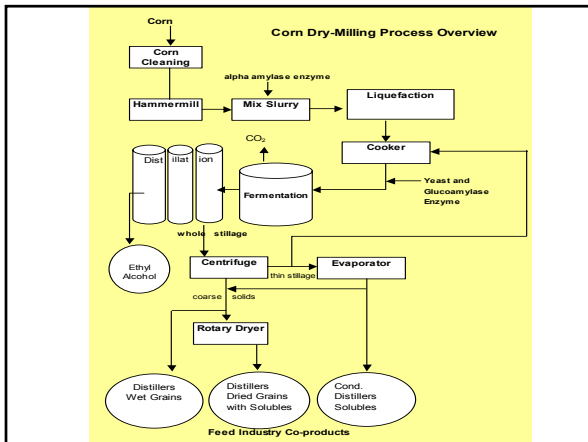


The Value of “New Generation” Corn Distiller’s Dried Grains with Solubles in Swine Feeding Programs

Dr. Jerry Shurson
Department of Animal Science
University of Minnesota

Production of DDGS

- ♦ Yeasts and enzymes are used to ferment the starch fraction of corn
- ♦ Ethanol and carbon dioxide are produced
- ♦ Distiller’s grains and distiller’s solubles are the residues remaining after fermentation
- ♦ These fractions are blended and dried to produce distiller’s dried grains with solubles (DDGS)



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



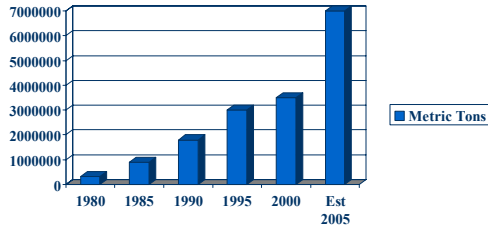
- ♦ Ethanol 2.7 gallons (10.2 liters)
- ♦ DDGS 18 lbs (8.2 kg)
- ♦ CO₂ 18 lbs (8.2 kg)

Slide courtesy of Ms. Kelly Davis, CVEC, Benson, MN

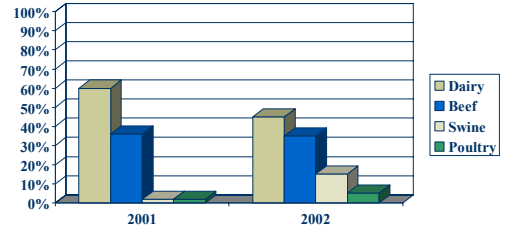
Most Fuel Ethanol Production is in the Western U.S. “Corn Belt”



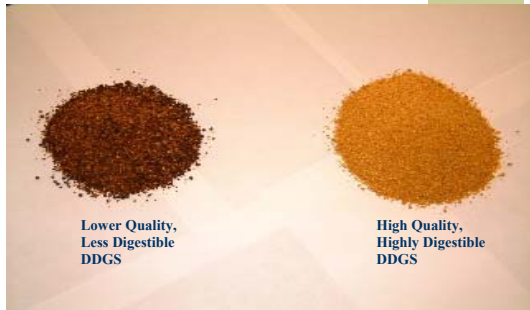
North American DDGS Production



Estimated North American DDGS Consumption in 2001 & 2002



“New Generation” vs. “Old Generation” DDGS



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

- ♦ “New Generation” 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?

Comparison of Energy Values of DDGS for Swine (88% DM Basis)

	“New” DDGS Calculated	“New” DDGS Trial avg.	“Old” DDGS Calculated	DDGS NRC (1998)
DE, kcal/kg	3488 Range 3418-3537	3528 Range 2975-4086	3409	3449
ME, kcal/kg	3162 Range 3087-3215	3367 Range 2820-3916	3098	2672

Corn (NRC, 1998): DE (kcal/kg) = 3484
ME (kcal/kg) = 3382

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

Maximum Inclusion Rates of "New Generation" DDGS in Swine Diets

(Based Upon University of Minnesota Performance Trials)

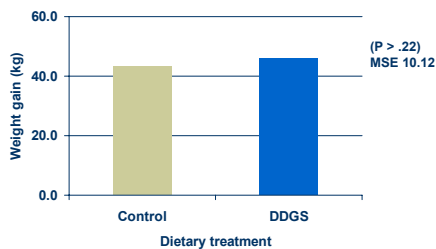
- Nursery pigs (> 7 kg)
 - Up to 25 %
- Grow-finish pigs
 - Up to 20% (higher levels may reduce pork fat quality)
- Gestating sows
 - Up to 50%
- Lactating sows
 - Up to 20%

