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

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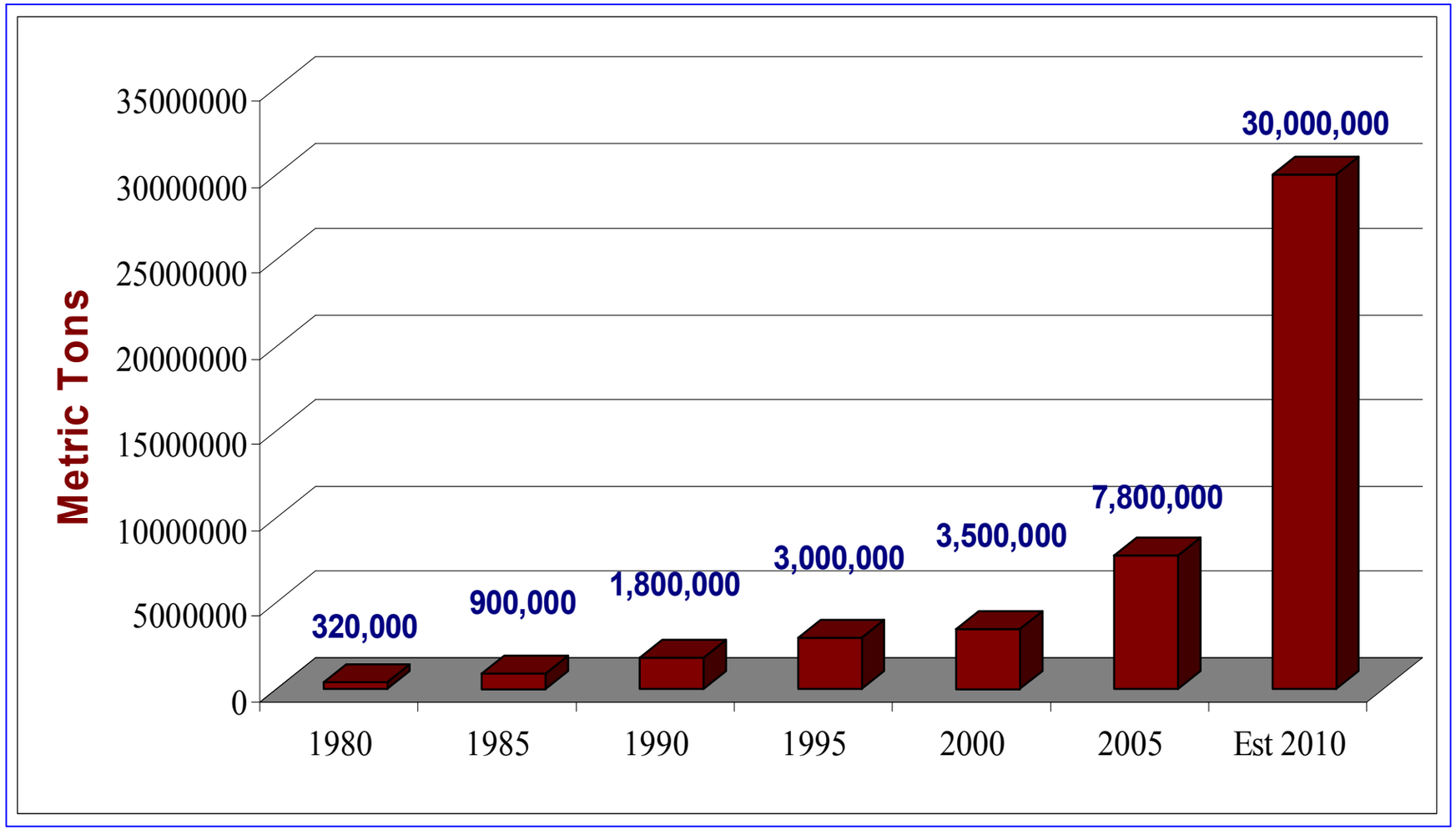
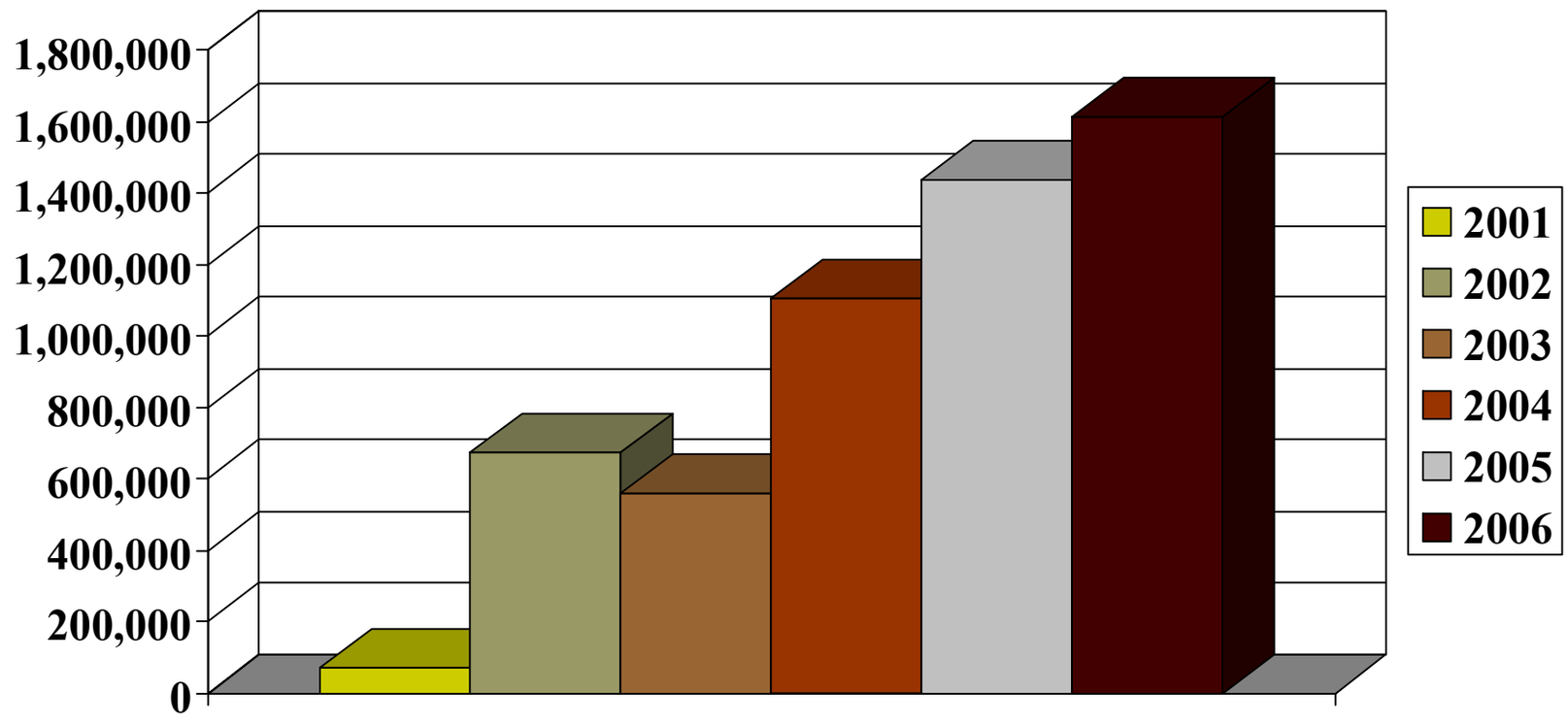
North American DDGS Production



Source: Sean Broderick, Commodity Specialists Company

Estimated DDGS Usage in U.S. Swine Feeds 2001-2006 (Metric Tonnes)



