Effects of adding distiller's dried grains with solubles to gestation and lactation diets on reproductive performance and nutrient balance in sows

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Introduction

- Adding high fiber ingredients to gestation diets has been shown to increase litter size.
  - Hagen et al., 1987 (alfalfa haylage)
  - Carter et al., 1987 (alfalfa meal)
  - Everts, 1991 (straw and corn silage)
  - Ewan et al., 1996 (wheat straw)

Distiller's Dried Grains with Solubles (DDGS)

Introduction

- “New Generation” DDGS
  - 0.7% soluble fiber
  - 42.2% insoluble fiber
- These levels of fiber in DDGS are comparable to those found in alfalfa (4.3% and 52.4% respectively).
- Will feeding high amounts of DDGS to sows also result in litter size improvements?

Introduction

- Published recommendations for maximum use of DDGS in sow diets:
  - Feed Co-Products Handbook (1997)
    - up to 50% in gestation diets
    - up to 20% in lactation diets
  - Pork Industry Handbook (1998)
    - up to 40% in gestation diets
    - up to 10% in lactation diets

Objectives

- To determine the effects of feeding diets containing 50% DDGS during gestation and/or 20% DDGS during lactation on sow and litter performance.
- To determine the effects of feeding a diet containing 50% DDGS on nutrient balance of gestating sows:
  - Nitrogen
  - Phosphorus
  - Sulfur

Methodology – sow performance

- Reproductive cycle 1 (RC1)
  - 93 sows (5 breeding groups)
- Sows were blocked by initial BW and parity
  - randomly assigned to 1 of 4 dietary treatment combinations in a 2 x 2 factorial arrangement
- Each dietary treatment combination consisted of a gestation and lactation diet
  - GC/LC (n = 21)
  - GC/LDG (n = 22)
  - GDG/LC (n = 25)
  - GDG/LDG (n = 25)

Methodology – sow performance

- Reproductive cycle 2 (RC2)
  - 49 sows remained on previous gestation and lactation dietary treatments
- Each dietary treatment combination consisted of a gestation and lactation diet
  - GC/LC (n = 11)
  - GC/LDG (n =12)
  - GDG/LC (n = 7)
  - GDG/LDG (n=19)

Composition of experimental gestation diets

Ingredient (%)	Control**	DDGS**
Corn	81.8	36.5
Soybean Meal, 46%	13.6	8.7
DDGS	0.0	50.0
Dicalcium Phosphate	2.8	0.8
Limestone	0.3	2.5
Other*	1.5	1.5
Total	100.0	100.0

***Other includes salt, vitamin/trace mineral premix, choline, and biotin**

**** Diets were formulated to contain 0.55% available P, 0.45% app. dig. lysine**

Composition of experimental lactation diets

Ingredient (%)	Control**	DDGS**
Corn	70.6	52.5
Soybean Meal, 46%	22.6	20.6
DDGS	0.0	20.0
Tallow	2.5	2.5
Dicalcium Phosphate	2.5	1.7
Limestone	0.4	1.3
Other*	1.4	1.4
Total	100.0	100.0

***Other includes L-Lysine HCl, salt, vitamin/trace mineral premix, and biotin**

**** Diets were formulated to contain 0.51% available P, 0.79% app. dig. lysine**

Methodology - sow performance

- Gestation diets were limit fed:
  - day 0 (1% BW)
  - day 30 (1% BW + 100g)
  - day 60 (1% BW + 300g)
  - day 90 (1% BW + 500g)
- On day 110 of gestation, lactation diets were limit fed
- After farrowing, sows were provided ad libitum access to lactation diets.

Methodology - sow performance

- Sow body weight measurements taken at:
  - **breeding (d 0)**
  - **days 30, 60, and 90 of gestation**
  - **farrowing (within 24h)**
  - **weaning**
- Litter size and weight were recorded at farrowing
  - **total pigs born**
  - **total pigs born alive**
  - **individual pig birth weights**
- Pigs were cross-fostered among litters within dietary treatment within 24-48 h after birth to equalize litter size
- Pigs were weighed at weaning (18 ± 1 d of age)

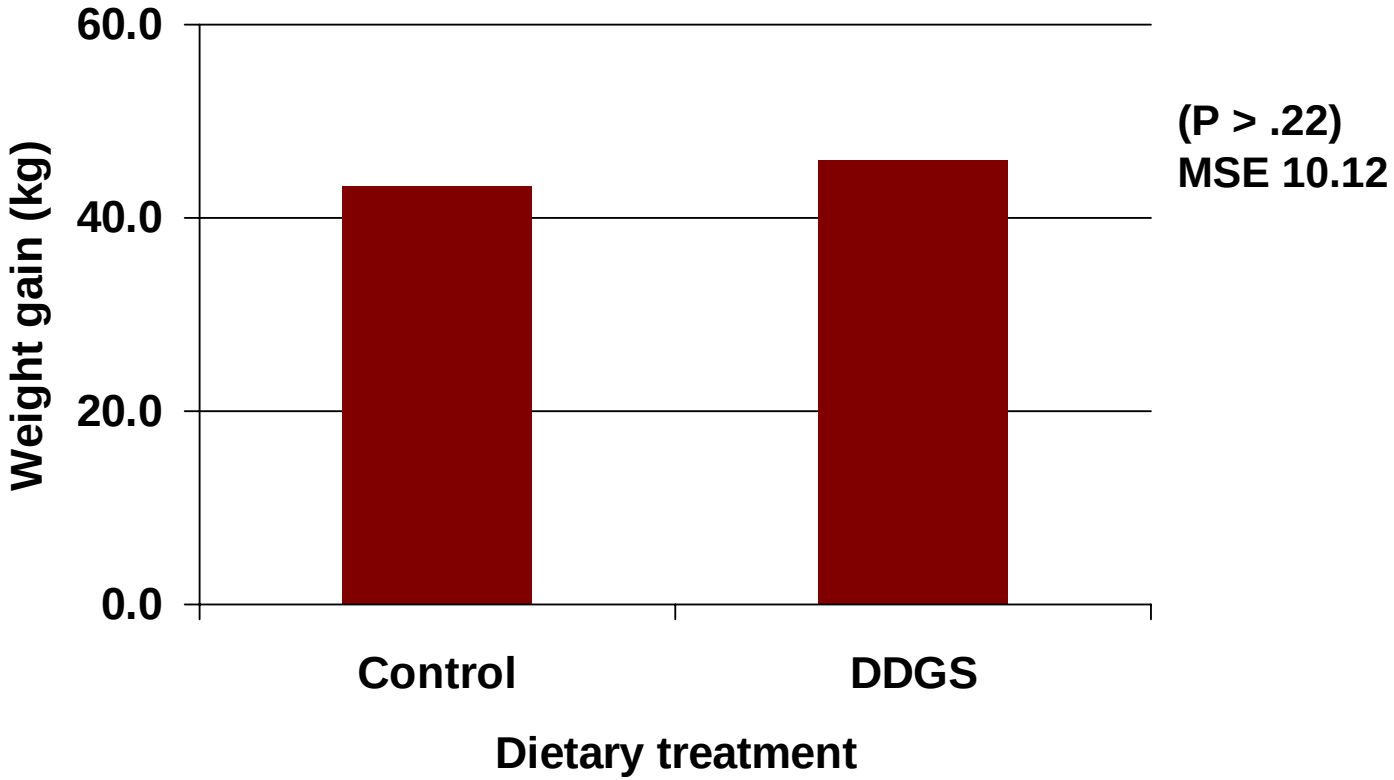
Methodology - nutrient balance

- Utilized 14 sows at d 90 of gestation (7 sows per gestation treatment)
- After a 10 d adjustment period, a 5 d collection period was used to collect:
  - total urine (via urinary Foley catheter)
  - total feces
- Feed, feces and urine analyzed for:
  - nitrogen - Kjeldahl analysis
  - phosphorus and sulfur - ICP