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

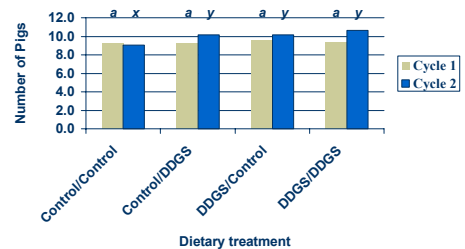
Feeding "New Generation DDGS to Sows"



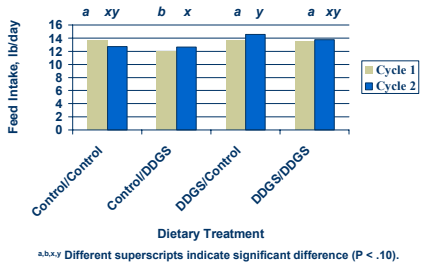
Effect of Feeding a 50% DDGS Diet on Sow Weight Gain During Gestation (Reproductive Cycle 1)



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



Effect of Dietary Treatment Combination on Sow Lactation ADFI



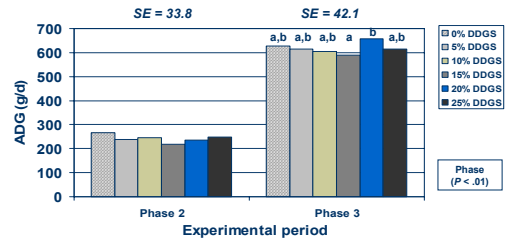
Feeding "New Generation" DDGS to Weaned Pigs



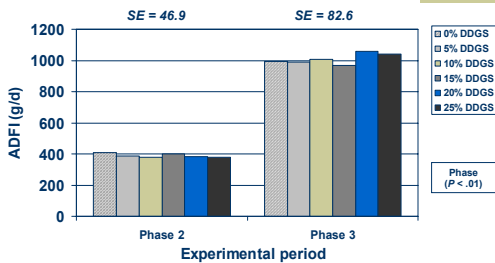
Materials and Methods – Nursery Experiments

- 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

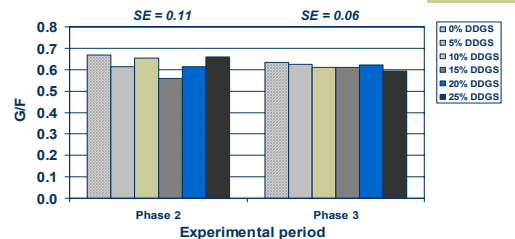
Effect of DDGS Level on Growth Rate (Experiment 1)



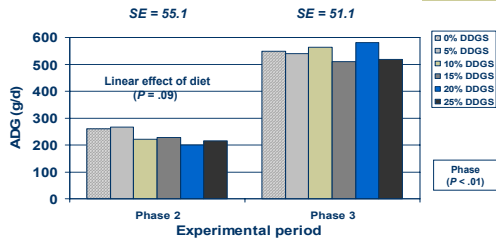
Effect of DDGS Level on ADFI (Experiment 1)



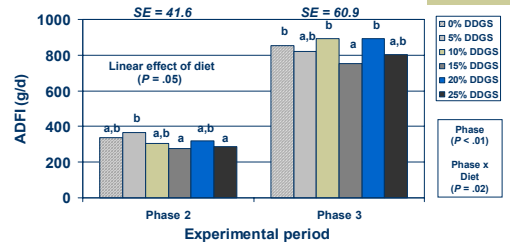
Effect of DDGS Level on Gain/Feed (Experiment 1)



Effect of DDGS Level on Growth Rate (Experiment 2)

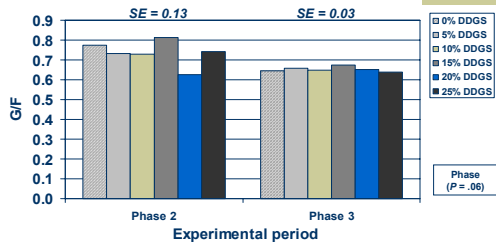


Effect of DDGS Level on Feed Intake (Experiment 2)

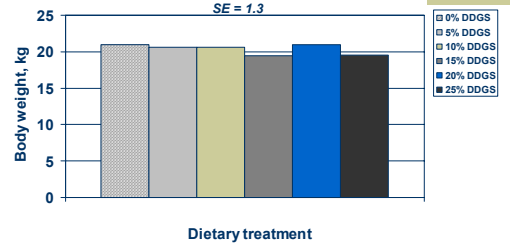


Means not sharing a common superscript letter are significantly different ($P < .05$)

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



Effect of DDGS Level on Final BW (Experiment 2)



Feeding "New Generation" DDGS to Grow-Finish Pigs



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 ($P < .05$).