Current Commercial Dietary DDGS Inclusion Rates and Estimated Usage

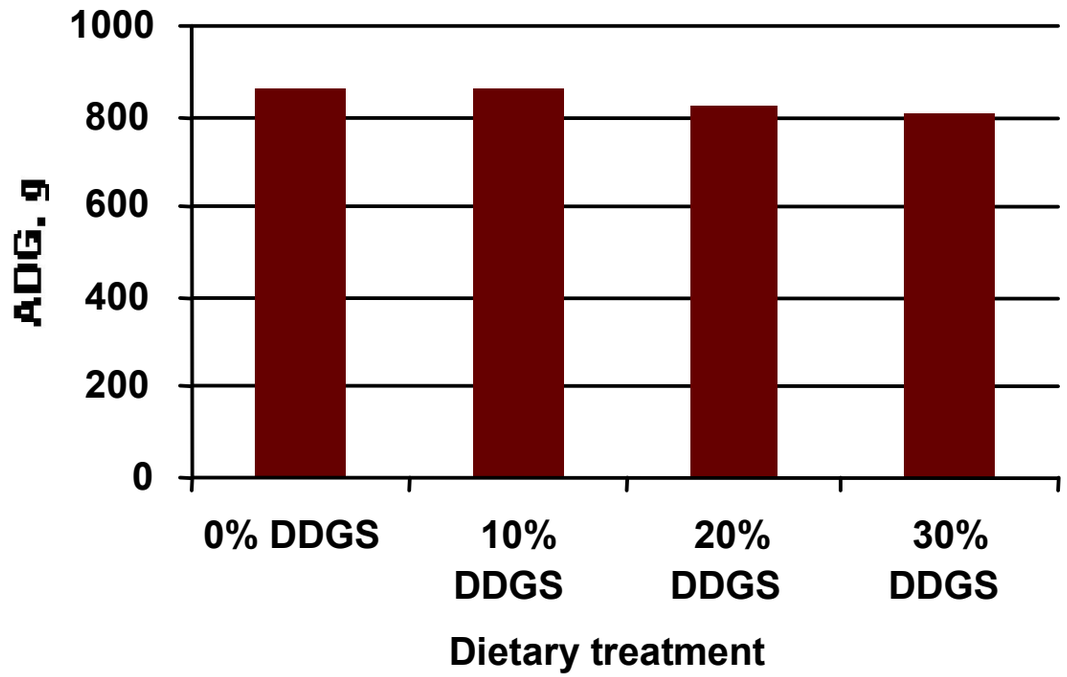
- Grower-finisher diets ~85-90%
  - 10-15% dietary inclusion rates
- Sow diets ~5-10%
  - Gestation - up to 30% dietary inclusion
  - Lactation - 5-10% of the diet
- Late nursery diets < 5%
  - Added at 5-10% of the diet

Study 1 – “Worst Case Scenario”

Materials and Methods

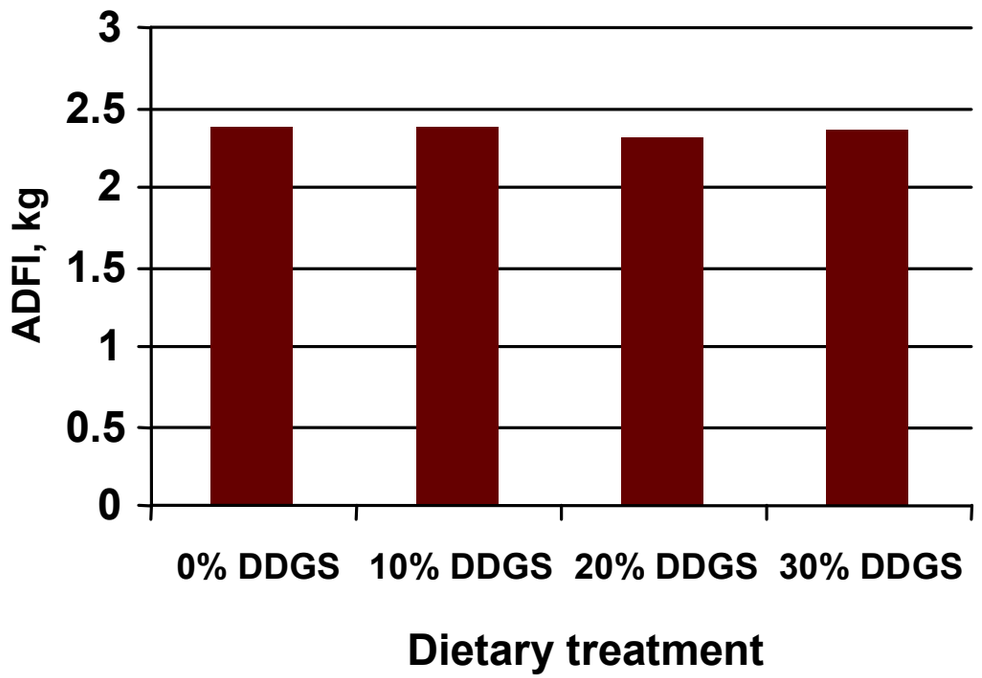
- 240 crossbred pigs (~ 63 lbs initial BW)
  - Grow-finish facilities at WCROC – Morris, MN
  - Blocked by weight, gender and litter
  - Blocks randomly assigned to 1 of 4 diet sequences
    - 5-phase feeding program
  - 0, 10, 20, or 30% DDGS diets **formulated on total lysine basis**
  - **Diets contained up to 4% soybean oil** as a supplemental fat source
  - 24 pens, 10 pigs/pen, 6 replications/trt

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



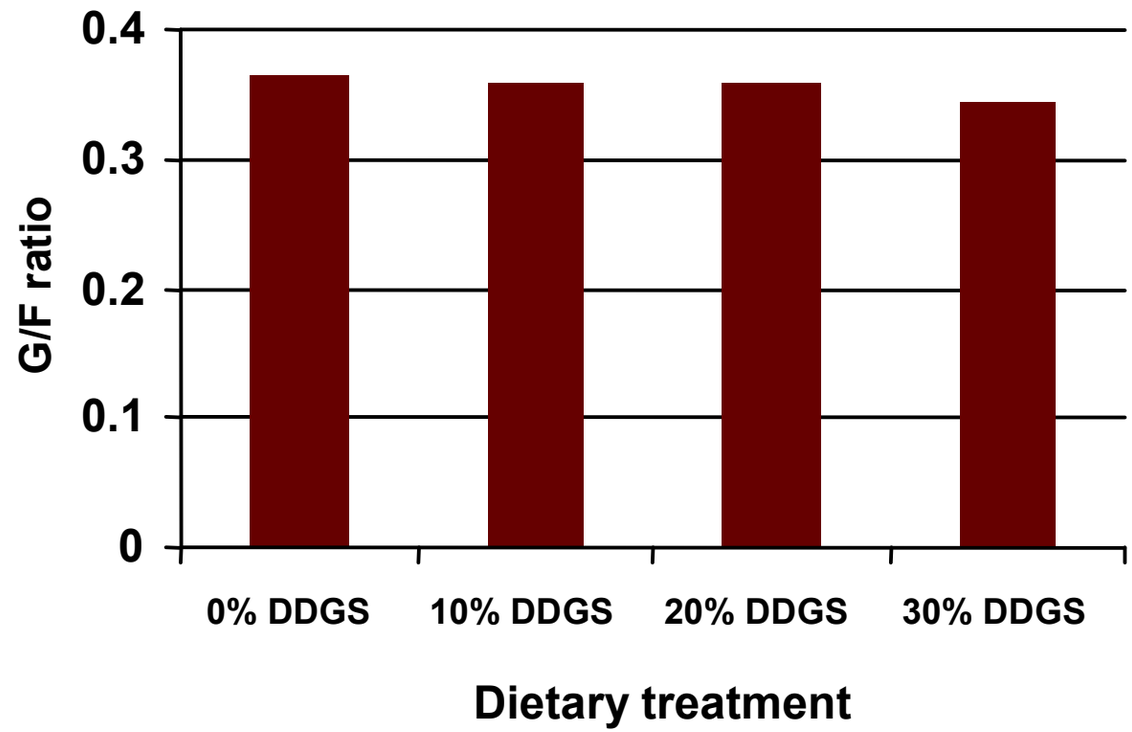
0 % and 10 % DDGS > 20% and 30% DDGS (P < .10)