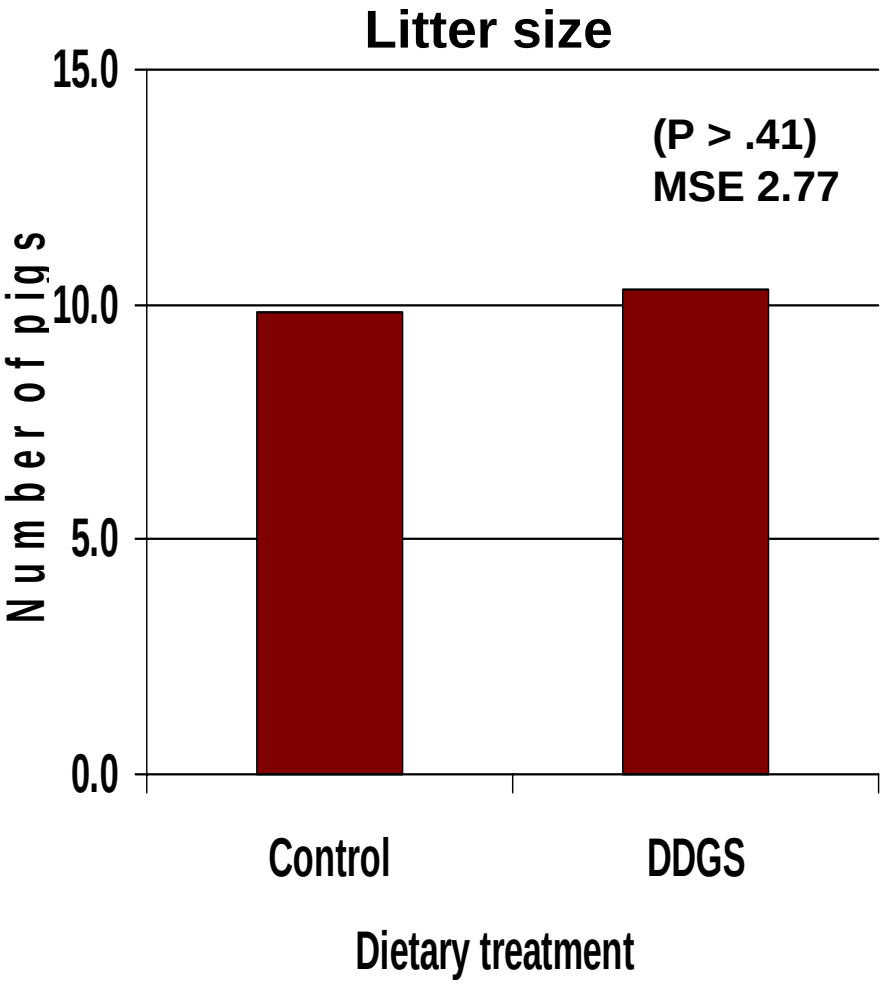
Statistical analysis

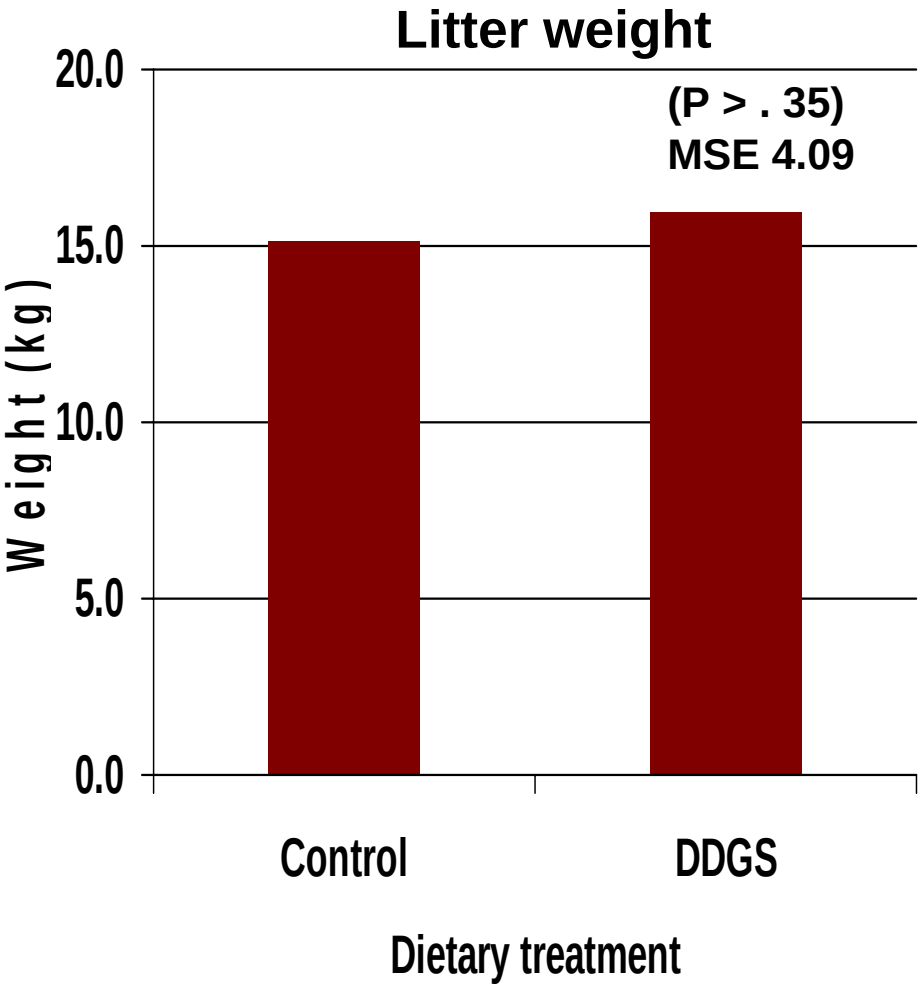
- Performance
  - Repeated measures in time
    - Litter size
    - Litter weight
  - ANOVA of the GLM procedures of SAS
    - All other data
  - Model included diet, parity, and time effects and their interactions
- Nutrient Balance
  - ANOVA of the GLM procedures of SAS.

Effect of gestation dietary treatment on sow weight gain during gestation (RC1)

