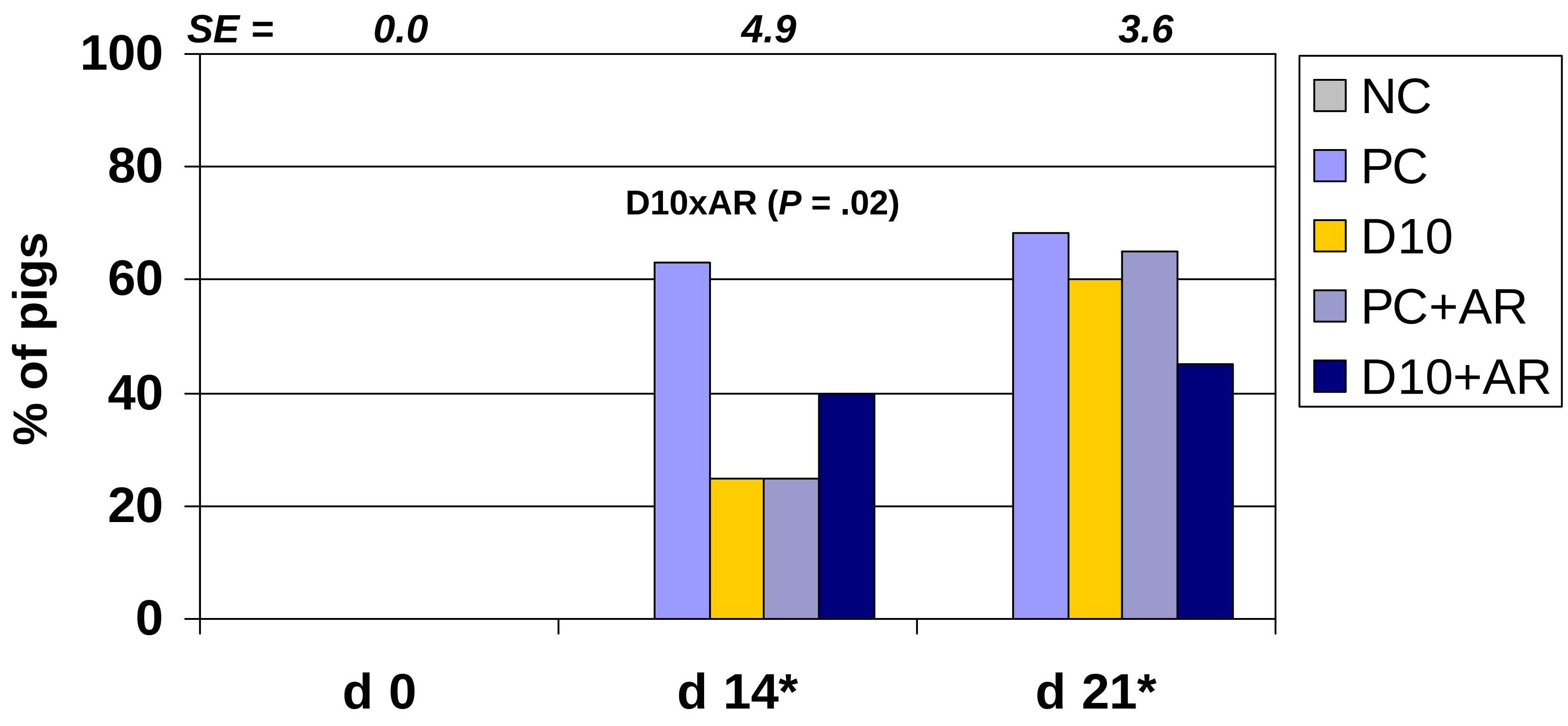
* Effect of disease challenge ($P < .01$).

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



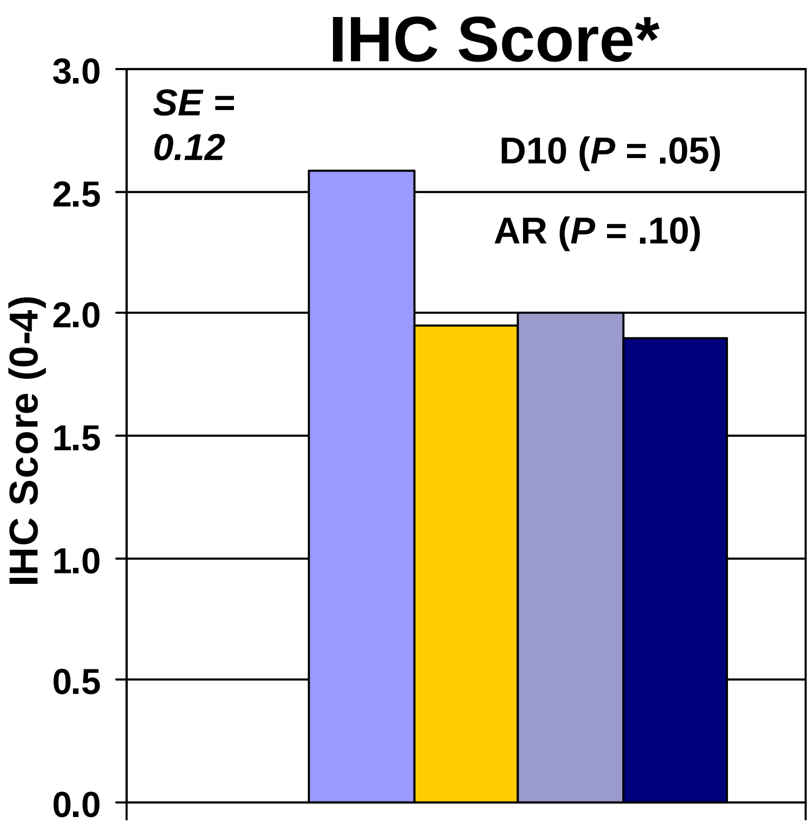
* Effect of disease challenge (*P* < .01).

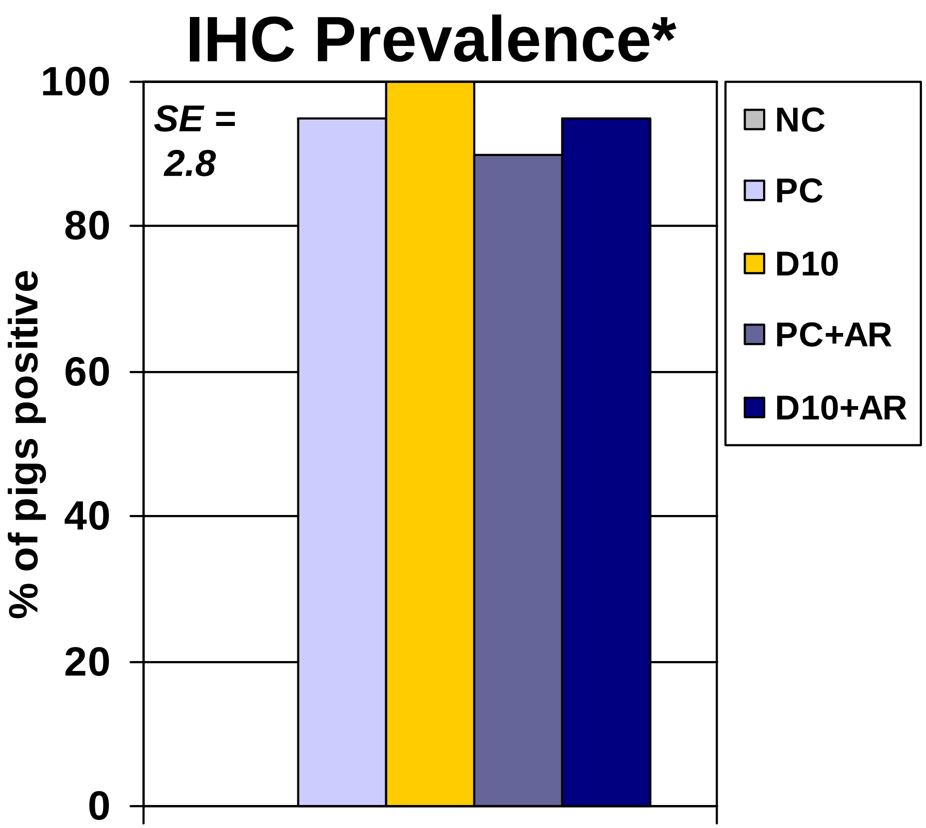
Effect of Dietary Treatment on Fecal Shedding (PCR Analysis) Experiment 2



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

Effect of Treatment on *L. intracellularis* Infection (IHC Analysis) Experiment 2



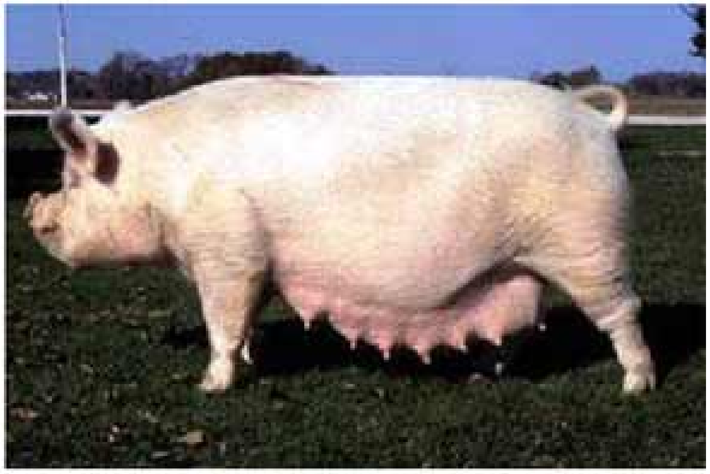


* Effect of disease challenge (*P* < .01).