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



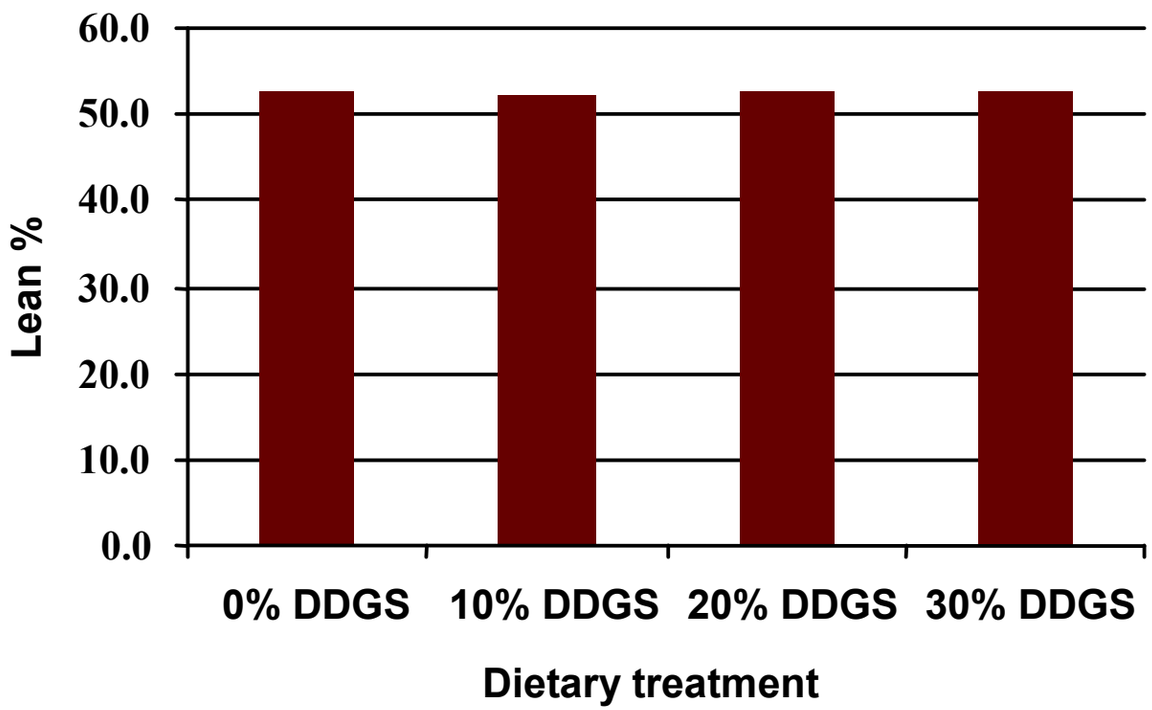
No significant differences among dietary treatments

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 Lean



No significant differences among dietary treatments

Effect of Dietary DDGS Level on Carcass Characteristics of Grow-Finish Pigs

	0% DDGS	10% DDGS	20% DDGS	30% DDGS
Slaughter weight, lbs	258	263	249	247
Carcass weight, lbs	189[c]	191[c]	180[d]	178[d]
Dressing %	73.4[c]	72.8[c]	72.1[d]	71.9[d]
Fat depth, in.	0.85	0.87	0.84	0.82
Loin depth, in.	2.26[ac]	2.16[b]	2.19[c]	2.06[d]
% Lean	52.6	52.0	52.6	52.5

[a, b] Means within row with unlike superscripts differ (P < .05).

[c, d] Means within row with unlike superscripts differ (P < .10).

Muscle Quality Characteristics from Grow-Finish 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, 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).

Study 2 – U of M/Land O' Lakes Field Trial

U of M/Land O' Lakes
Pork Fat Quality Field Study (2006)

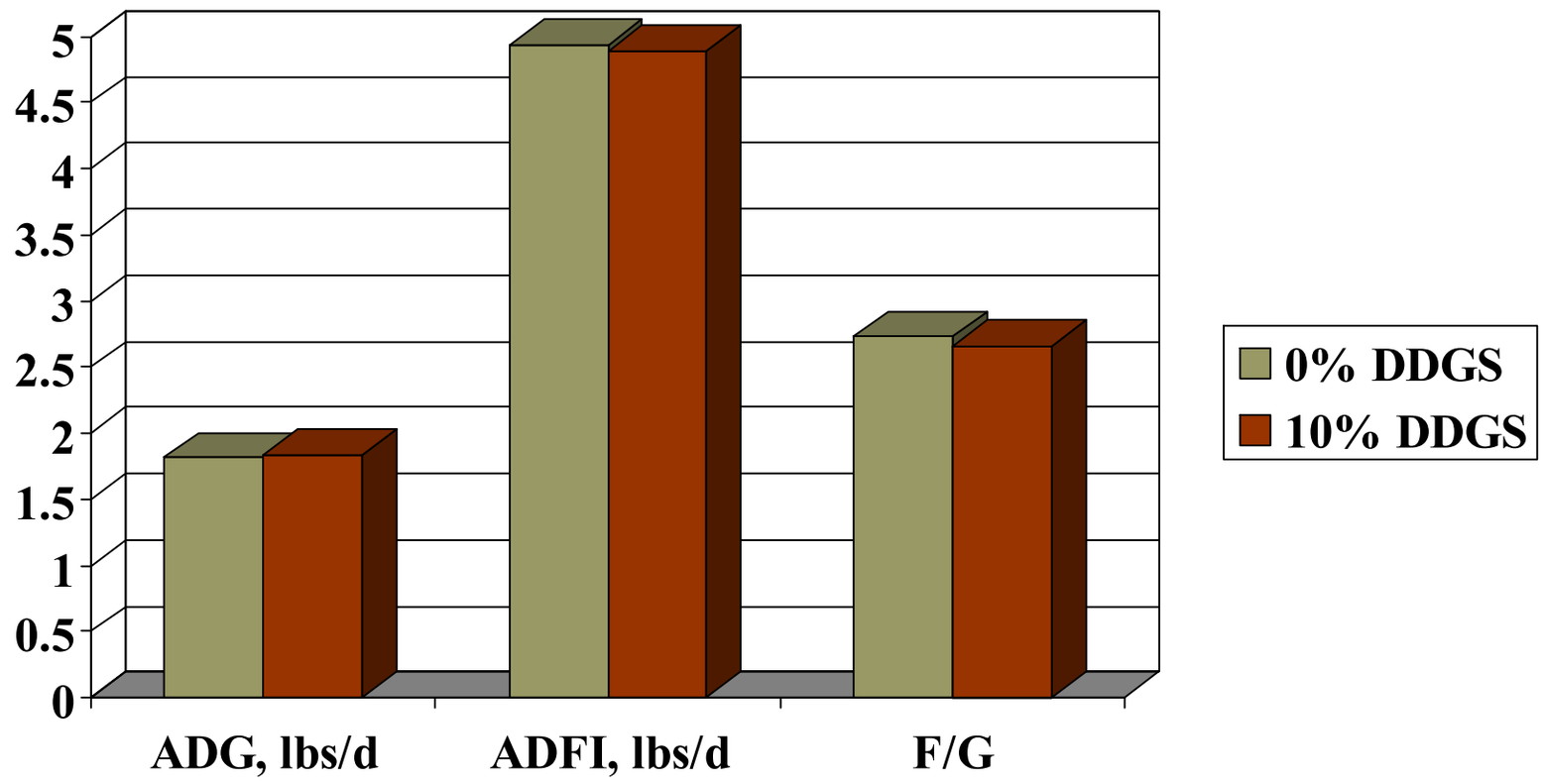
- Facilities
  - Two commercial 1000 head finishing barns in southern MN
  - Separate sites, two independent producers
  - Each barn had 40 pens, double sided curtain
    - buildings with 8' pits
    - pit fans for ventilation
    - weighted baffle ceiling air inlets

- Genetics
  - Monsanto Genepacker sows
  - Monsanto EB terminal semen

U of M/Land O' Lakes
Pork Fat Quality Field Study (2006)

- **Nutrition**
  - Provided by Land O' Lakes
  - Producer A fed typical corn-soybean meal diets
  - Producer B fed corn-soybean meal diets containing 10% DDGS
  - 7-phase mixed sex feeding program
  - Last finisher diet contained 4.5g Paylean
  - Diets contained similar nutrient levels with and without 10% DDGS
  - All diets contained choice white grease as the supplemental fat source (1.25 to 3.75%).