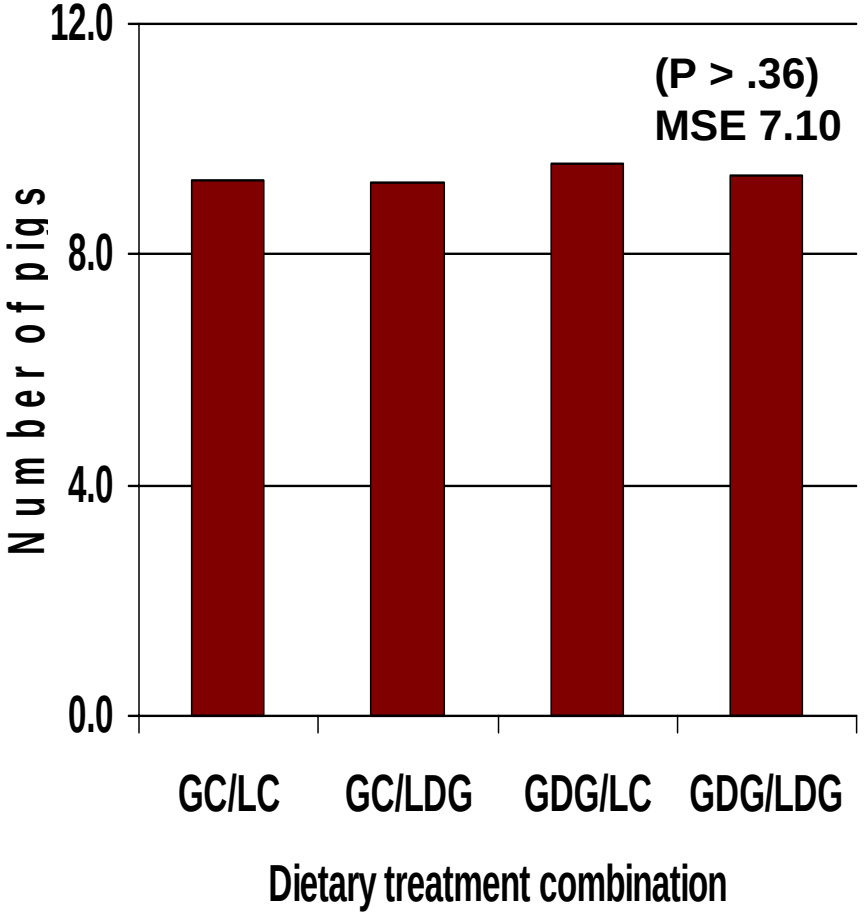


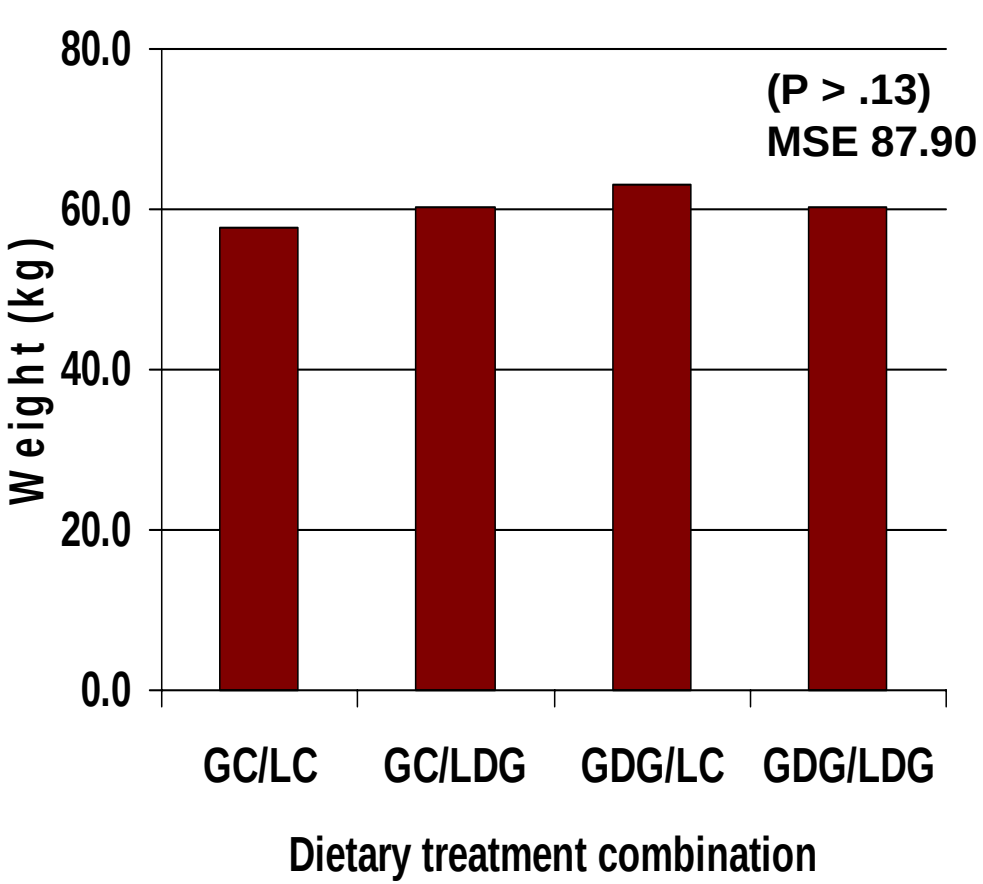
Effect of gestation dietary treatment on pigs born alive/litter and litter birth weight (RC1)



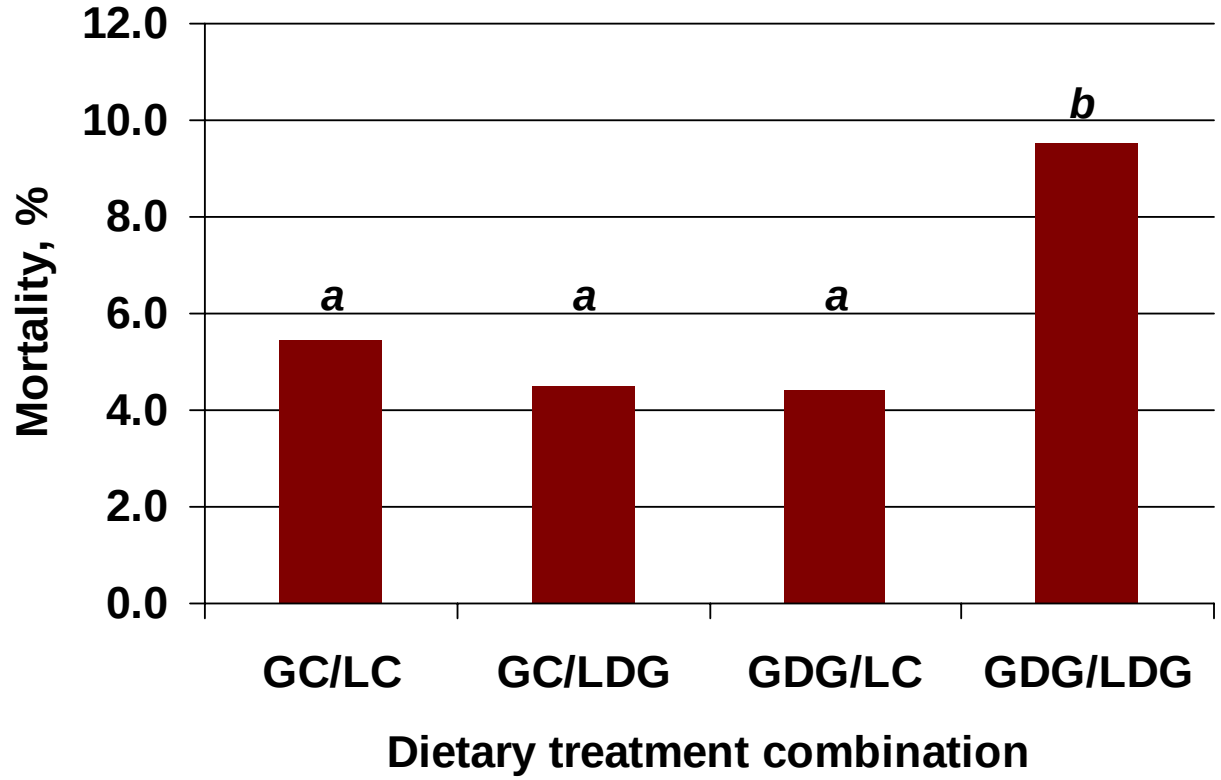


Effect of dietary treatment combination on weaning litter size and weight (RC1)