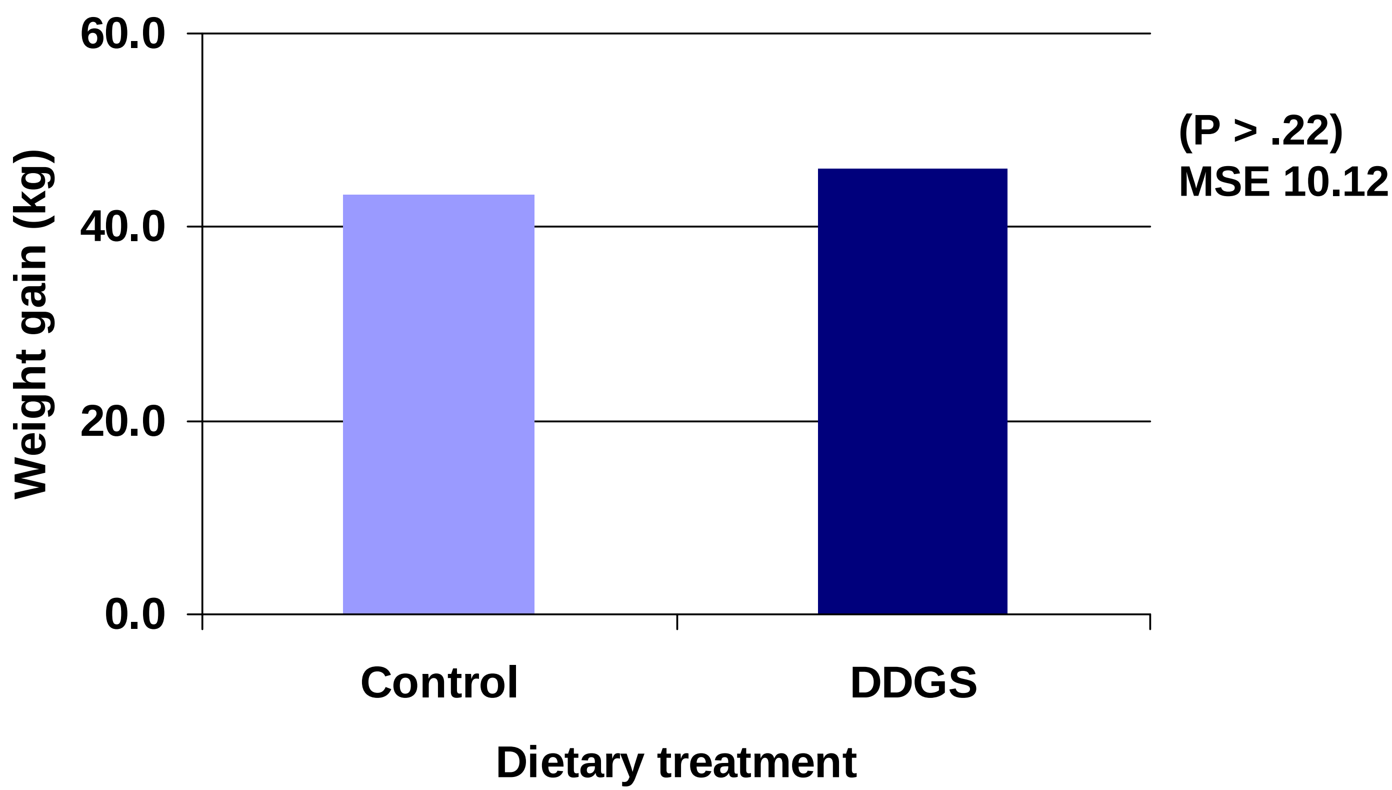
Summary of Results, Experiment 2

- Inoculation level was close to goal
- DDGS inclusion (10%) or antimicrobial regimen had a positive effect on the pig's ability to resist an ileitis challenge
- No beneficial additive effects of combining DDGS and BMD®/Aureomycin® regimen

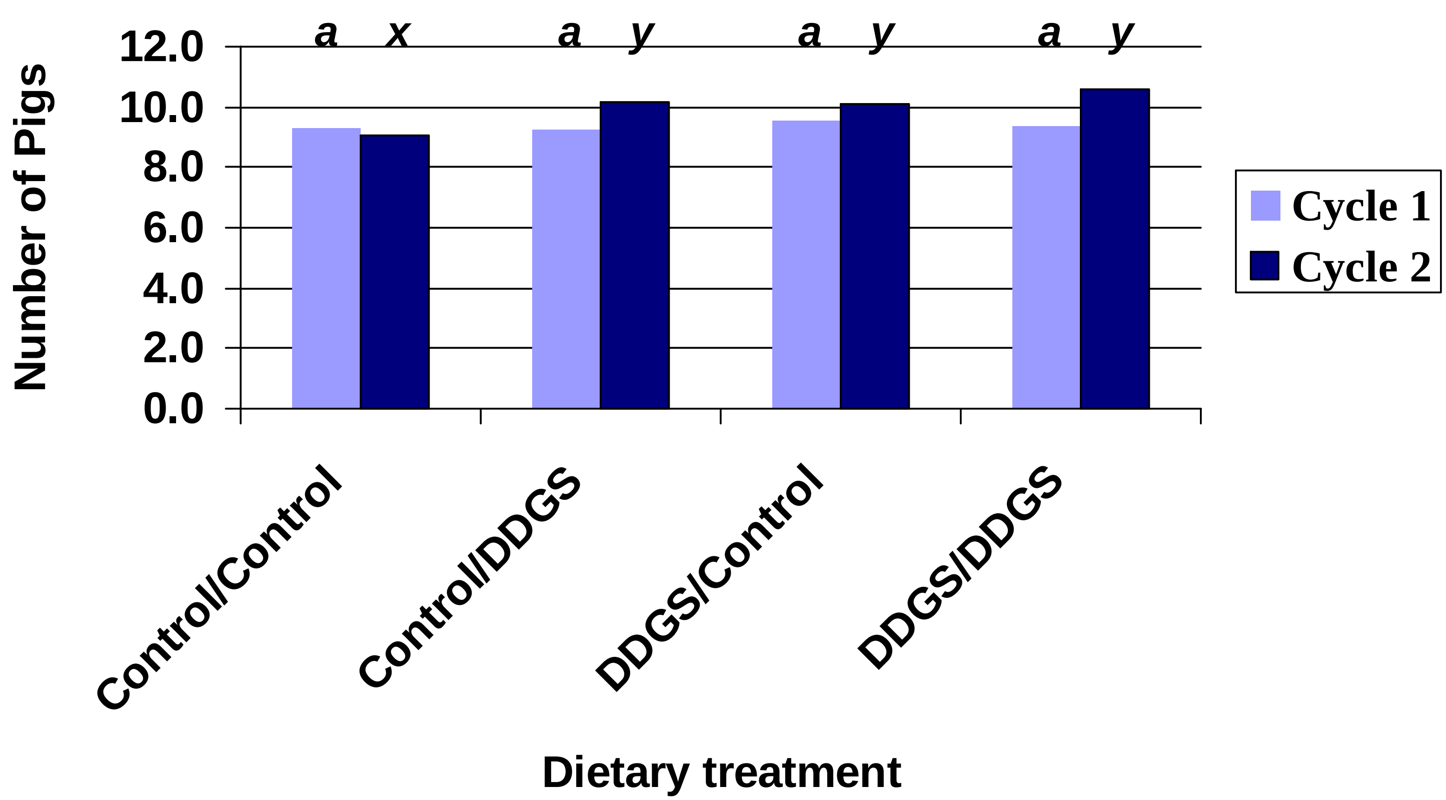
Feeding High Quality DDGS to Sows



Effect of Feeding a 50% DDGS Diet on Sow Weight Gain During Gestation (Reproductive Cycle 1)