Growth Performance of Grow-Finish Pigs Fed 0 or 10% DDGS Diets (UM/LOL Field Trial)



Carcass Characteristics of Grow-Finish Pigs Fed 0 or 10% DDGS Diets (UM/LOL Field Trial)

Measurement	0% DDGS Diets	10% DDGS Diets
Carcass weight, lbs	212	210
Last rib backfat, in.	1.09	1.11
Tenth rib backfat, in.	1.01	0.99
Ham, %	11.74	11.74
Loin, %	7.93	7.91
Belly, %	10.51	10.41
Loin depth, in.	2.72	2.72
Lean %	56.36	56.47

No significant differences in carcass characteristics.

Mid-Belly Fat Quality Characteristics of Carcasses of Grow-Finish Pigs Fed 0 or 10% DDGS Diets (UM/LOL Field Trial)

Measurement	0% DDGS Diets	10% DDGS Diets
Japanese fat color score (1-4)	1.76	1.81
Mean melting point, °C	29.26	28.70
Iodine value	66.7[a]	68.3[b]
14:0, 16:0, 16:1, 17:0, 17:1, 18:0, %	No differences	No differences
18:1 oleic acid, %	47.39[c]	45.12[d]
18:2 linoleic acid, %	11.94[c]	13.98[d]
18:3, 18:4, 20:0, 20:1, 20:2, 20:4, %	No differences	No differences
Saturated fatty acids, %	33.99	34.26
Monounsaturated fatty acids, %	51.78[c]	49.47[d]
PUFA, %	14.02[c]	16.11[d]
Total Omega 3, %	0.98	0.96
Total Omega 6, %	13.02[c]	15.14[d]
Omega 6:Omega 3 ratio	13.28[c]	15.78[d]

[a, b] Means within rows with unlike superscripts differ (P < .05).

[c, d] Means within rows with unlike superscripts differ (P < .0001).

Study 3 – Effect of Formulating G-F Diets Containing Increasing Levels of DDGS on a Digestible Amino Acid Basis on Growth Performance and Pork Quality

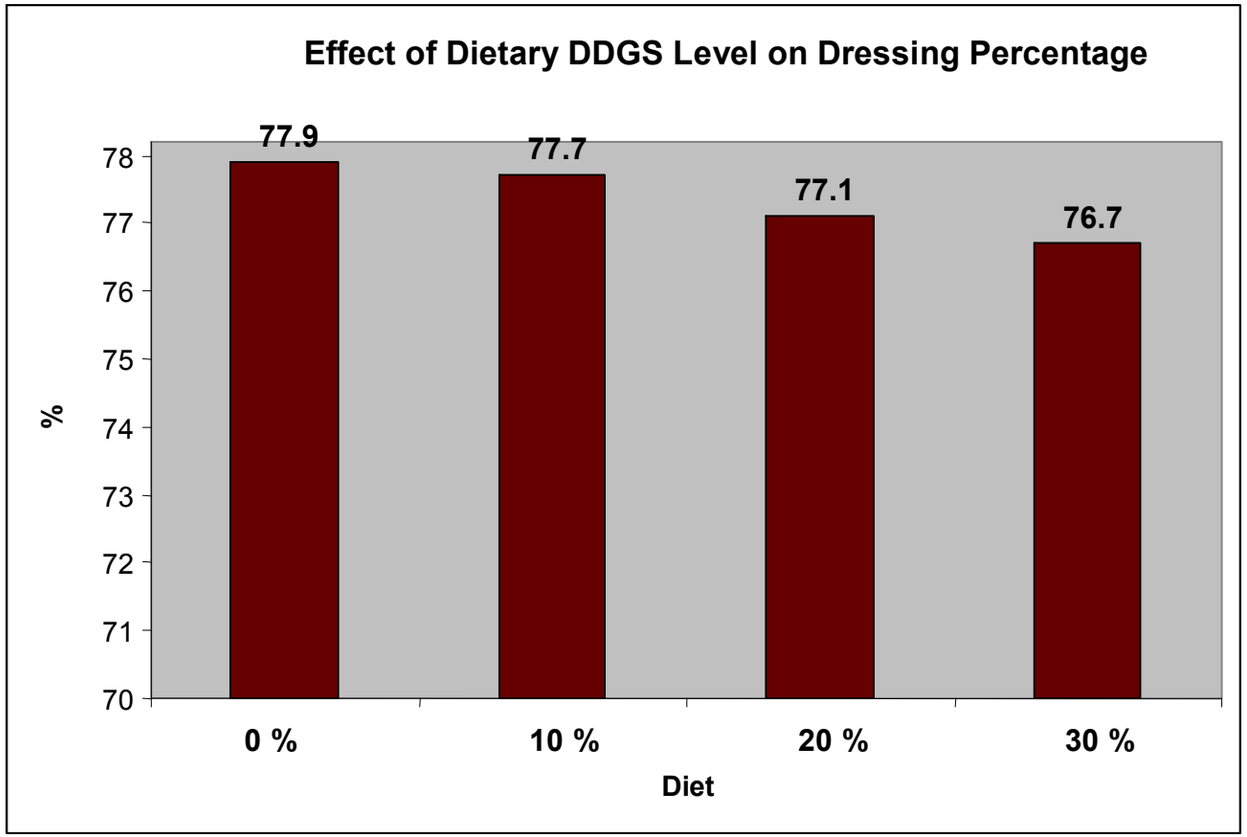
Effect of Formulating G-F Diets on a Digestible Amino Acid Basis, with Increasing Levels of DDGS, on Overall Growth Performance

	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/d	2.03	2.03	2.03	2.01
ADFI, lbs/d[a]	5.66	5.62	5.49	5.42
F/G[a]	2.79	2.76	2.71	2.70

[a] Linear effect of DDGS level

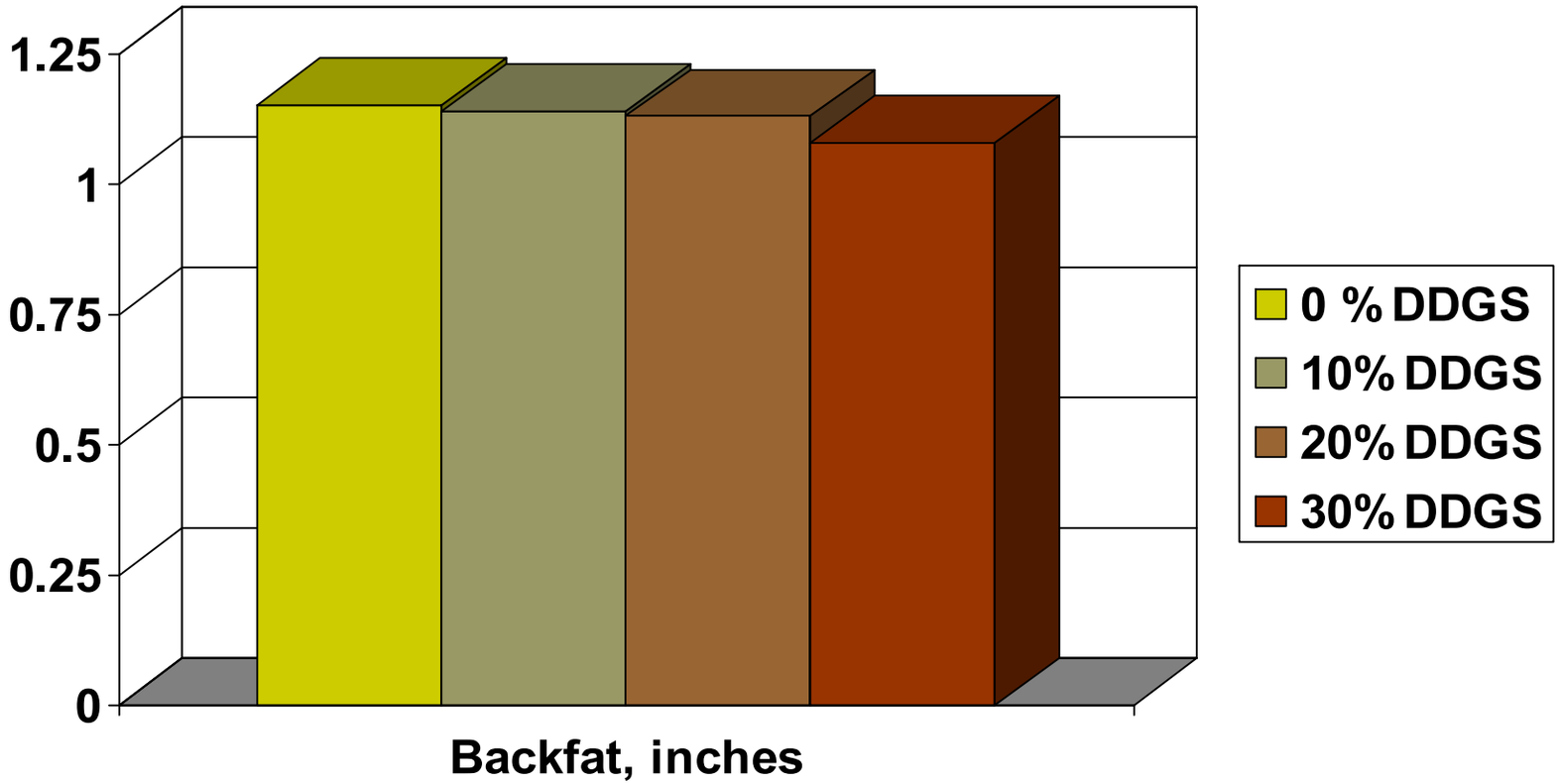
Data from 64 pens, 16 pens/treatment (Xu et al., 2007, unpublished)