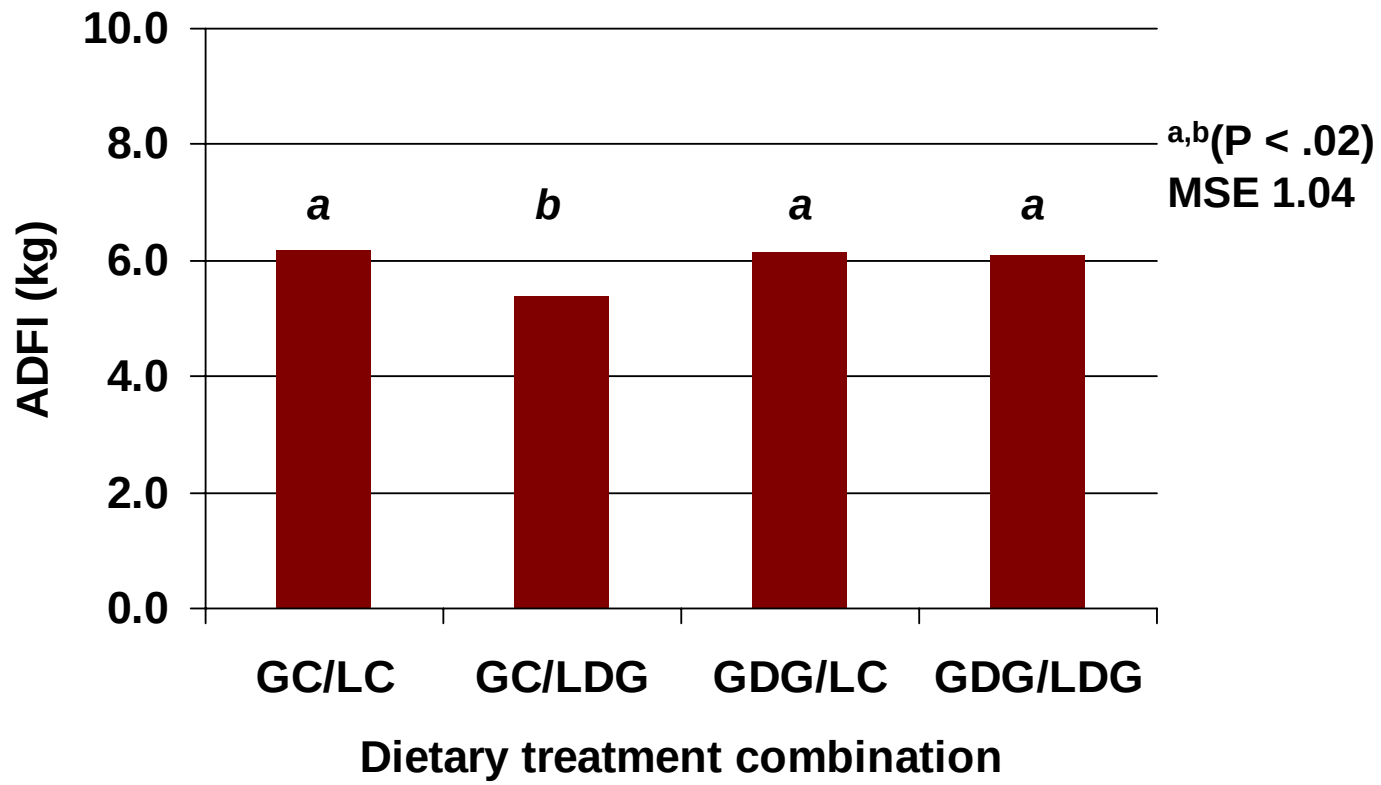


Effect of dietary treatment combination on pre-weaning mortality (RC1)

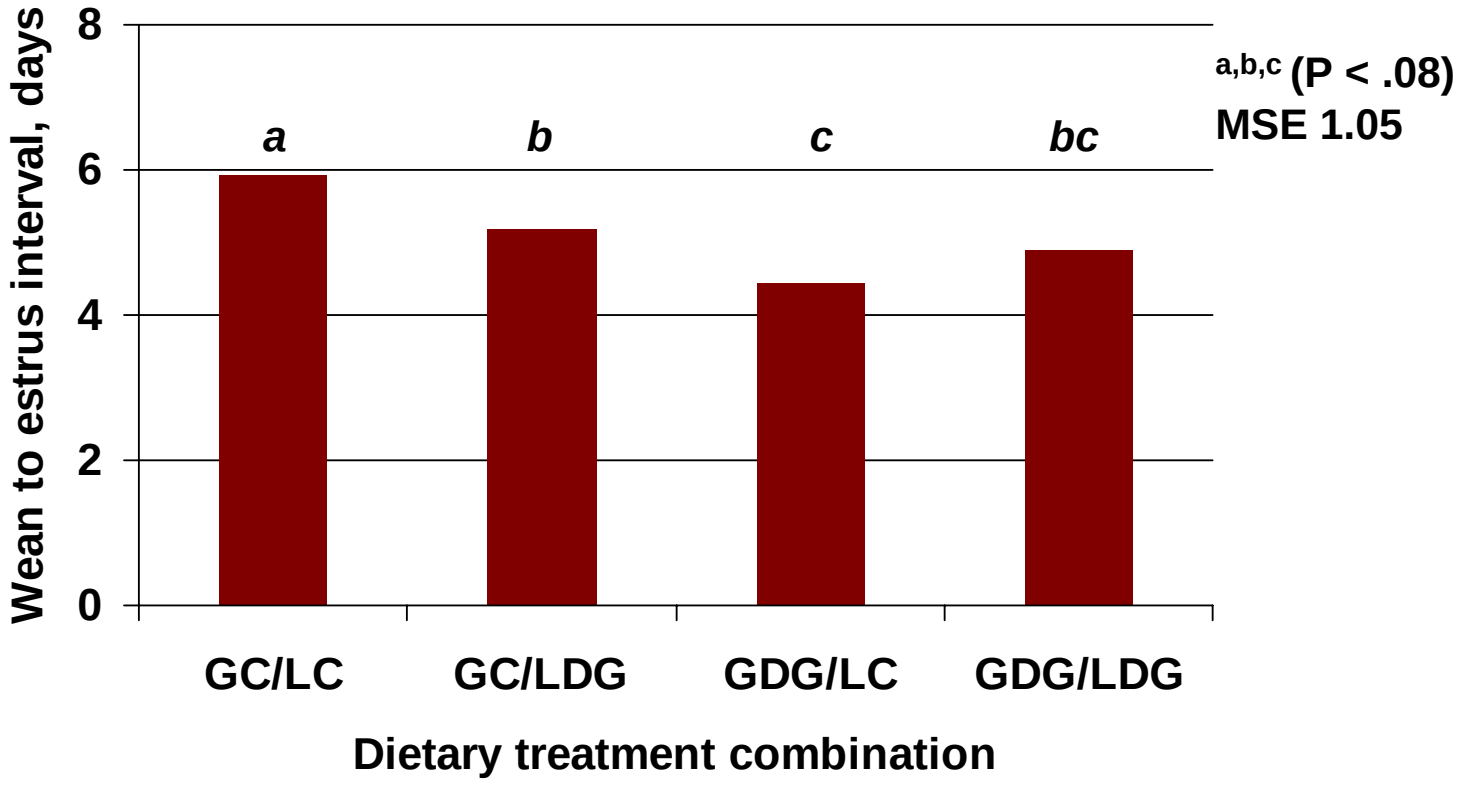


^{a,b} ($P < .08$)
MSE 7.46

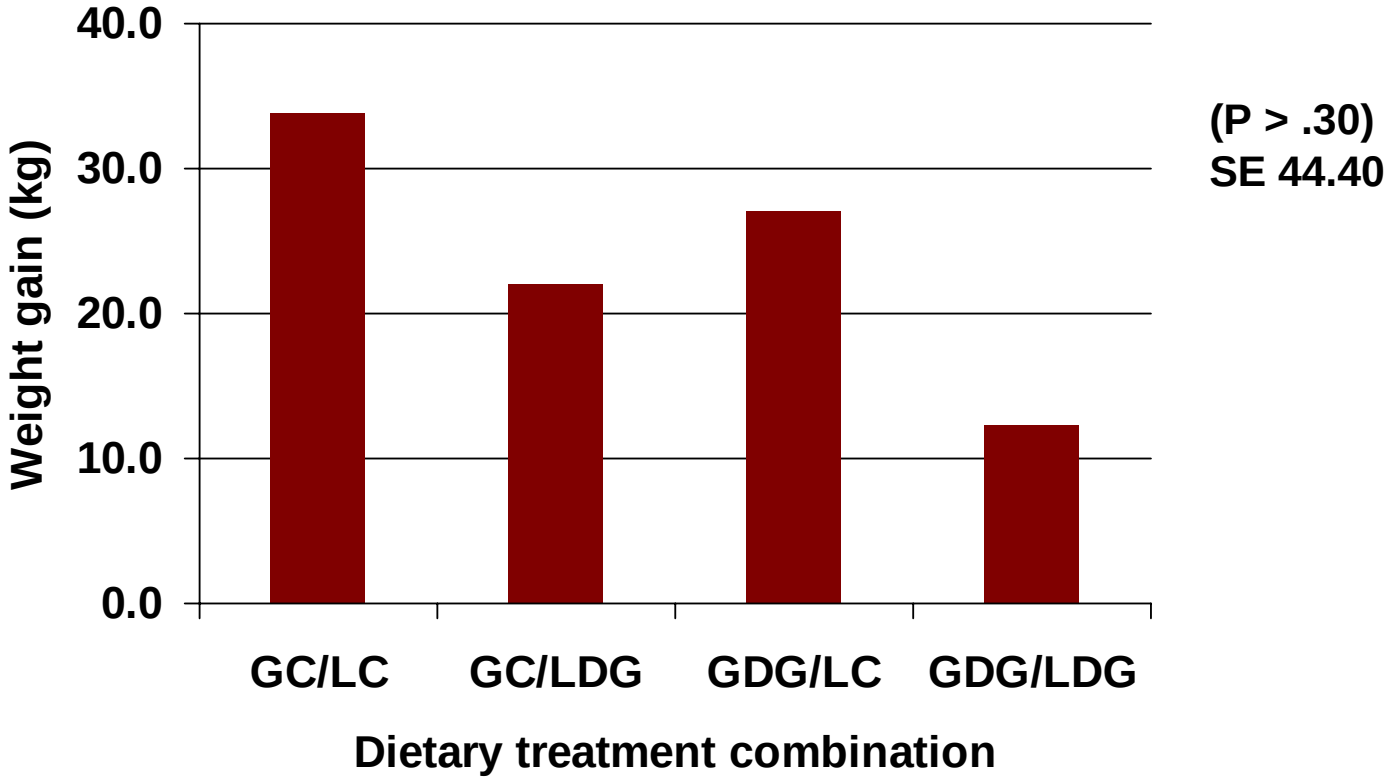
Effect of dietary treatment combination on sow lactation ADFI (RC1)