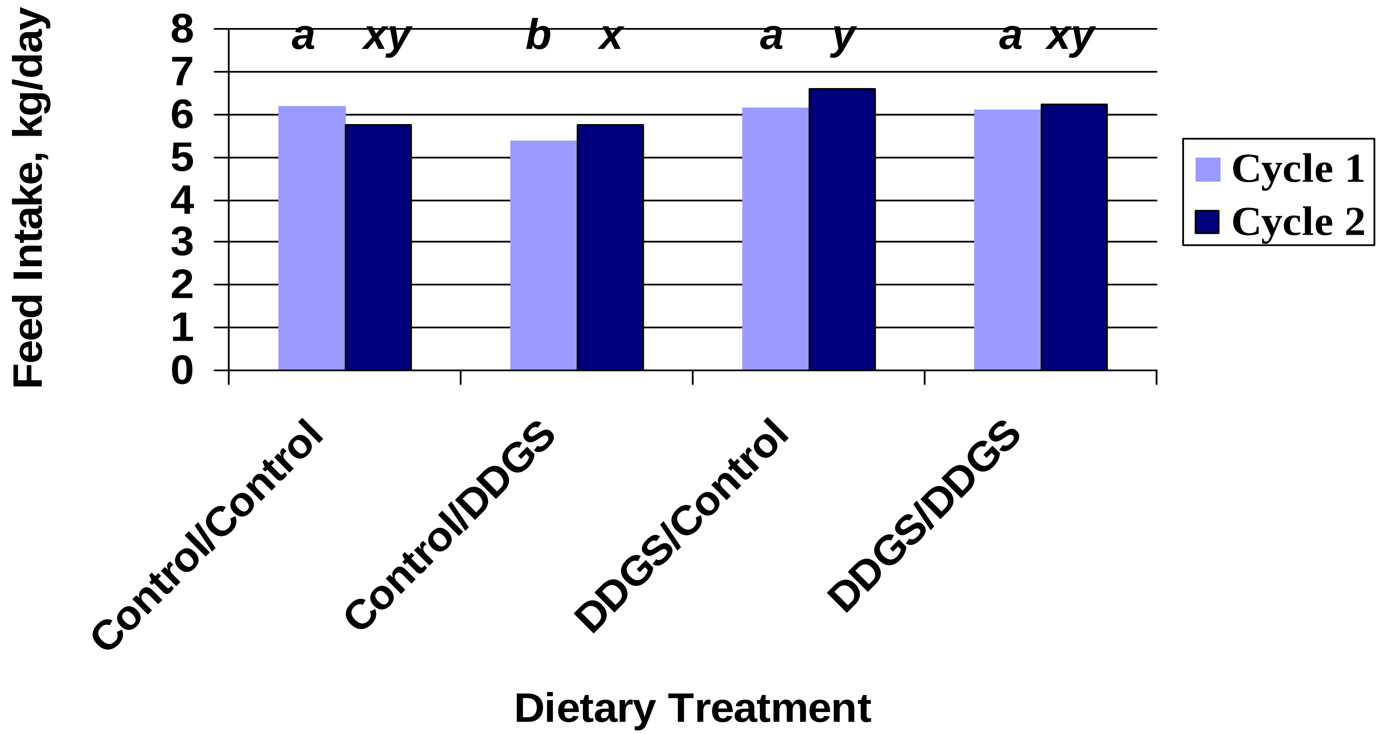


Effect of Feeding 0 or 50% DDGS Gestation Diets and 0 or 20% DDGS Lactation Diets on Pigs Weaned/Litter



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

Effect of Dietary Treatment Combination on Sow Lactation ADFI

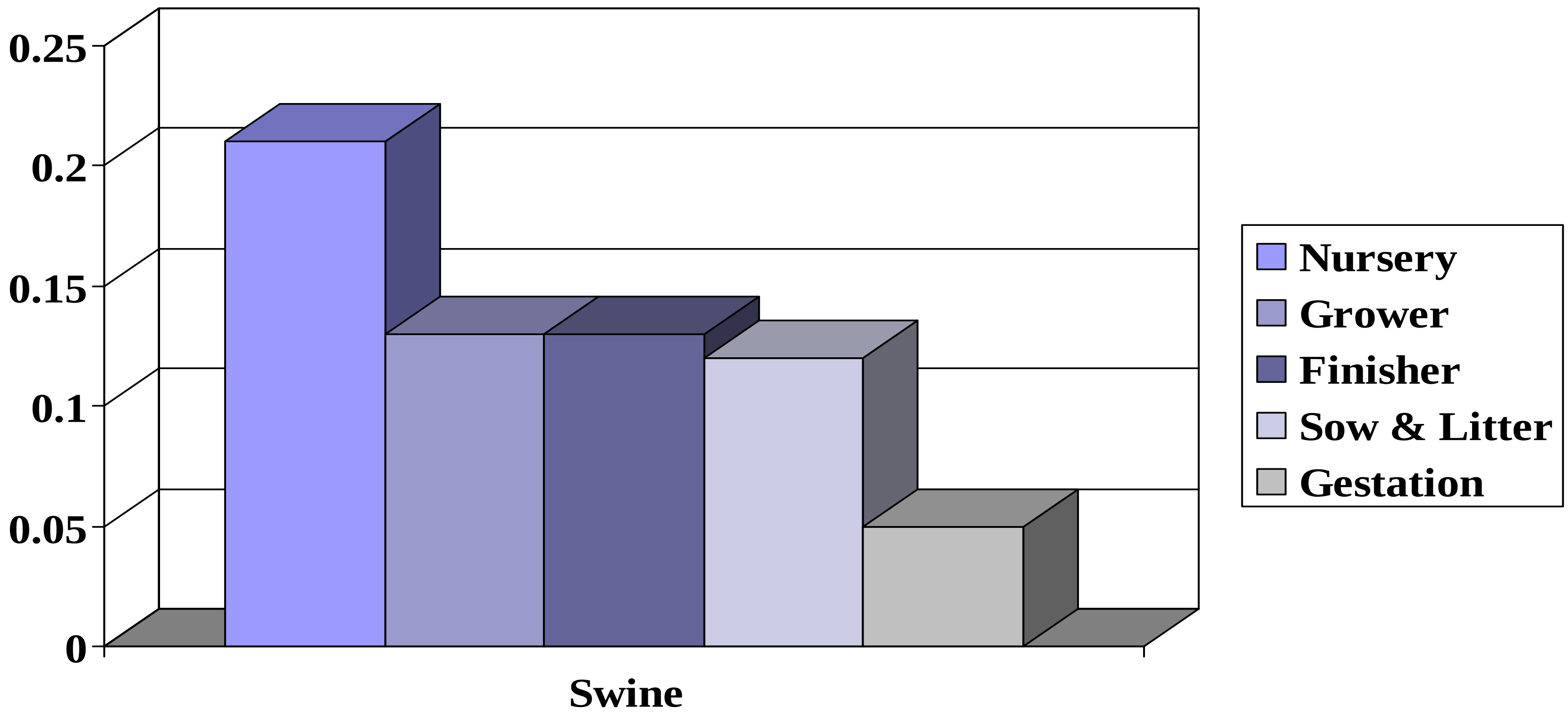


a,b,x,y **Different superscripts indicate significant difference (P < .10).**

Phosphorus in Swine Manure

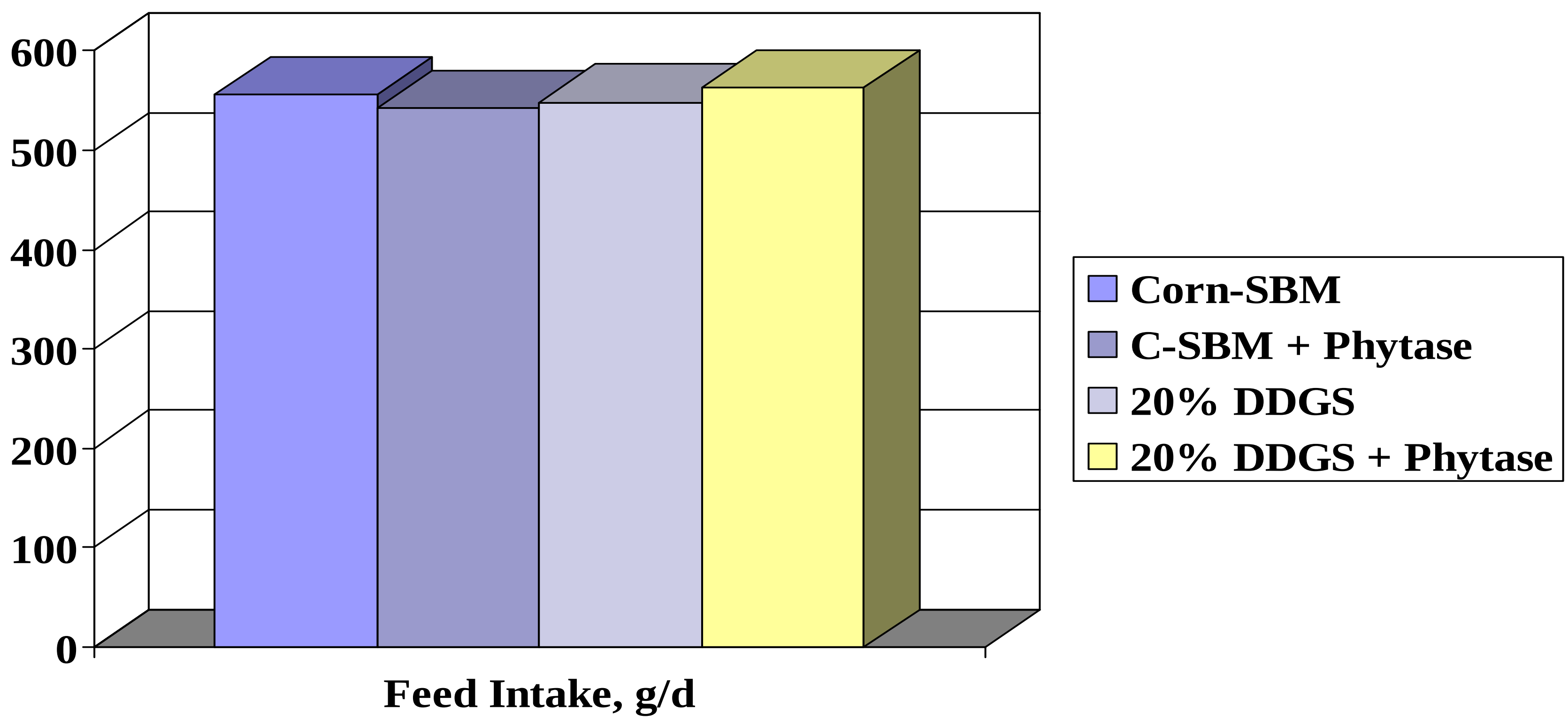
- Swine manure has a N:P ratio of 3:1
  - Lower than needed by crops grown (e.g. corn 6:1)
  - When manure is applied to meet the N needs of the crop:
    - Excess P is applied
  - Excess P in soil has potential for leaching and runoff that contributes to eutrophication of surface water