Adding Increasing Levels of DDGS to G-F Diets Slightly Reduces Carcass Yield



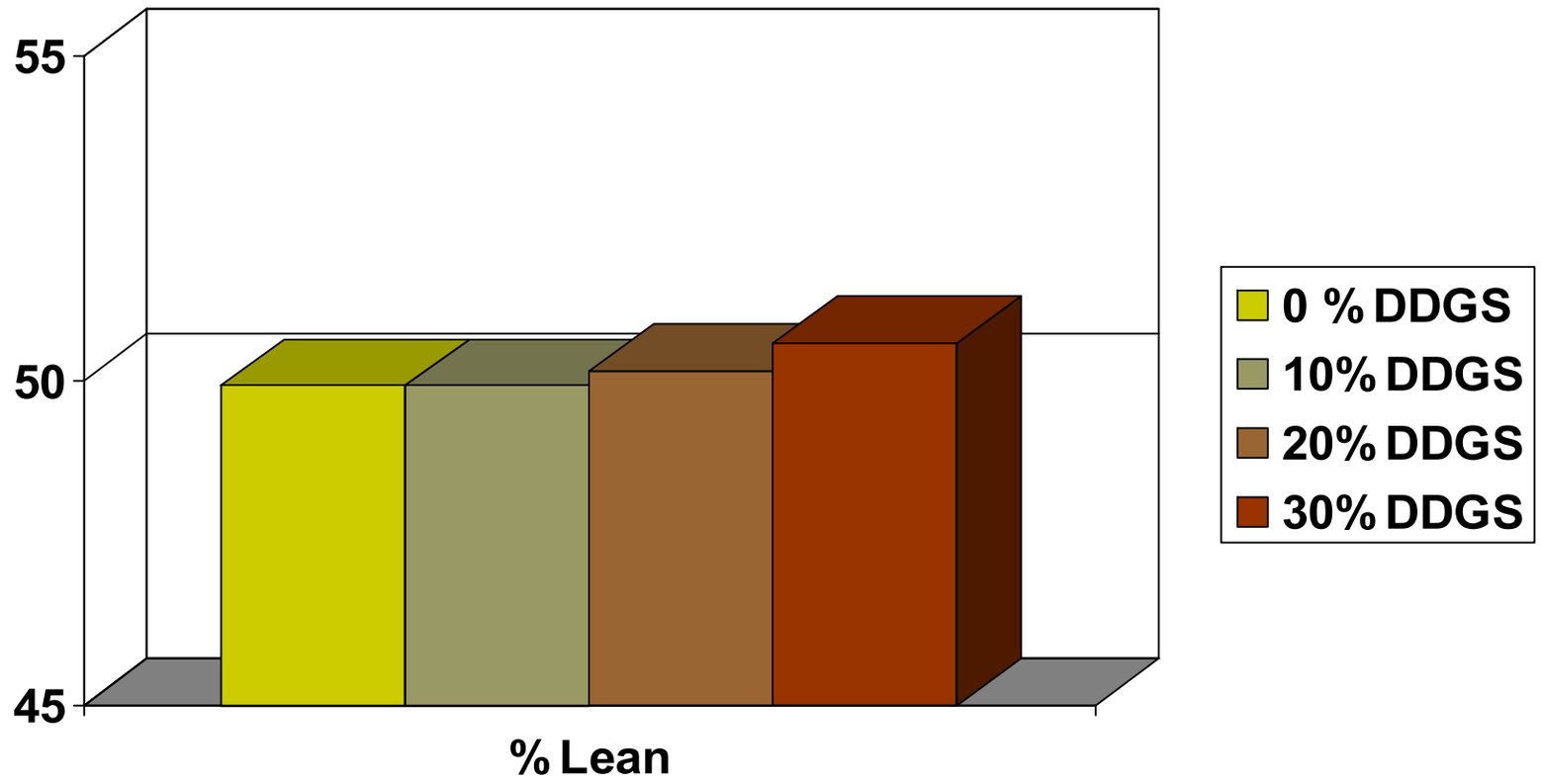
Xu et al. (2006) unpublished
Linear effect ($P < 0.01$)