Effect of dietary treatment combination on wean to estrus interval (RC1)

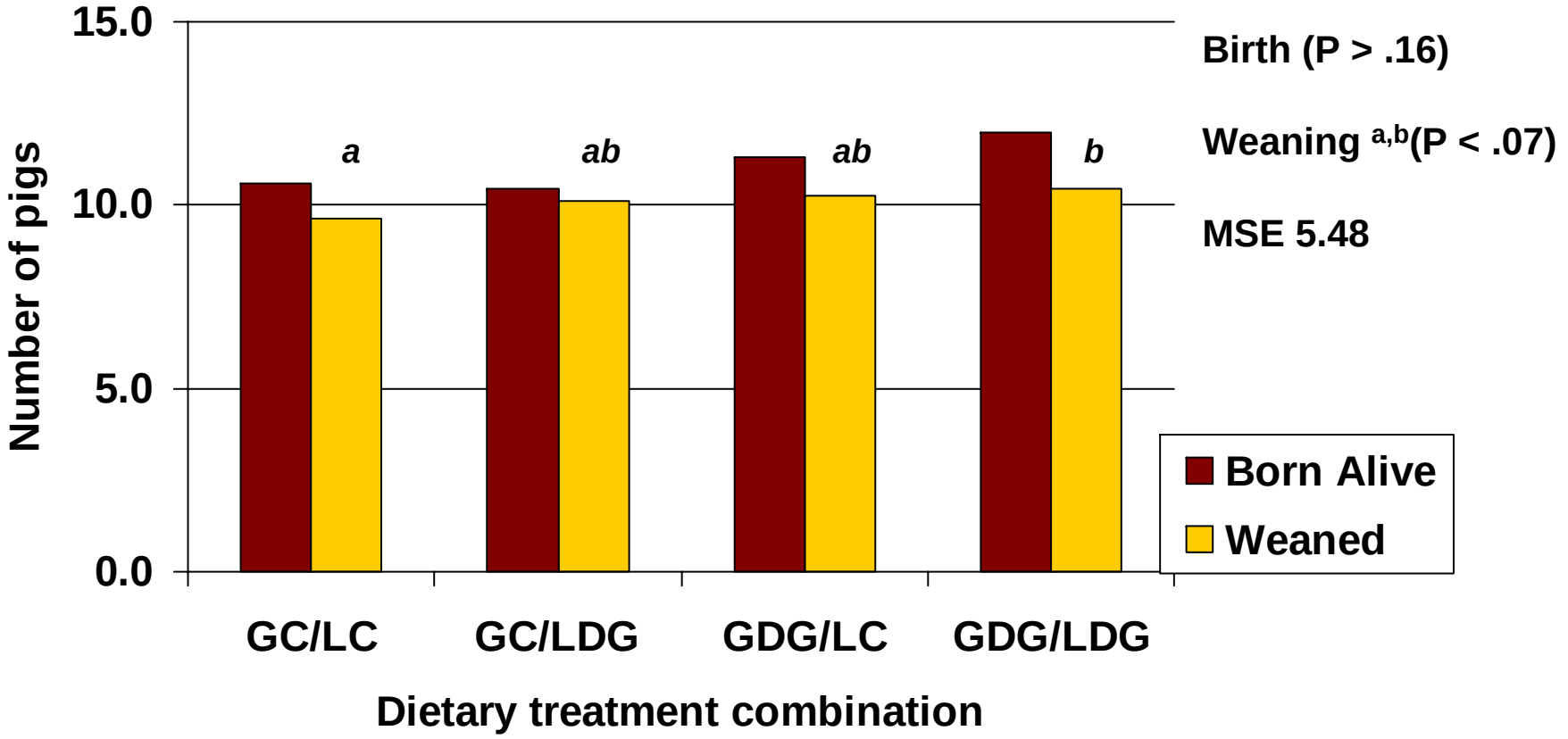


Effect of dietary treatment combination sow weight gain during gestation (RC2)