Lbs. of P_2O_5 per Lb. of Animal Wt./Yr

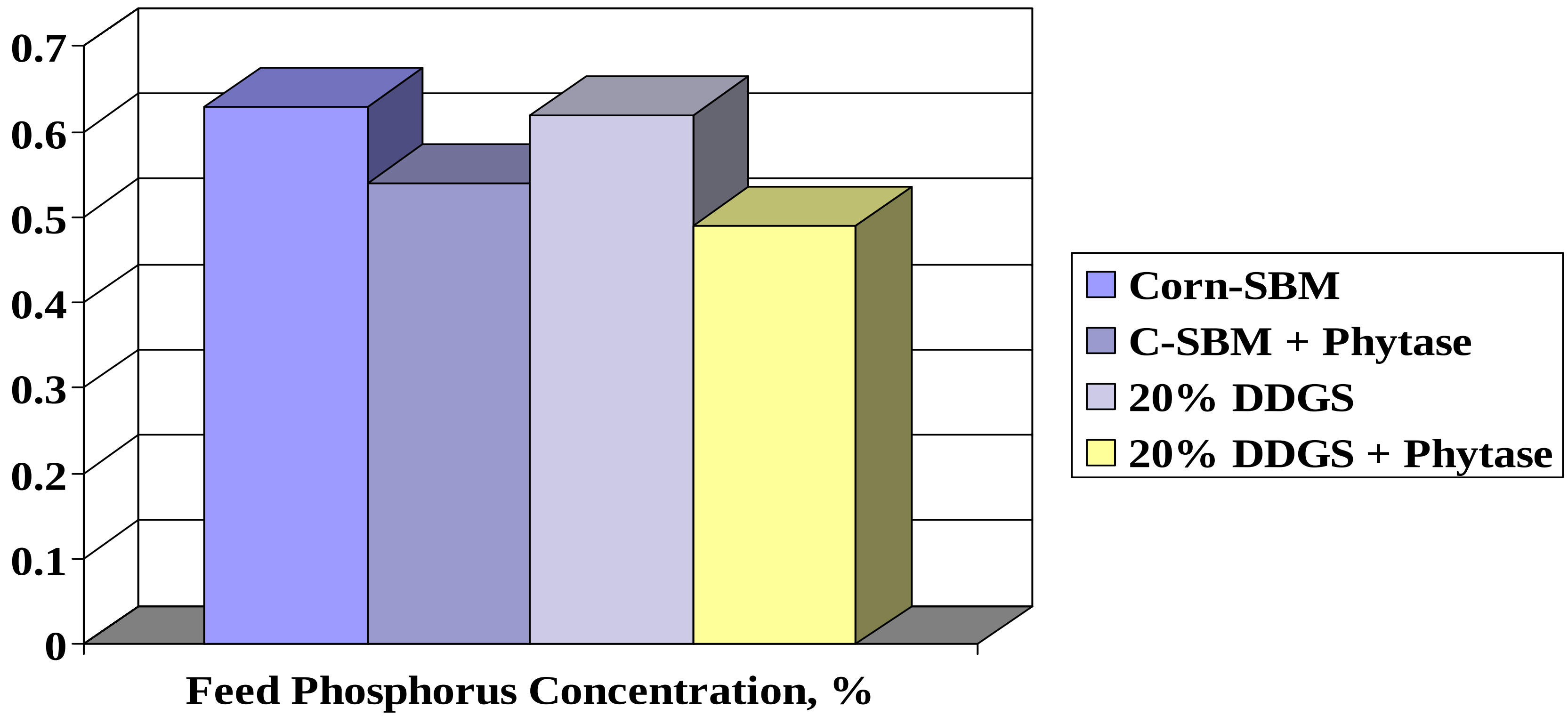


Source: Estimating Manure Nutrients from Livestock and Poultry. NebGuide G1334, 1997.

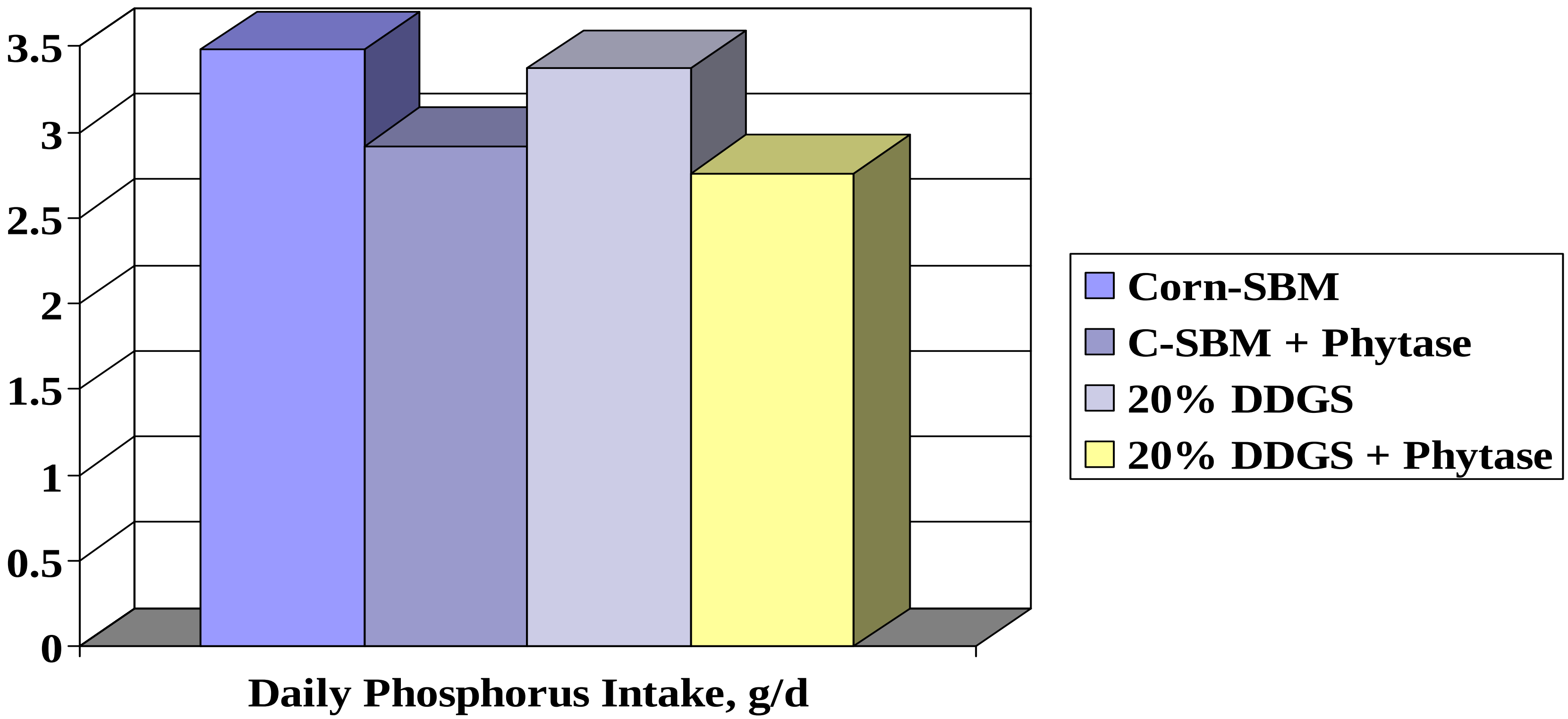
Effect of Feeding Corn-SBM Diets With or Without 20% DDGS or Phytase on Feed Intake of Nursery Pigs (g/day)