Effects of Dietary DDGS Level on Last Rib Backfat



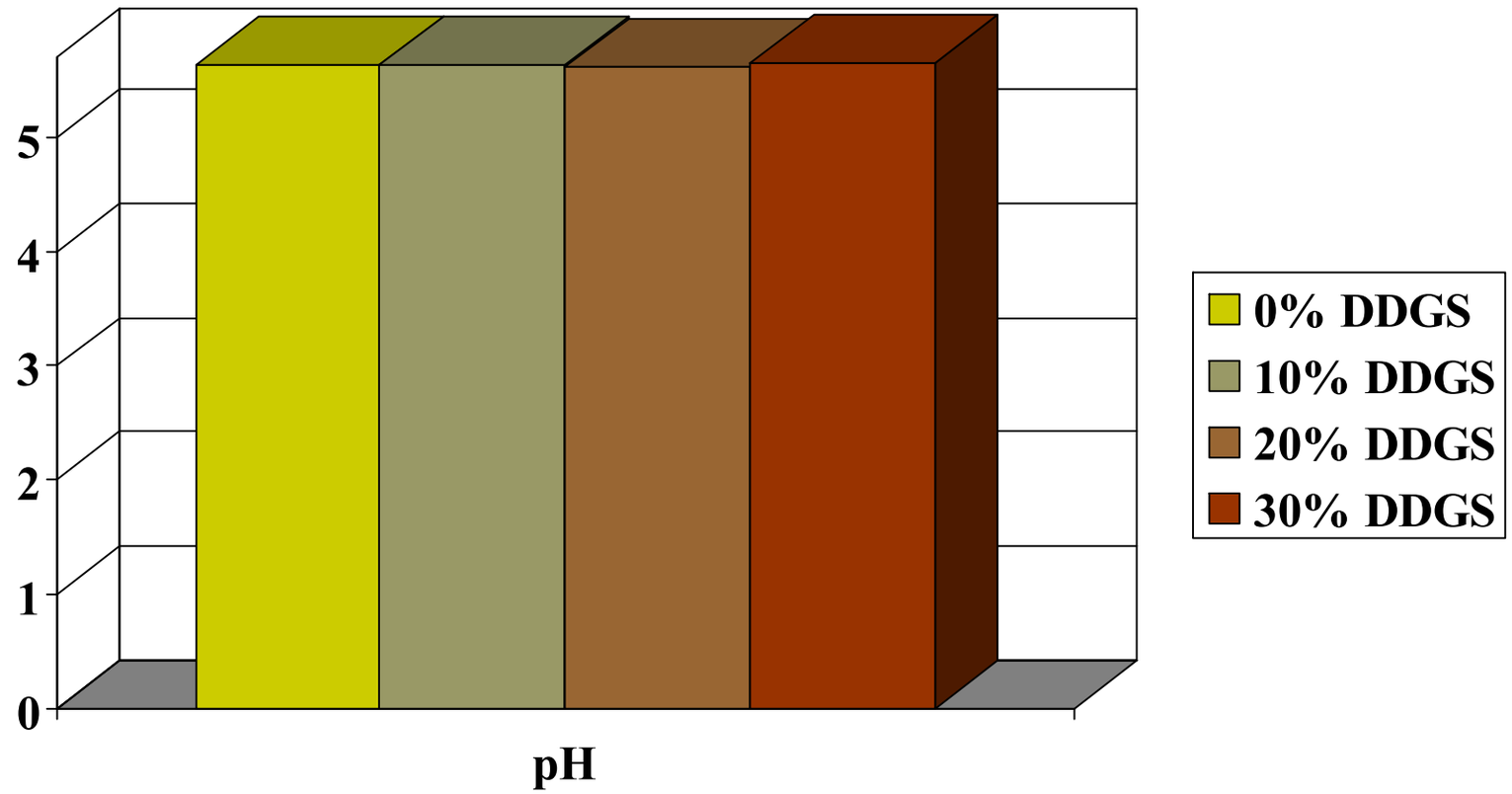
Xu et al. (2006) unpublished
30% DDGS tended to be lower than 0% DDGS (P = 0.09)

Effects of Dietary DDGS Level on % Carcass Lean



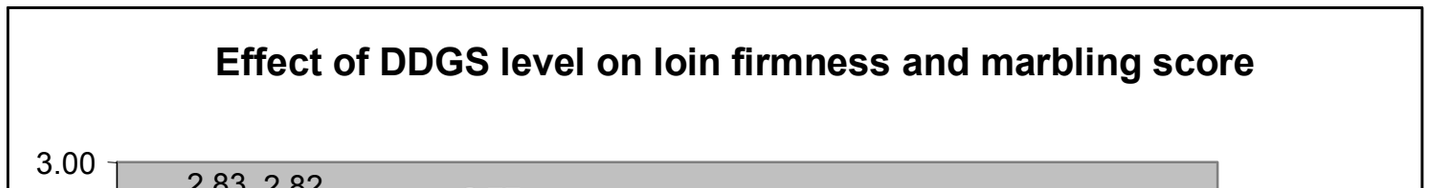
Xu et al. (2006) unpublished
30% DDGS tended to be higher than 0% DDGS (P = 0.11)

Effects of Dietary DDGS Level on Ultimate Muscle pH

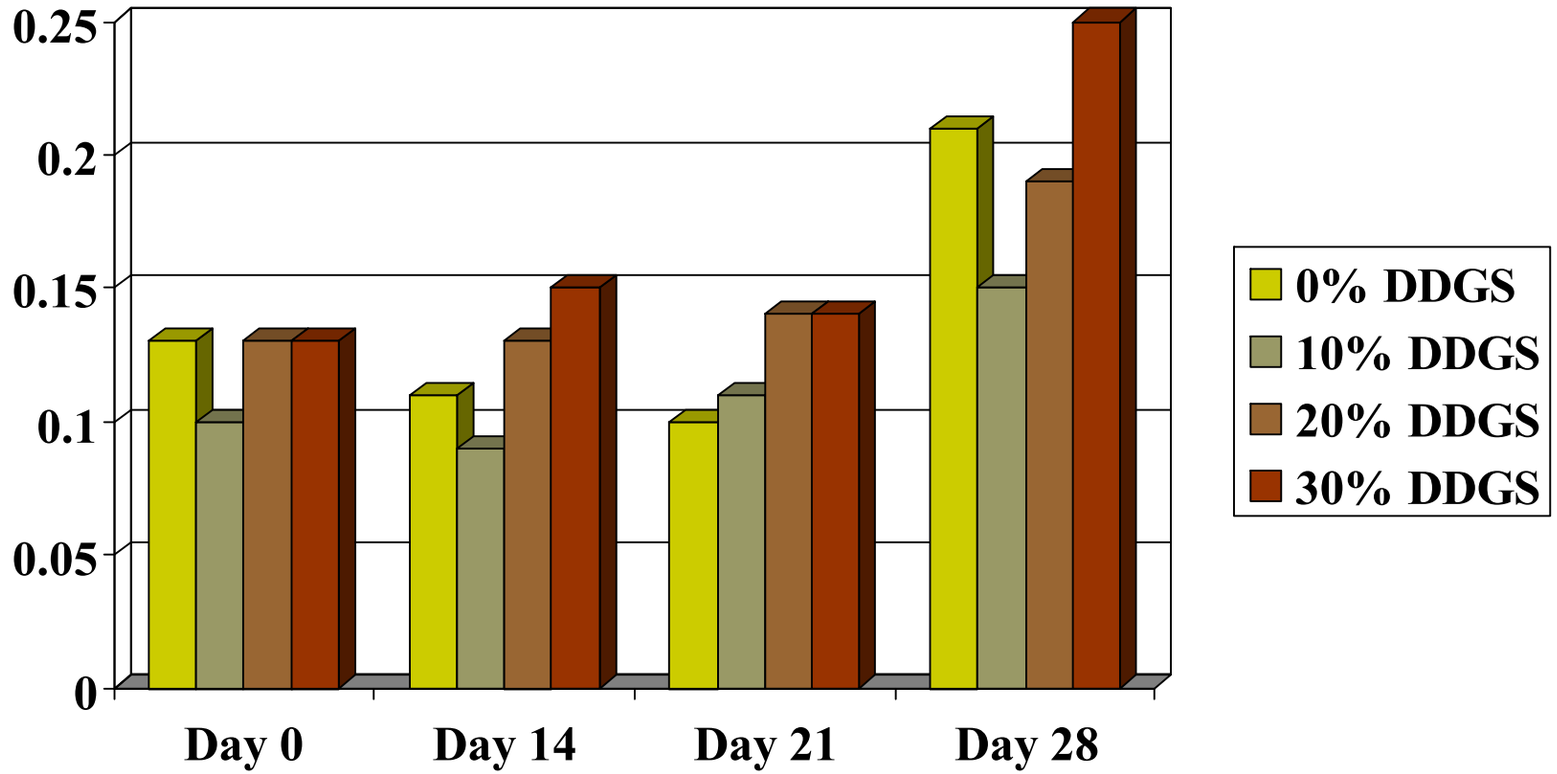


Effects of Increasing Dietary DDGS Level on Loin Characteristics

- Loin firmness was linearly reduced
  - Due to reduced marbling
- Marbling was linearly reduced
  - Due to trend for reduced backfat
- Pigs fed the 30% DDGS diets had loins that were slightly less red
- No overall differences in subjective color score
- No differences in drip loss on day 0, 14, 21, or 28 post-harvest
- No differences in lipid oxidation in loins at 28 days of shelf storage