Formulation Methods for Diets Containing DDGS

- ♦ Total vs digestible amino acid basis
 - Maximum DDGS inclusion rate = 10%
 - if formulating on a total amino acid basis
 - Much higher DDGS inclusion rates (>10%)
 - if diets are formulated using digestible amino acids
- ♦ Total vs available phosphorus basis
 - Formulating diet on an available P basis increases economic benefit and reduces P content of manure

Does Feeding DDGS Improve Gut Health?

DDGS and Gut Health

- ♦ Field reports:
 - Beneficial effect of adding 5 to 10% DDGS in grow-finish diets
- ♦ DDGS contains low levels of soluble (0.7 %) and high levels of insoluble (42.2 %) fiber (Shurson et al., 2000)
 - Low soluble fiber diets may reduce the proliferation of pathogenic organisms in the GI tract (Hampson, 1999).
- ♦ DDGS contains components of yeast cells
 - May have nutraceutical properties

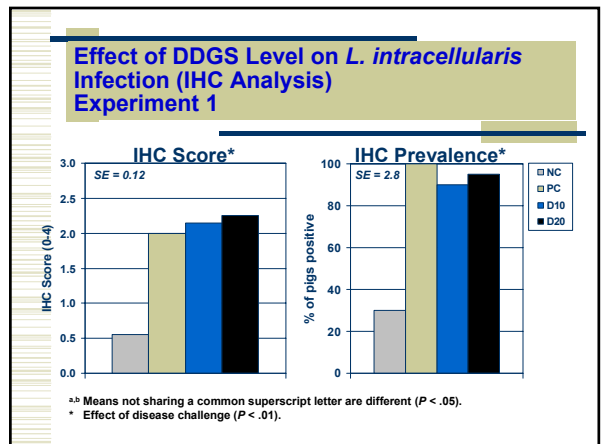
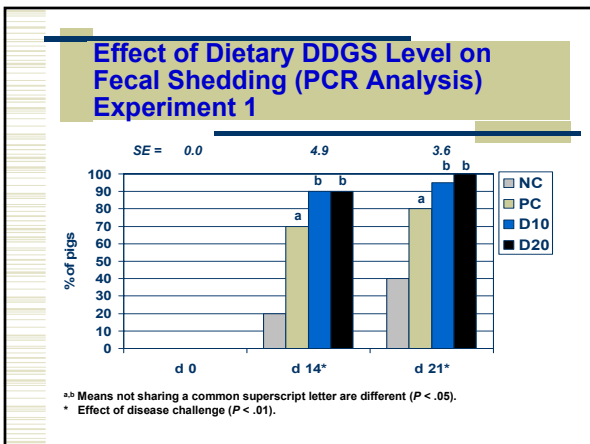
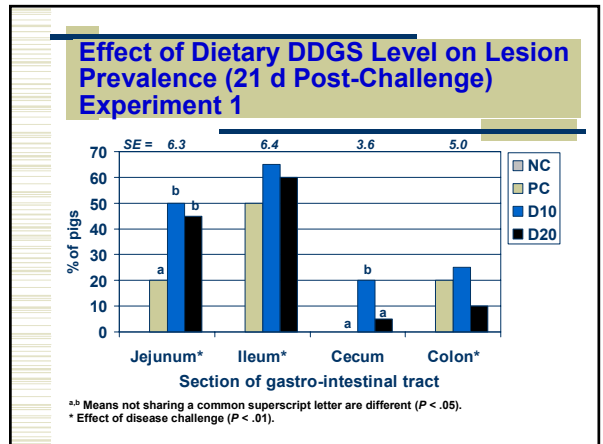
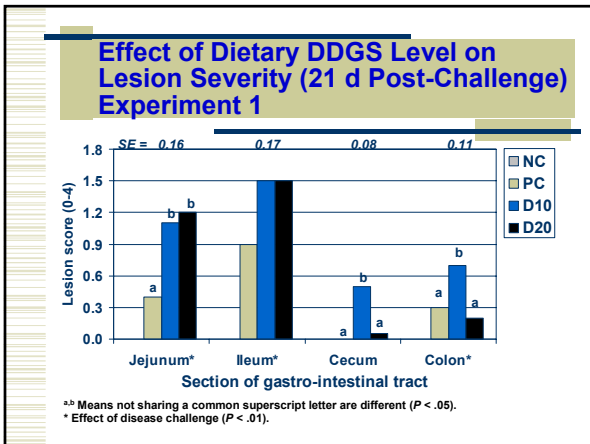
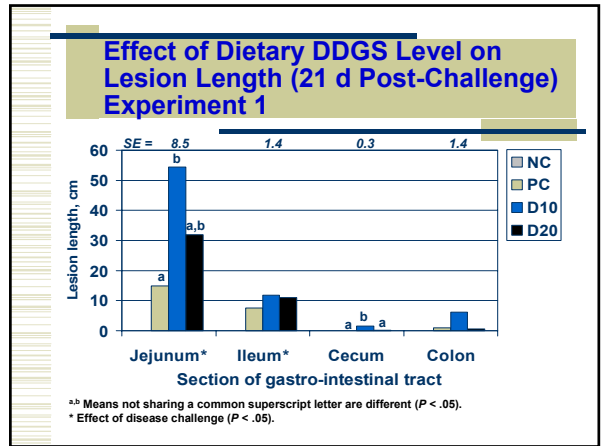
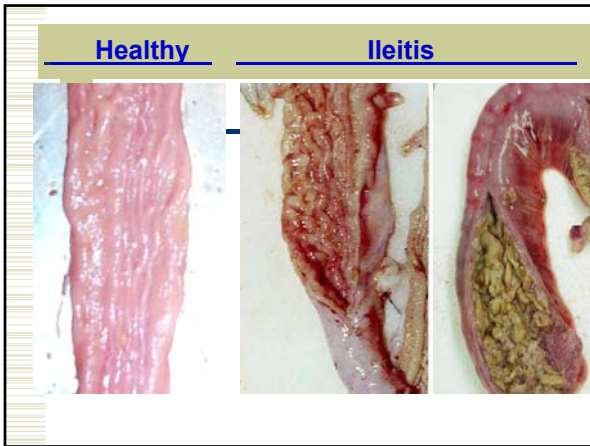
What is Ileitis?