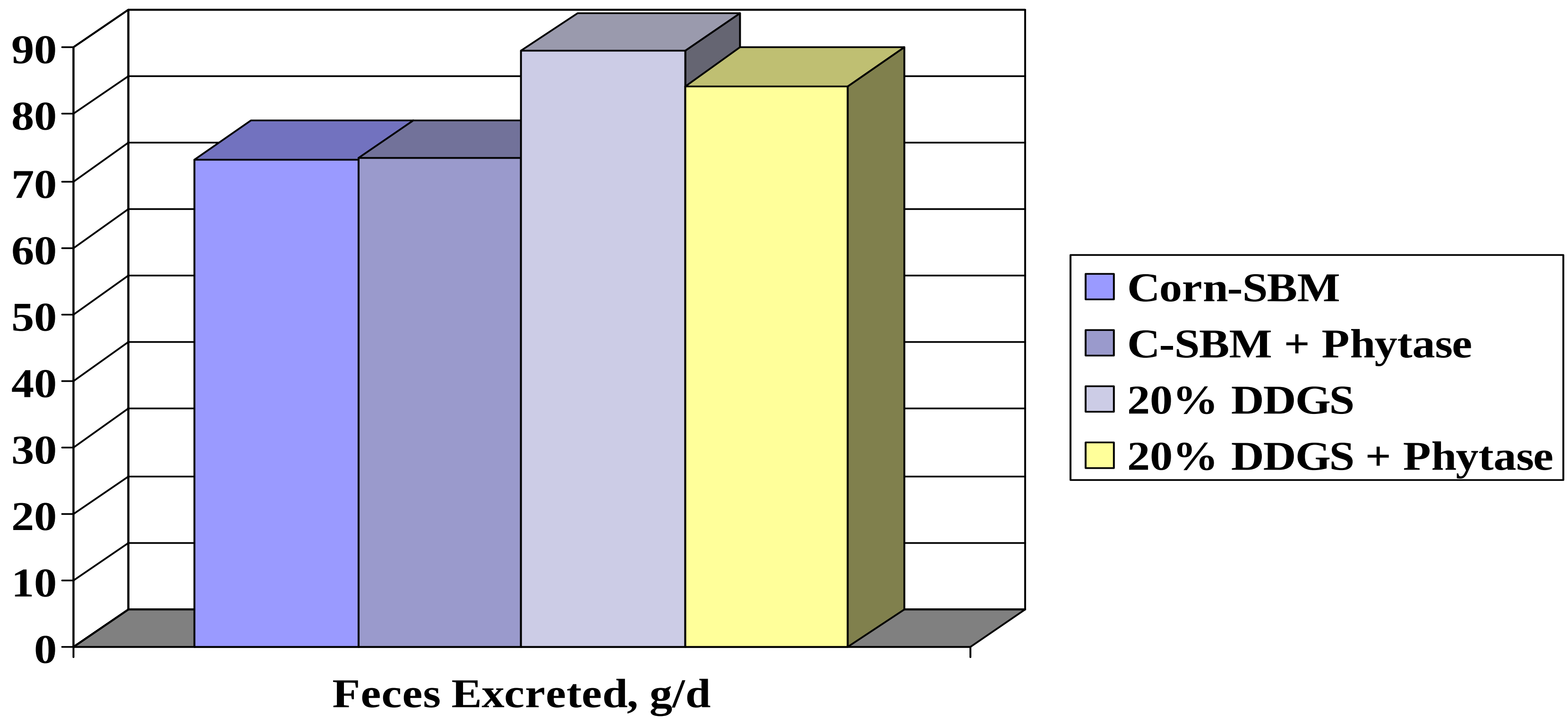
Effect of Feeding Corn-SBM Diets With or Without 20% DDGS or Phytase on Dietary Phosphorus Concentration(%)



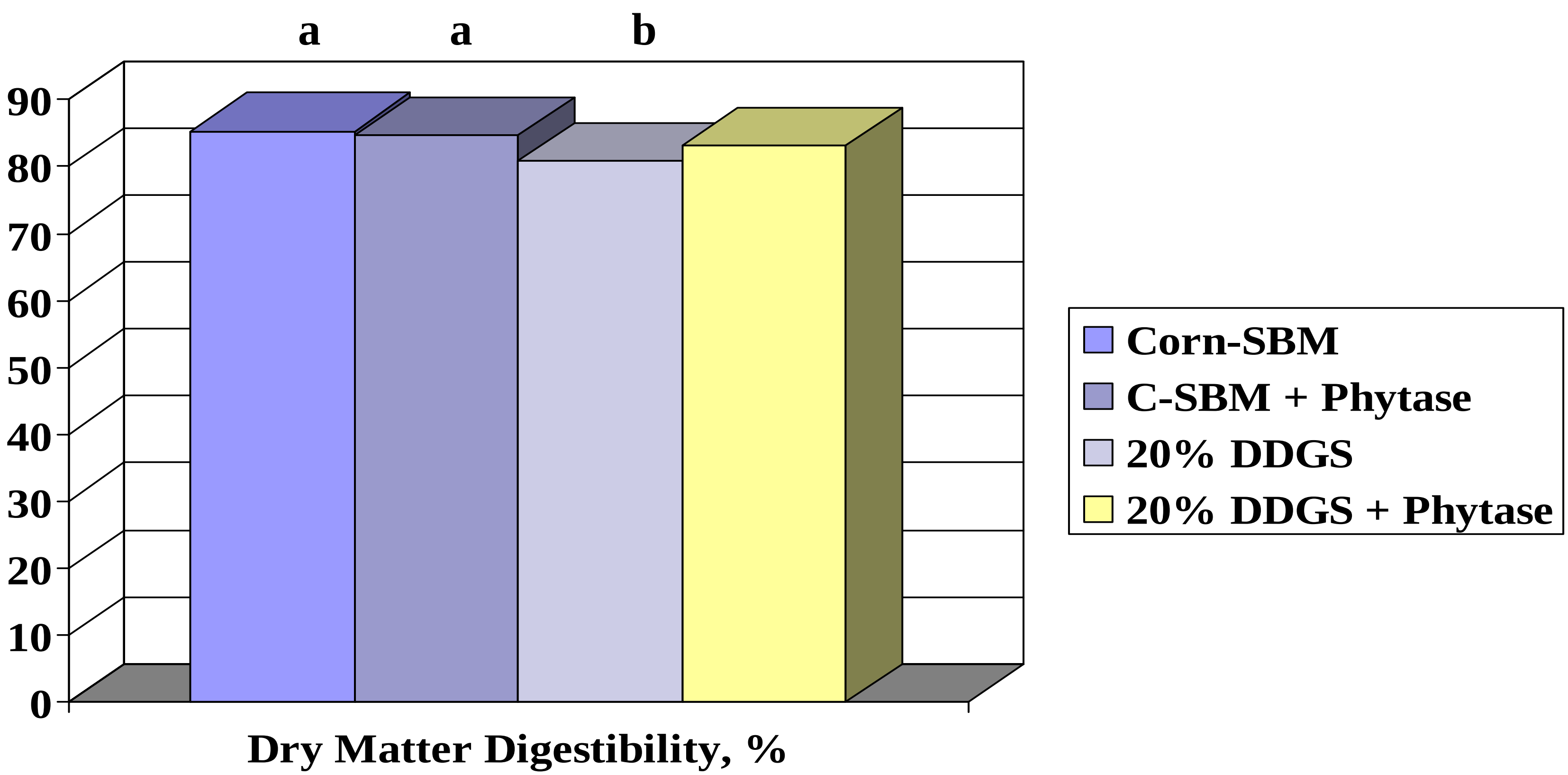
Effect of Feeding Corn-SBM Diets With or Without 20% DDGS or Phytase on Daily Phosphorus Intake (g/d)