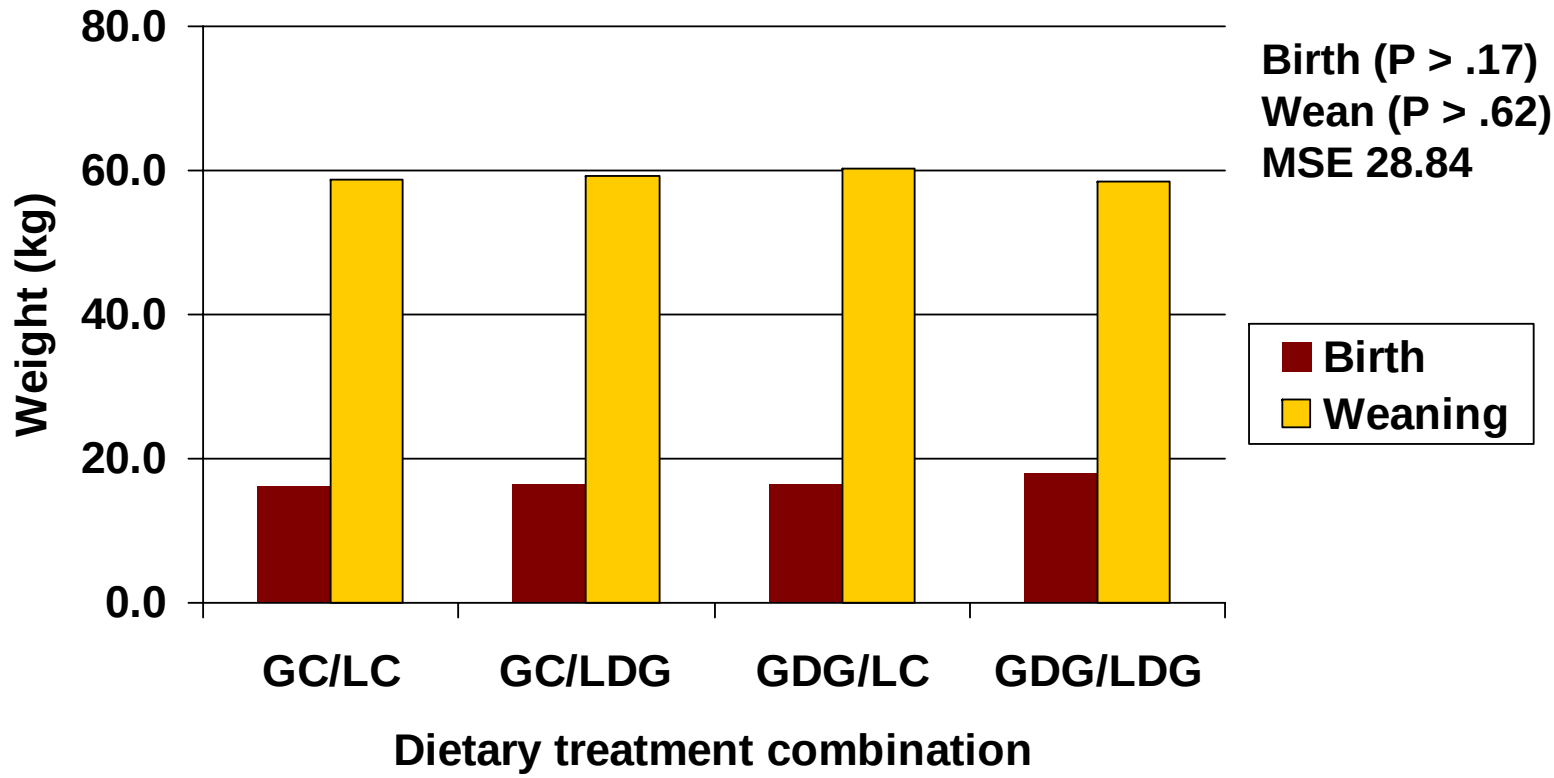


(P > .30)
SE 44.40

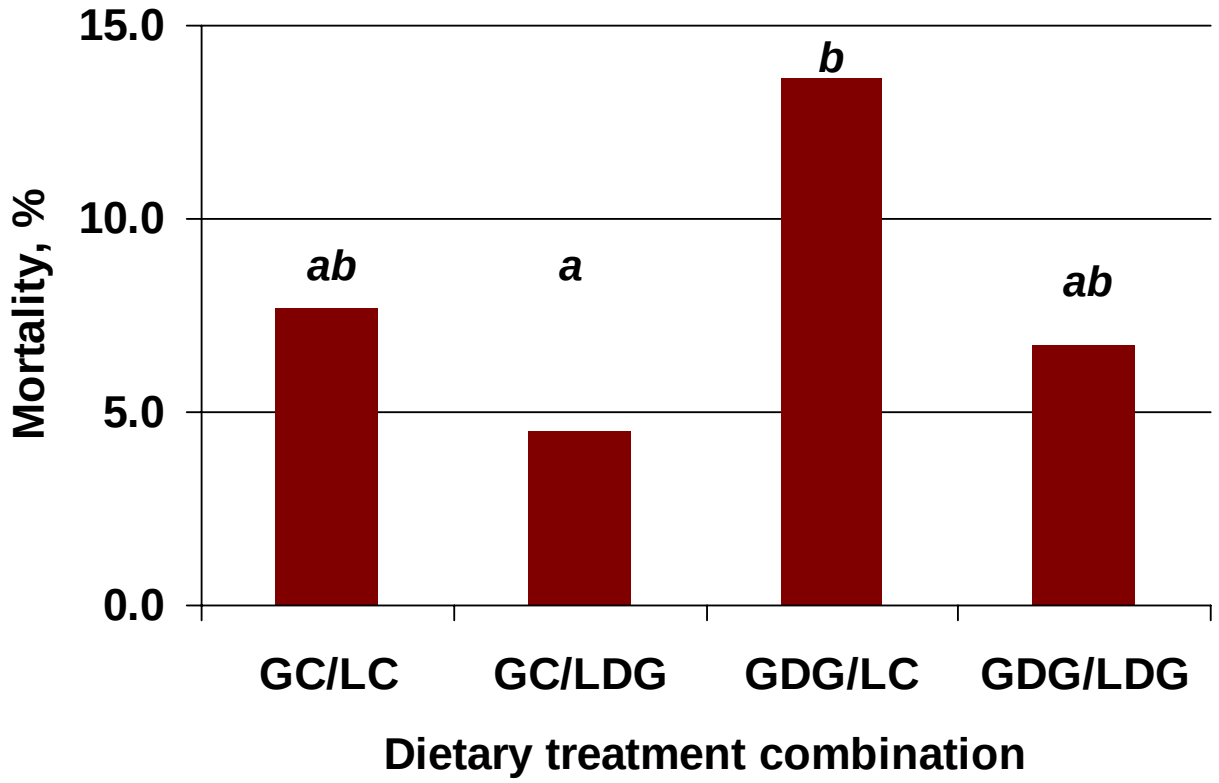
Effect of dietary treatment combination on litter size (RC2)



Effect of dietary treatment combination on litter weight (RC2)

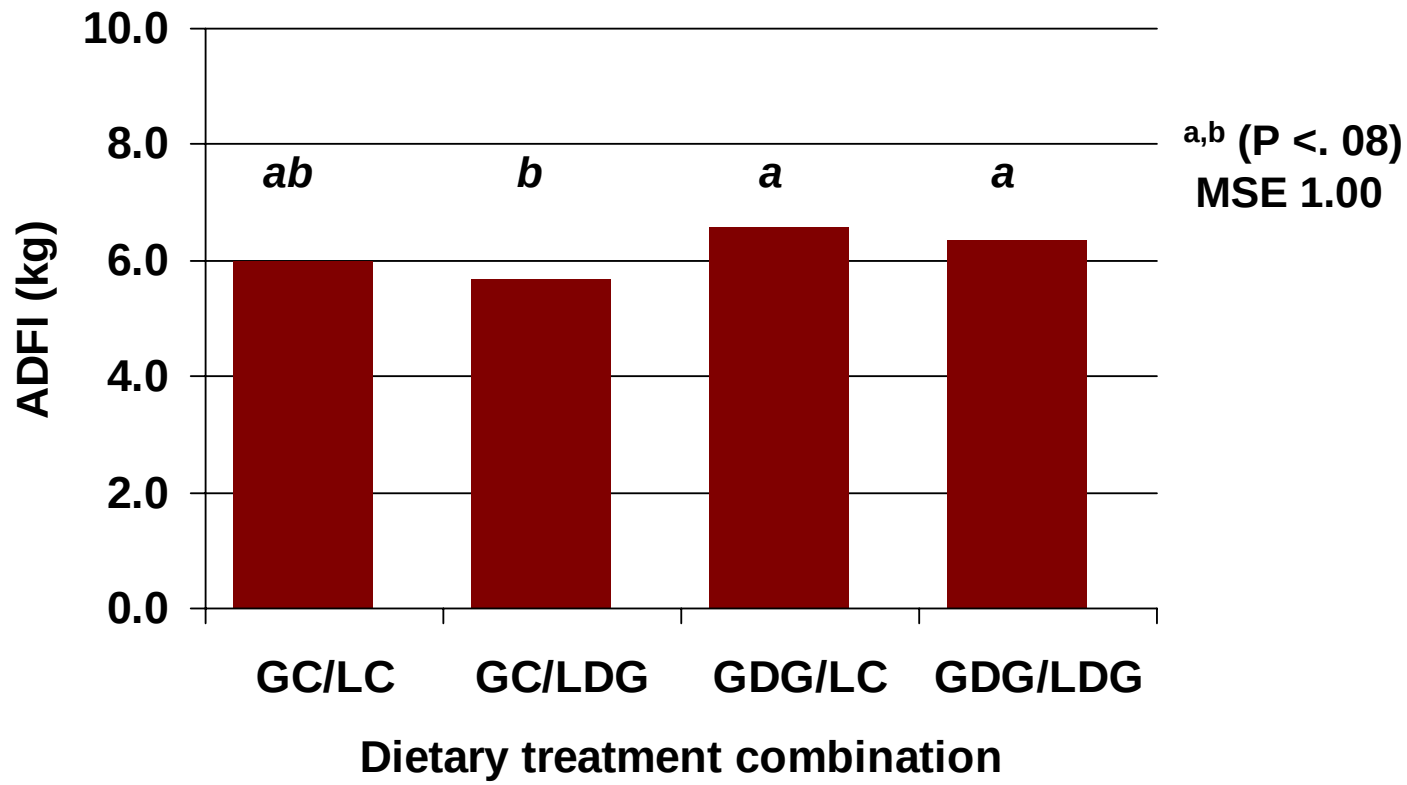


Effect of dietary treatment combination on pre-weaning mortality (RC2)