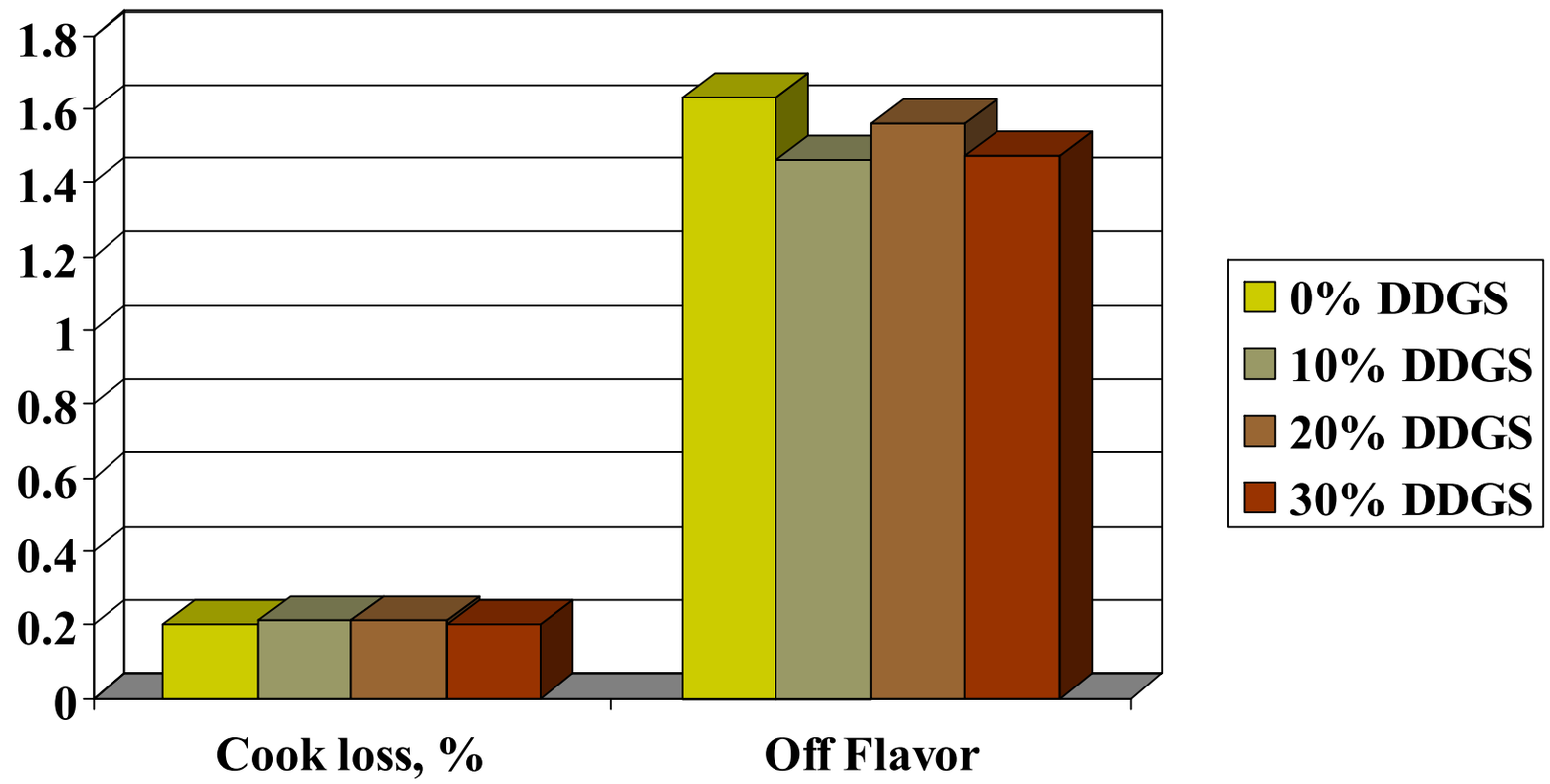

Effect of DDGS level on loin firmness and marbling score
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
2.83
2.82
2.77
2.74
2.65
2.43
2.52
2.42
Contr.
D10
D20
D30
Diet
Firmness
Marbling

Effects of Increasing Dietary DDGS Level on Fat Stability of Pork Loins (TBARS, mg malonaldehyde/kg)



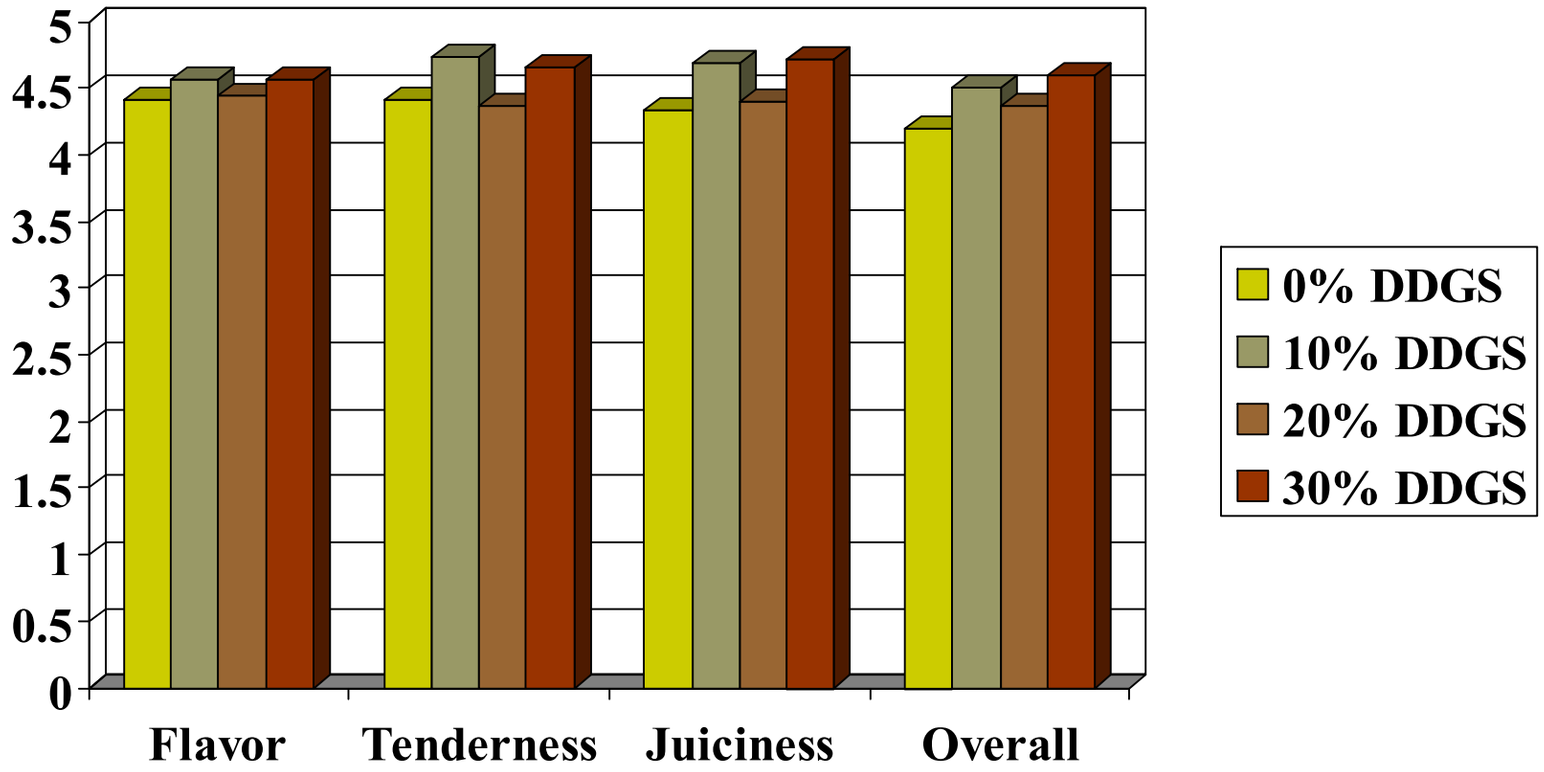
No significant differences among dietary treatments.