- ♦ 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

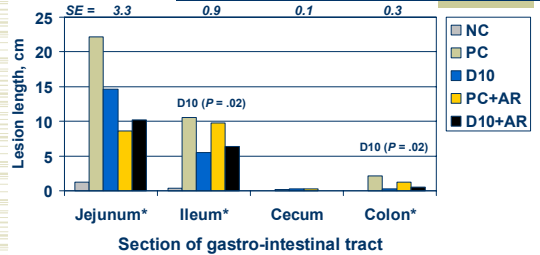




Summary of Results – Experiment 1

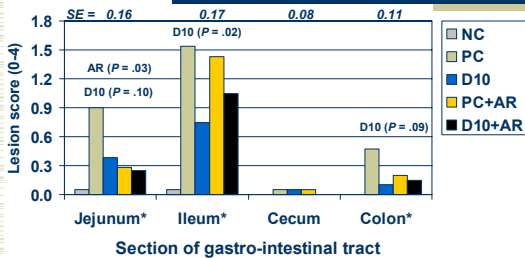
- DDGS inclusion did not improve the pig's ability to resist an ileitis challenge
- Dosage (inoculation) rate was higher than desired
 - Actual: 1.56×10^9 dose of *L. intracellularis*
 - Goal: 1×10^8 dose of *L. intracellularis*

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



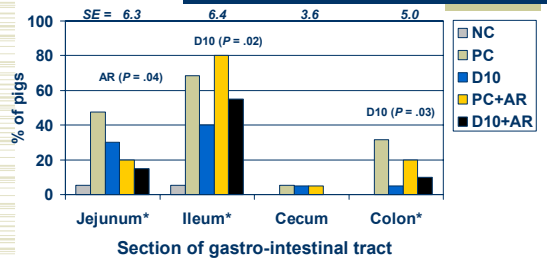
* Effect of disease challenge ($P < .01$).

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



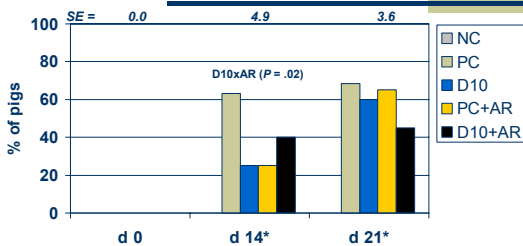
* Effect of disease challenge ($P < .01$).

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



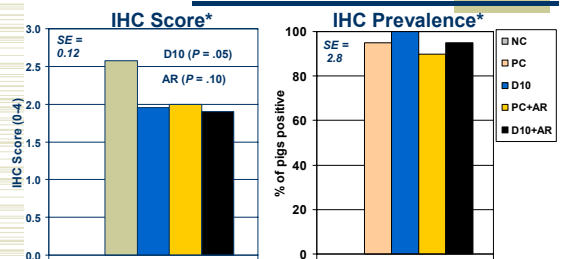
* Effect of disease challenge ($P < .01$).

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 closer 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

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

We have developed a DDGS web site featuring:

- * research summaries
 - swine, poultry, dairy, & beef
 - DDGS quality
- * presentations given
- * links to other DDGS related web sites
- * international audiences