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

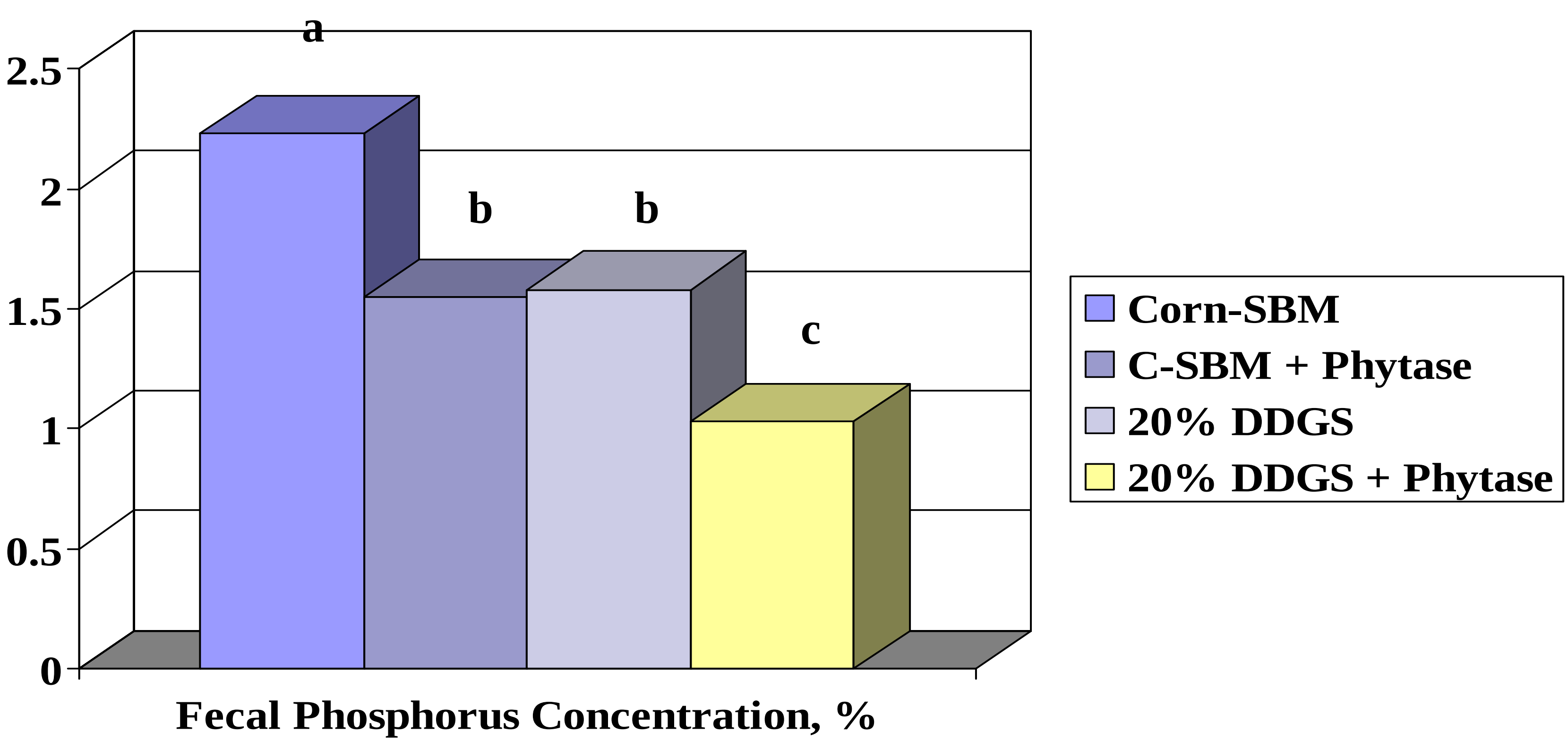


Effect of Feeding Corn-SBM Diets With or Without 20% DDGS or Phytase on Dry Matter Digestibility (%)



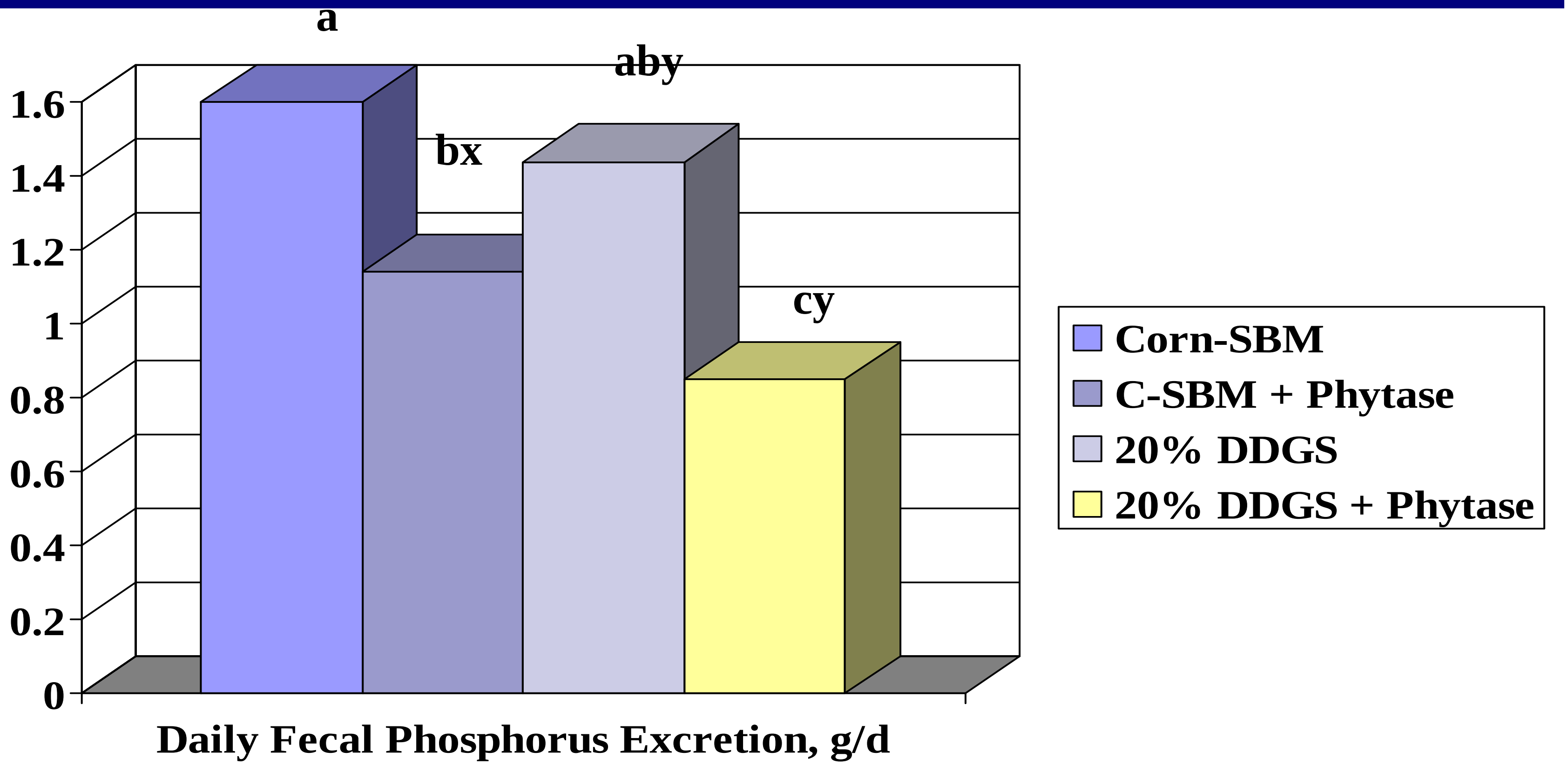
a,b Means with different superscripts are significantly different (P < .05).