Effects of Increasing Dietary DDGS Level on Cook Loss and Off Flavor of Pork Loins



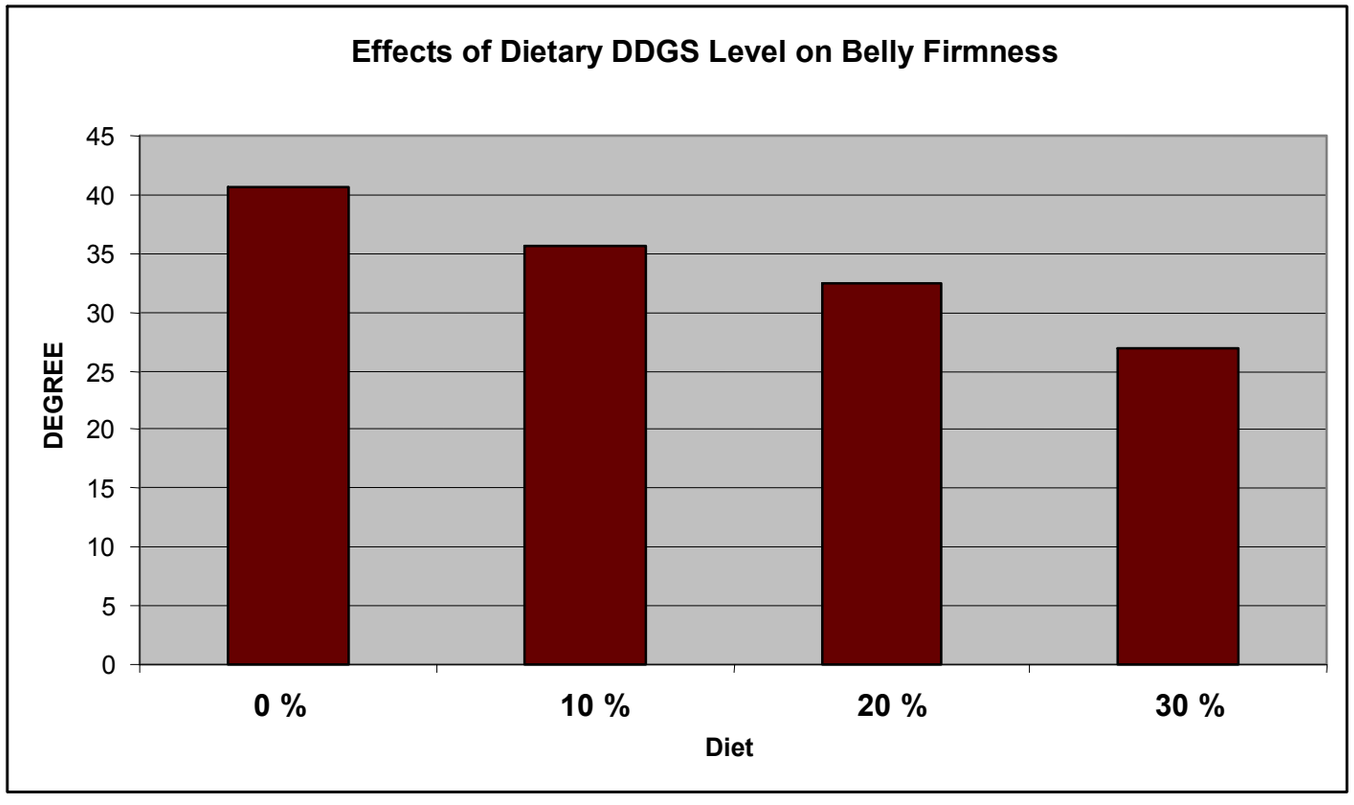
No significant differences among dietary treatments.

Effects of Increasing Dietary DDGS Level on Eating Characteristics of Pork Loins



No significant differences among dietary treatments.

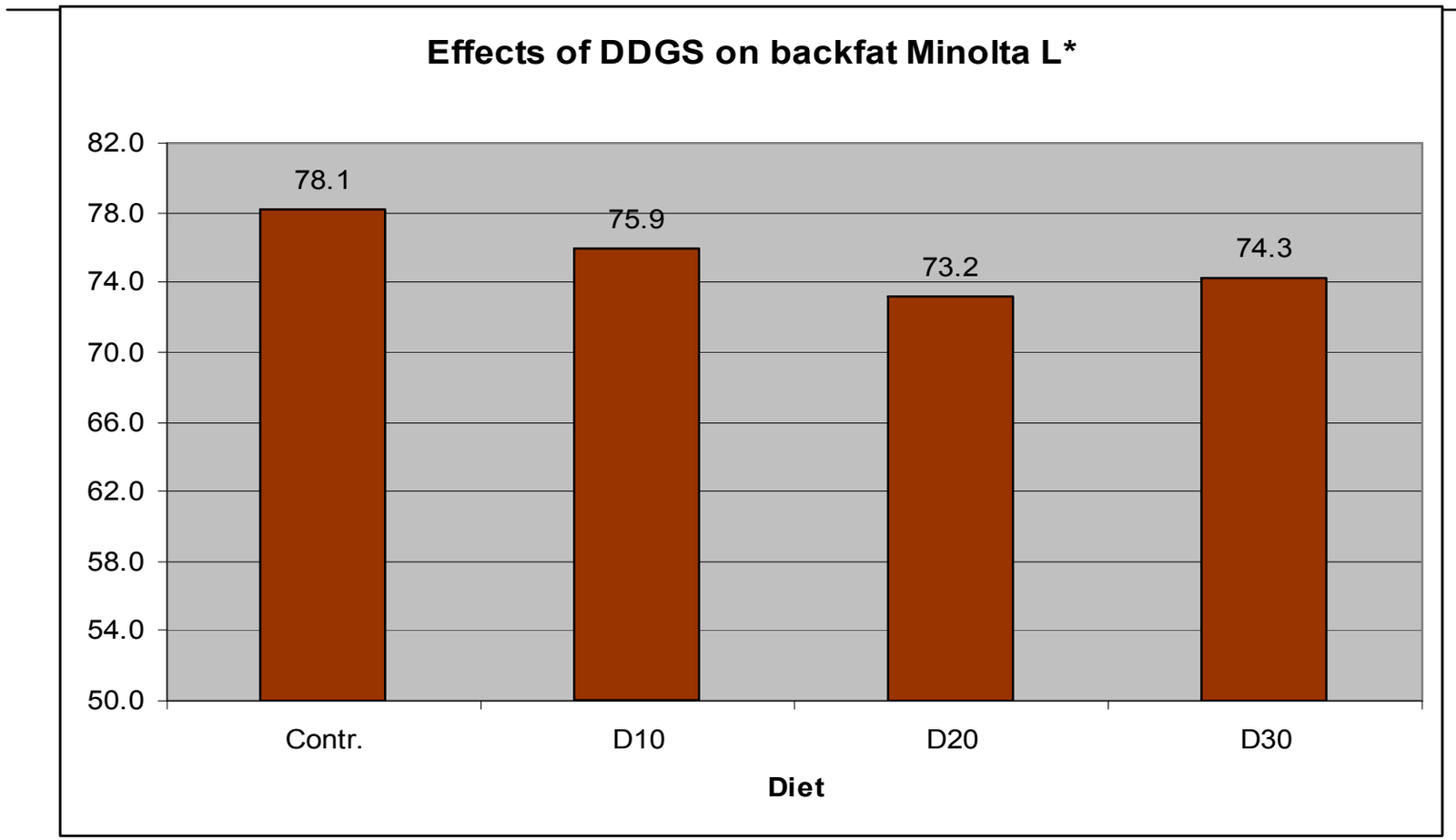
Adding Increasing Levels of DDGS to G-F Diets Linearly Reduces Belly Firmness



Xu et al. (2006) unpublished

Effects of Increasing Dietary DDGS Level on Belly and Backfat Characteristics

- No effect on belly thickness
- No differences in belly fat color
  - Japanese color score
  - Minolta L*, a*, b*
- Backfat was slightly darker (lower L*) for pigs fed the 20% and 30% DDGS diets
- No differences in backfat color
  - Japanese color score
  - Minolta a*, b*


Effects of DDGS on backfat Minolta L*
82.0
78.0
74.0
70.0
66.0
62.0
58.0
54.0
50.0
78.1
75.9
73.2
74.3
Contr.
D10
D20
D30
Diet

Take Home Messages

- 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

- 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 are generally unaffected by feeding diets containing increasing levels of DDGS

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