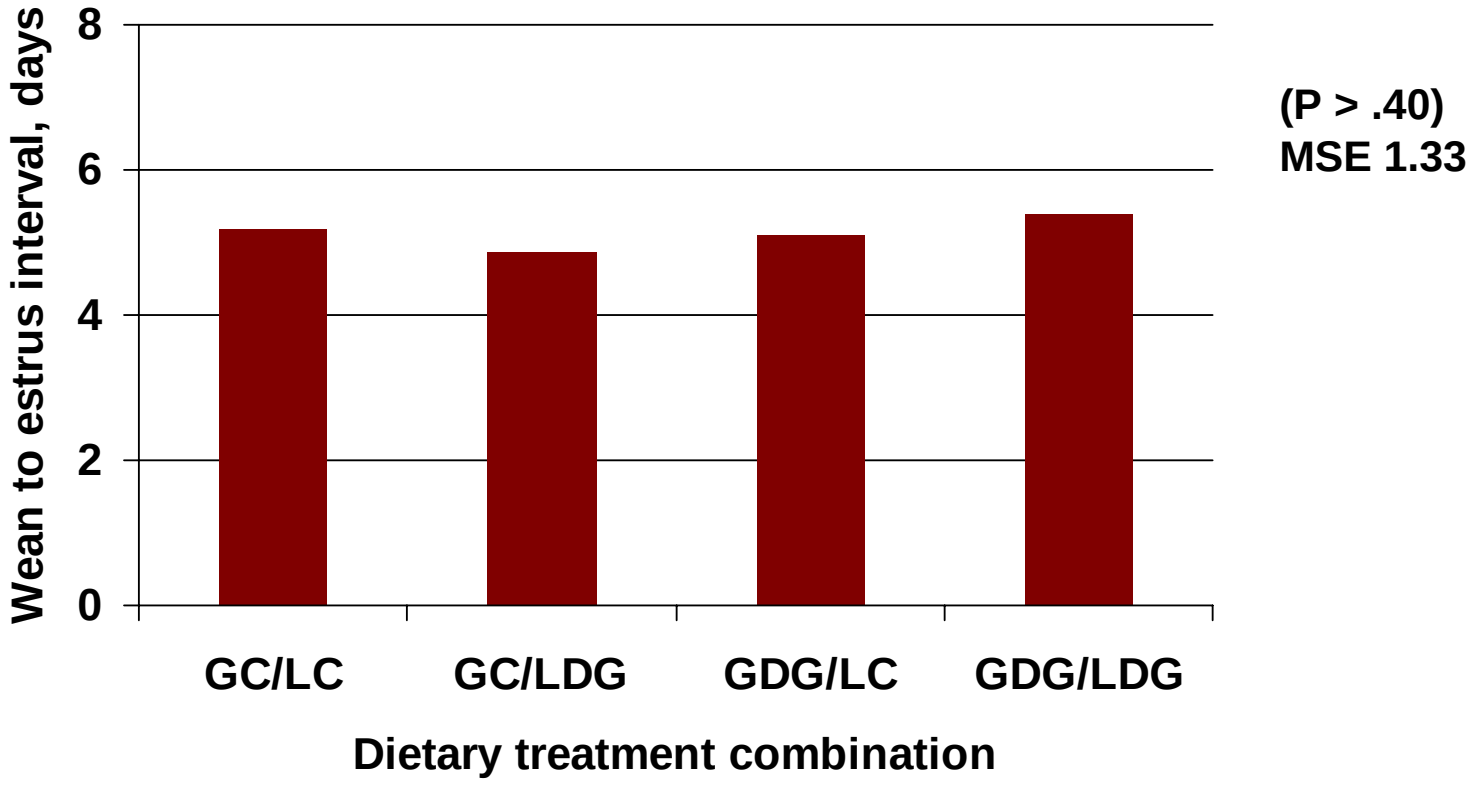


a,b (P < .09)
MSE 10.25

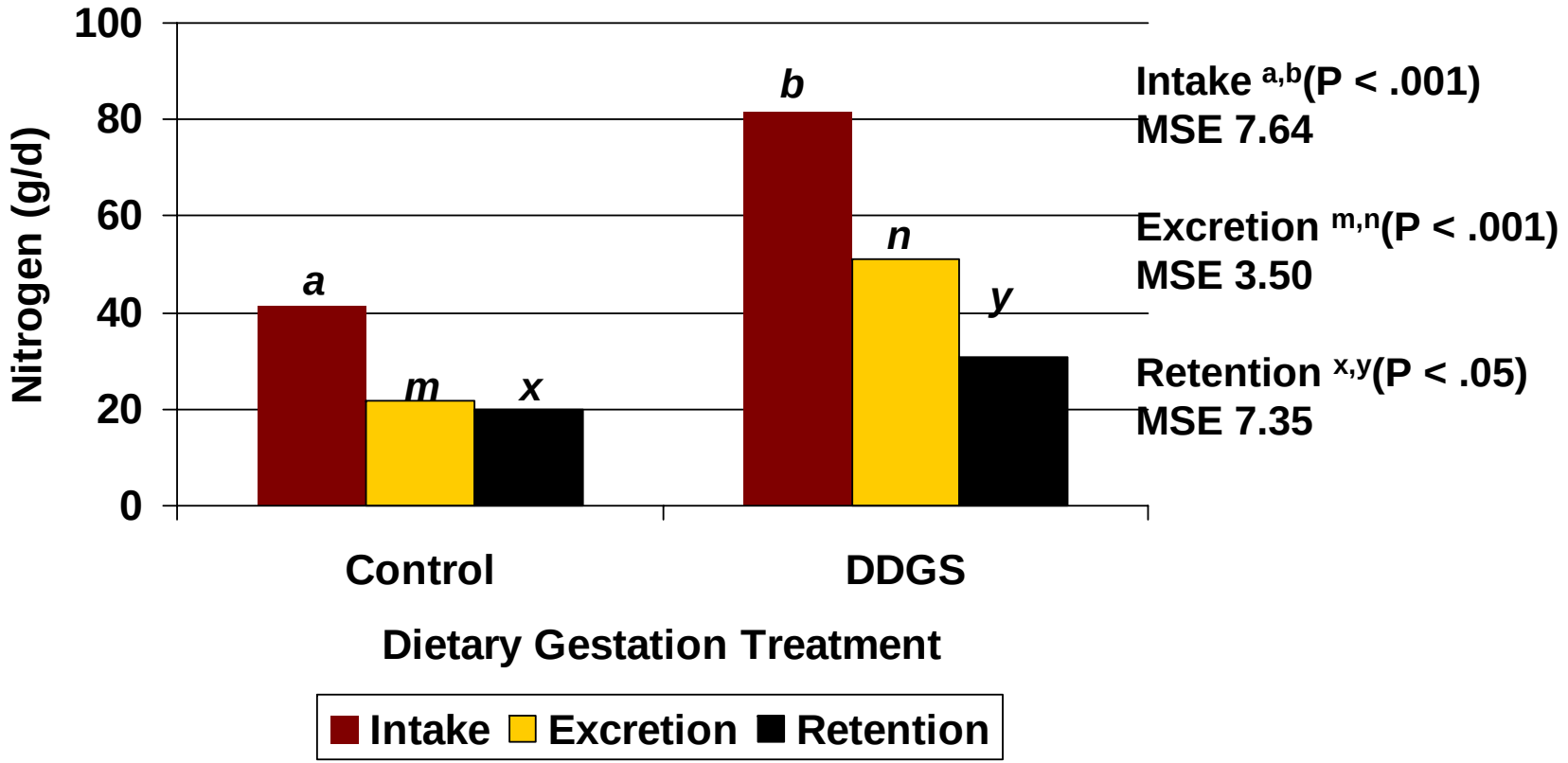
Effect of dietary treatment combination on sow lactation ADFI (RC2)