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



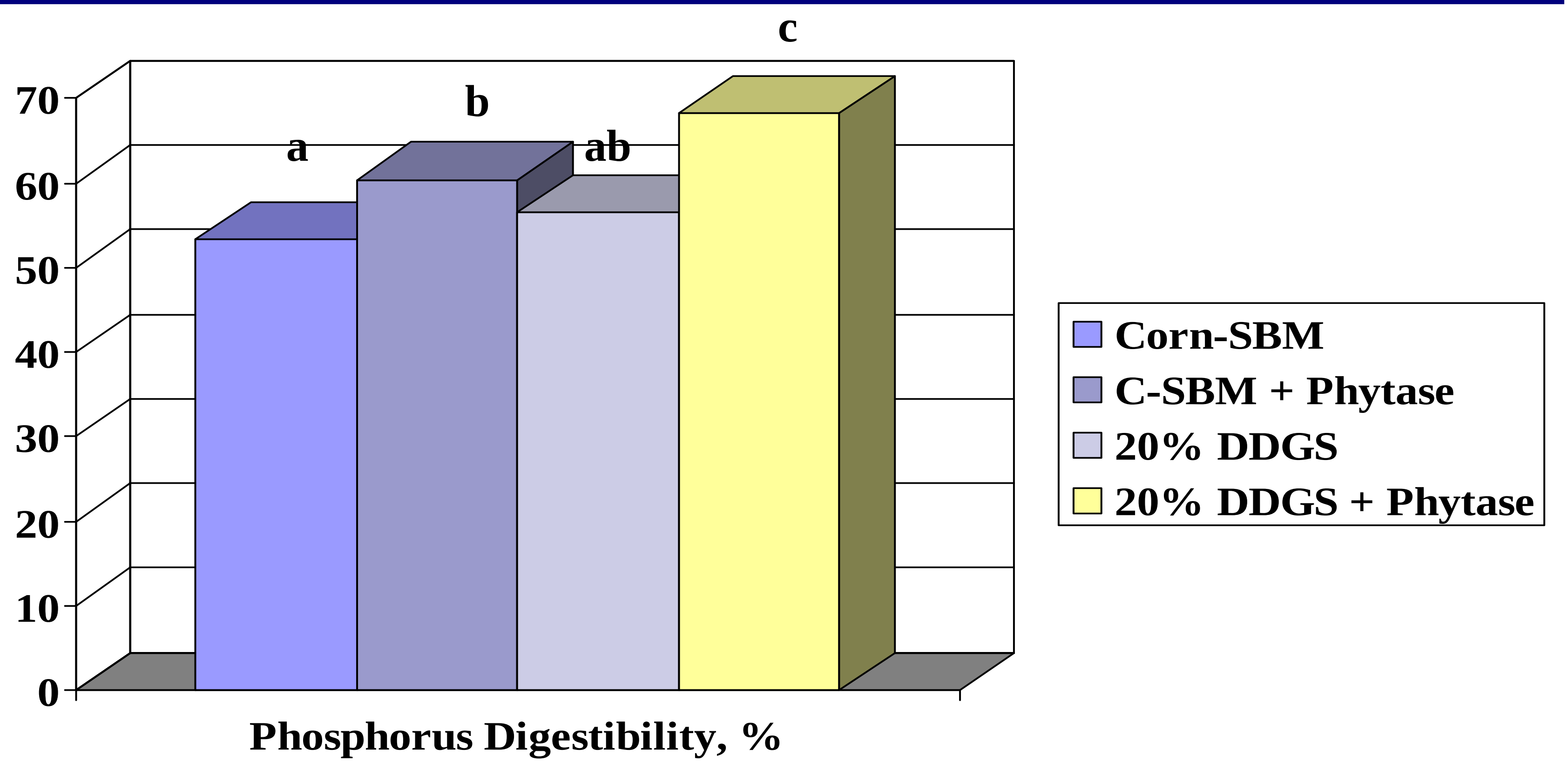
a,b Means with different superscripts are significantly different (P < .05).

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

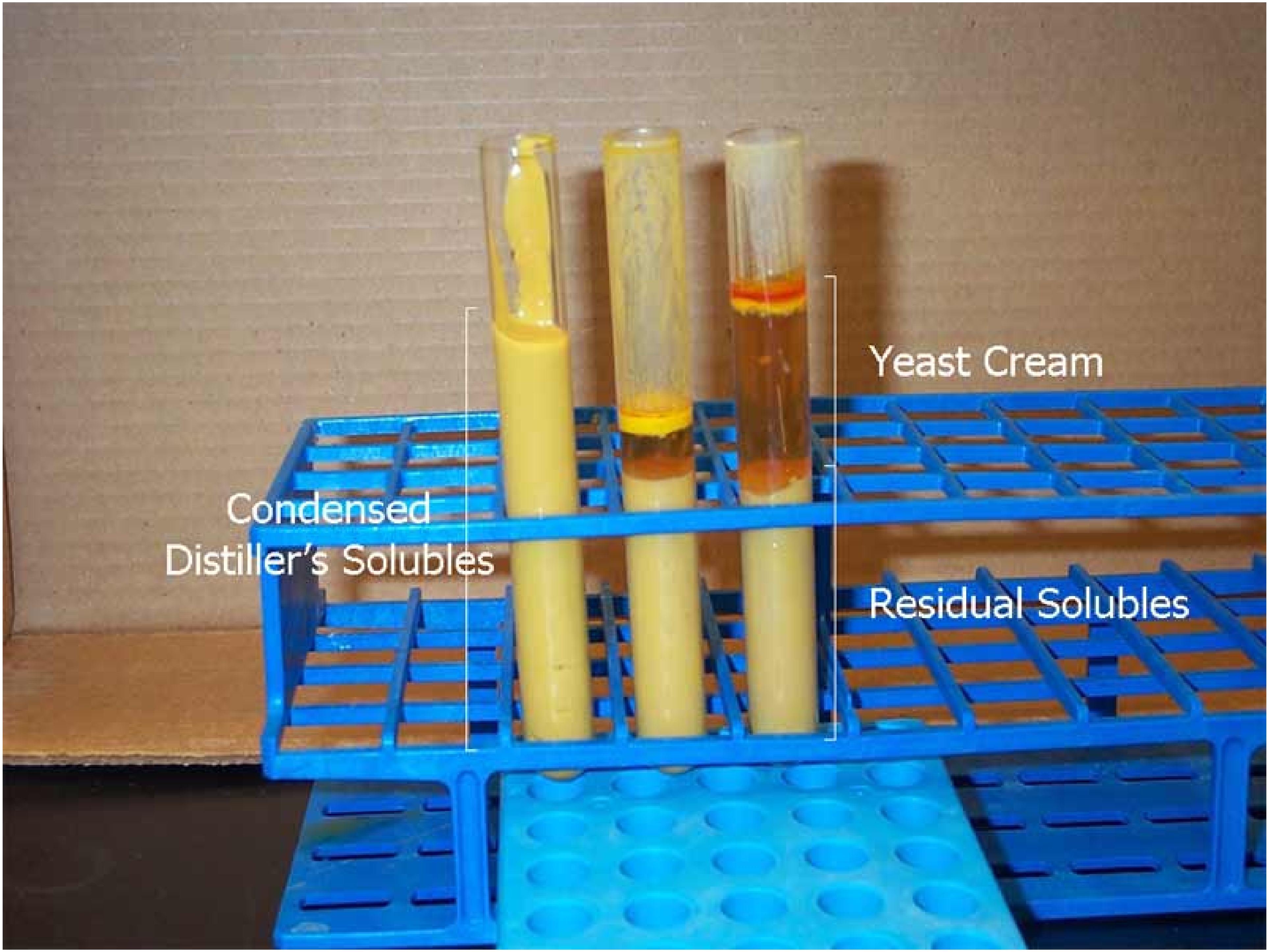


a,b Means with different superscripts are significantly different ($P < .05$).

Diet Composition When 18.8% DDGS and Phytase are Added to the Diet

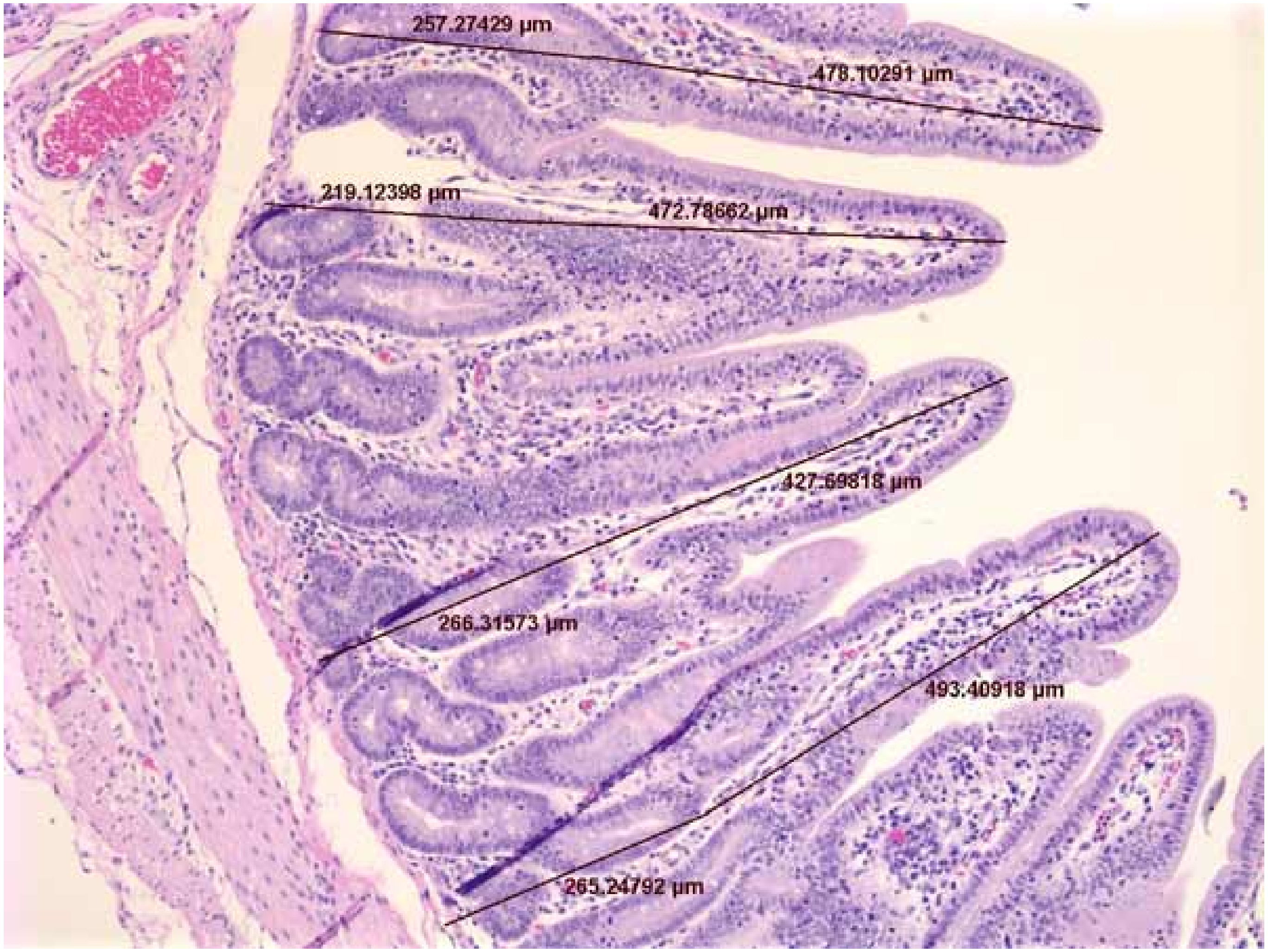
Ingredient	Corn-SBM-1.5 kg Lysine	18.8% DDGS + Phytase
Corn, kg	798.3	636.3
Soybean meal 44%, kg	176.9	159.4
DDGS, kg	0.0	188
Dicalcium phosphate, kg	11.6	0.0
Limestone, kg	7.2	9.8
Salt, kg	3.0	3.0
L-lysine HCl, kg	1.5	1.5
VTM premix, kg	1.5	1.5
Phytase, 500 FTU/kg	0.0	0.5
TOTAL, kg	1000.0	1000.0