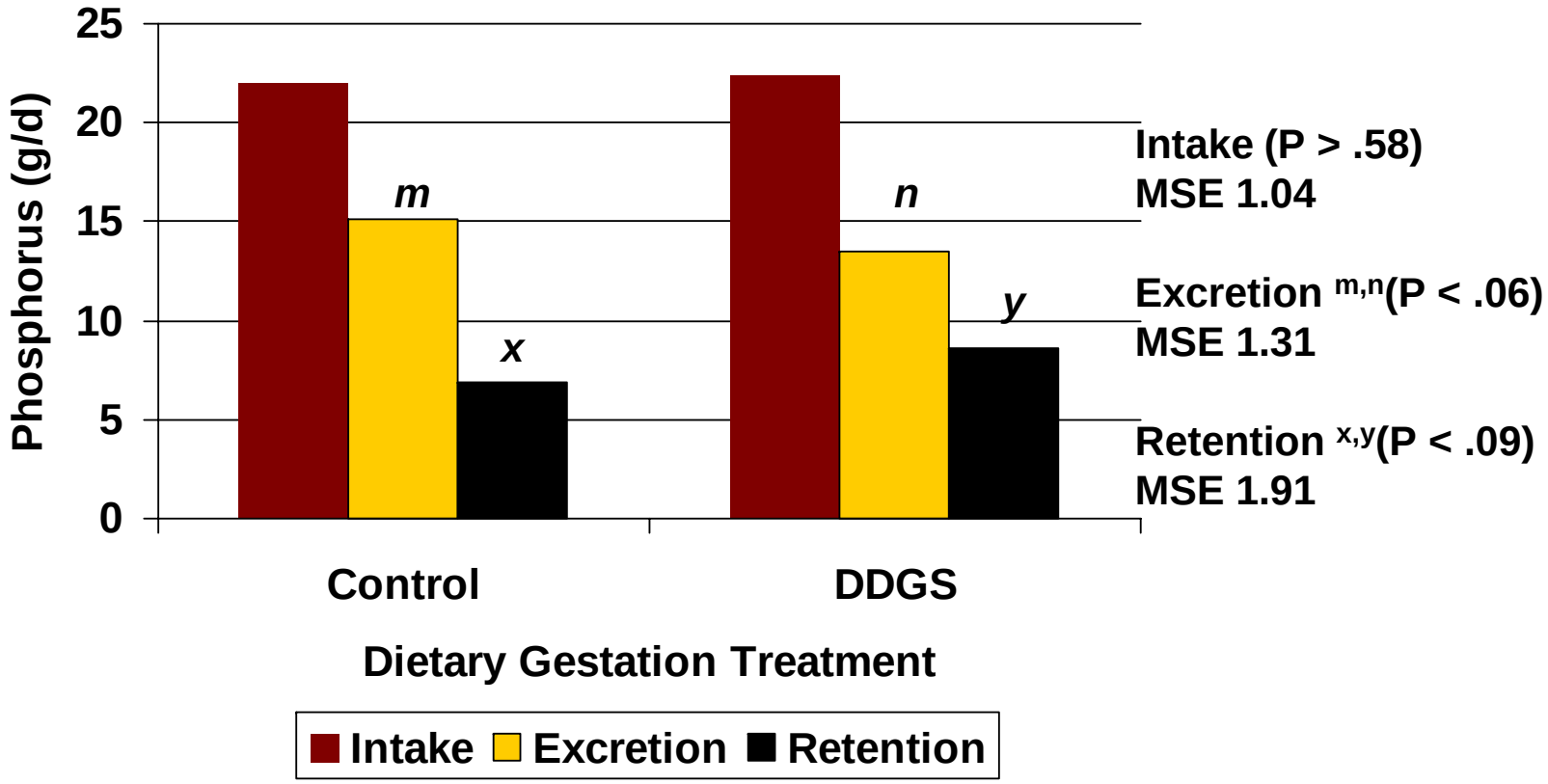
Effect of dietary treatment combination on wean to estrus interval (RC2)



Effect of feeding a 50% DDGS gestation diet on nitrogen balance



Effect of feeding a 50% DDGS gestation diet on phosphorus balance

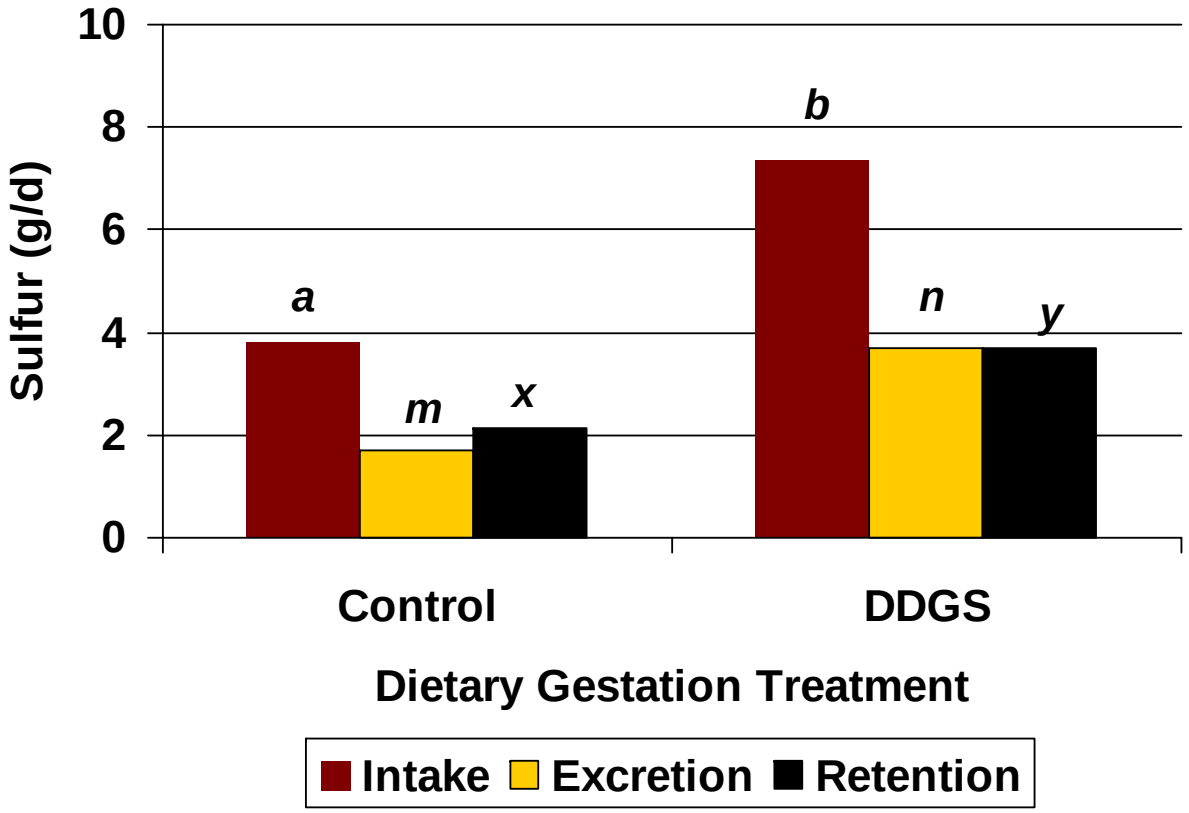


Intake (P > .58)
MSE 1.04

Excretion ^{m,n}(P < .06)
MSE 1.31

Retention ^{x,y}(P < .09)
MSE 1.91

Effect of feeding a 50% DDGS gestation diet on sulfur balance



Intake ($P < .0001$)
MSE 0.27

Excretion ^{m,n}($P < .02$)
MSE 1.19

Retention ^{x,y}($P < .03$)
MSE 1.06

Summary

- Feeding gestating sows a 50% DDGS vs. a corn-soybean meal diet resulted in:
  - Similar gestation weight gains
  - Similar litter size and weight at birth
- Sows fed a corn-soybean meal gestation diet had reduced lactation feed intake when fed a 20% DDGS lactation diet.

Summary

- Sows fed DDGS diets in gestation and lactation through 2 reproductive cycles weaned larger litters than sows fed corn-soybean meal diets.
- Feeding lactating sows a 20% DDGS diet vs. a corn-soybean meal based diet resulted in:
  - Similar litter weaning weights
  - Similar or reduced wean to estrus interval
- Feeding a 50% DDGS diet:
  - increased N and S intake, excretion, and retention
  - reduced P excretion

  compared to feeding a corn-soybean meal based gestation diet.

Conclusion

- Feeding diets containing 50% DDGS during gestation will support adequate sow performance.
- Sows fed 20% DDGS diets during lactation should be adapted to a diet containing DDGS at least one week prior to farrowing.
- DDGS addition to the diet could have environmental implications:
  - Increasing N and S excretion
  - Decreasing P excretion

Acknowledgments

- Thank you Midwest DDGS Association for funding this study.