Research on the Use of Spray Dried Distiller’s Solubles Fractions in Baby Pig Feeds

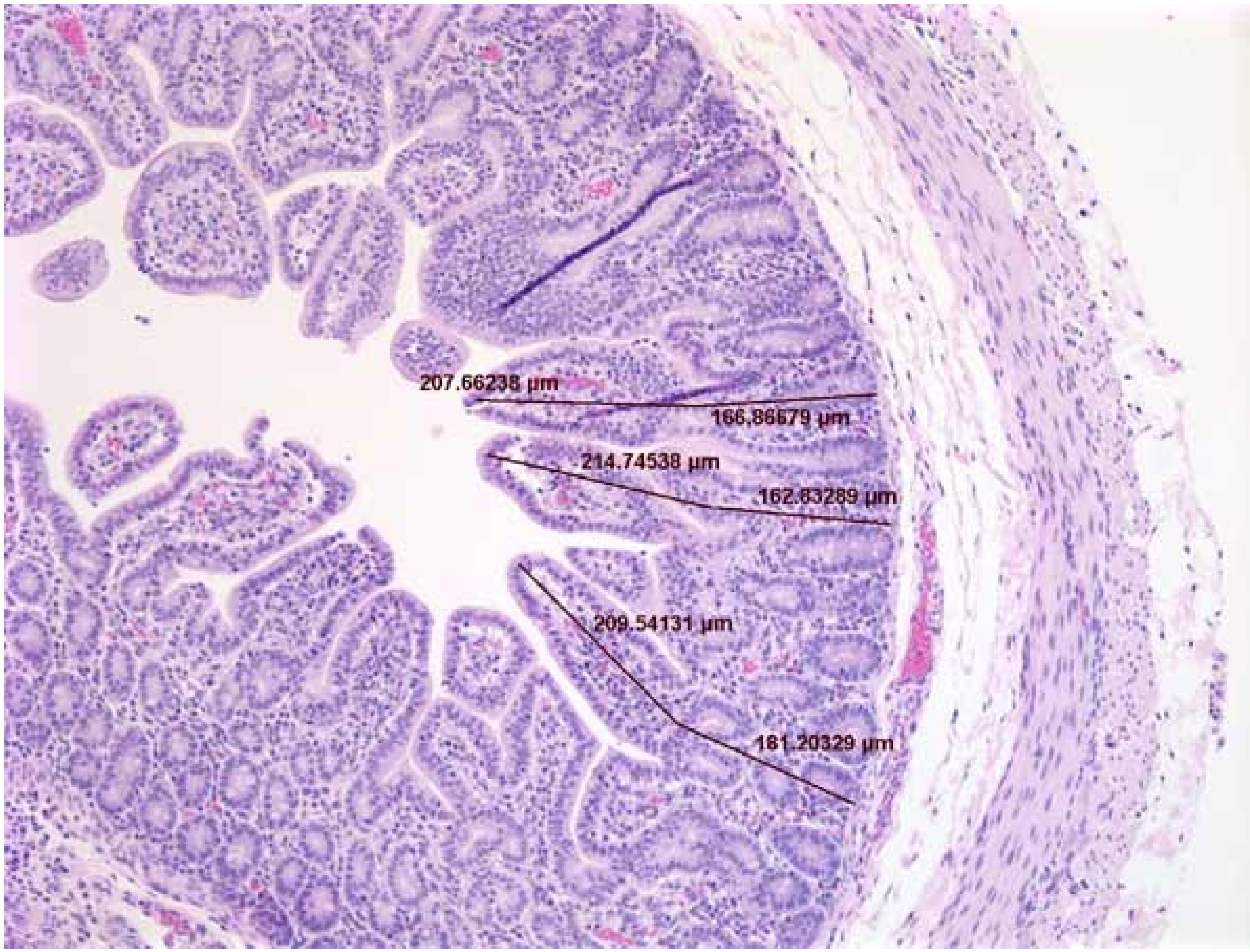

Yeast Cream
Condensed
Distiller's Solubles
Residual Solubles


Spray Dried Distiller's Solubles
(DS)
Spray Dried Yeast Cream
(YC)
Spray Dried Residual Solubles
(RS)

Villi Measurements from the Upper 25% of the Small Intestine from a Pig Fed the Residual Solubles Diet (10X)



Villi Measurements from the Upper 25% of the Small Intestine from a Pig Fed the Carbadox Diet (10X)



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

We have developed a DDGS web site featuring:

* nutrient profiles of U.S. DDGS sources
* research summaries
    - swine, poultry, dairy, & beef
    - DDGS quality
* presentations given
* links to other DDGS related web sites
* international audiences

UNIVERSITY OF MINNESOTA

Home

General Information

Research Summaries
- Swine
- Poultry
- Dairy
- Beef
- DDGS Quality

Ongoing & Future Research

PowerPoint Presentations
- Swine
- Poultry
- Dairy
- Beef
- Price, Quantity, Distribution
- DDGS Quality

Feeding Recommendations
- Swine
- Poultry
- Dairy
- Beef

Economics of Ethanol Production

The Value and Use of Distillers Dried Grains with Solubles (DDGS) in Livestock and Poultry Feeds

Welcome to the University of Minnesota DDGS Web site!

This site was developed to provide its users a "one stop" place to find all of the most current information related to using DDGS in dairy, beef, swine and poultry feeds.

The ethanol industry is one of the most rapidly growing agricultural industries in the U.S. Currently, dry mill ethanol plants produce over 3.8 million metric tonnes of DDGS annually. Industry experts predict that the volume of DDGS produced will increase to over 5.5 million metric tonnes by the year 2005. Because of the large supply of DDGS available to the feed and livestock industry, researchers at several Land Grant Universities have been conducting experiments to evaluate the nutritional value of DDGS in order to develop feeding recommendations for dairy, beef, swine, and poultry. In addition to DDGS research conducted by scientists in the Department of Animal Science at the University of Minnesota, we are pleased to provide you with research and technical publications from researchers at:

University of Georgia
Kansas State University
University of Nebraska-Lincoln
South Dakota State University

The majority of DDGS produced by ethanol plants in the US today is derived form corn. However, there is also a small but increasing amount of DDGS that is produced from sorghum (milo). The majority of information included on this Web site involves the evaluation of corn DDGS in livestock and poultry feeds. However, we have also included a section for research and technical information specific to sorghum DDGS (see Other Types of DDGS).

International Audiences

Key Contacts

Links

- General Information
- MN Ethanol Industry
- DDGS Marketing

Other Types of DDGS

There is considerable variation in DDGS quality, nutrient composition, and nutrient digestibility among sources. Research conducted at the University of Minnesota

has shown that corn DDGS produced by modern, dry mill ethanol plants in Minnesota and South Dakota is of much higher quality and nutritional value for swine and poultry than DDGS produced by older, more traditional ethanol plants. Distiller's dried grains with solubles produced by these "new generation" ethanol plants is an excellent source of energy, digestible amino acids, and available phosphorus for swine and poultry diets.

Currently, DDGS is an economical, partial replacement for corn, soybean meal, and dicalcium phosphate in livestock and poultry feeds. Historically, over 85% of DDGS has been fed to dairy and beef cattle, and DDGS continues to be an excellent, economical feed ingredient for use in ruminant diets.

Please email us with your comments.

Acknowledgments.