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The effects of vitamin D supplementation on production parameters and immune function in pre-wean and nursery piglets

Introduction

Clinical and subclinical rickets is increasingly observed in piglets. Surveys reveal serum 25-hydroxyvitamin D (25-OHD) levels below ideal values in all suckling, and many nursery pigs. Serum 25-OHD levels can be corrected via oral vitamin D dosing. The goal of this study was to determine if vitamin D supplementation could improve piglet growth, mortality, and immune function.

Study Aims

To determine the impact of vitamin D supplementation on ADG, 56 day weight, mortality, and antibody titer.

Methods

- 1-3 day old piglets from 2 sow farms were allocated to treatment groups based on weight and sex (Farm 1, N=674, Farm 2, N=336).
- Treatment (D+) pigs received 40,000 and 160,000 IU vitamin D3 at processing and weaning respectively.
- Controls (C) received carrier only.
- A subset of 144 piglets on Farm 1 were vaccinated with bovine antigens (Parainfluenza 3, Infectious bovine rhinotracheitis) on day 7 and again on day 28 of the trial.
- All piglets were also vaccinated for *M. hyopneumoniae* on day 7 of life.
- Antibody titers were determined on serum obtained 11 days after boosting.

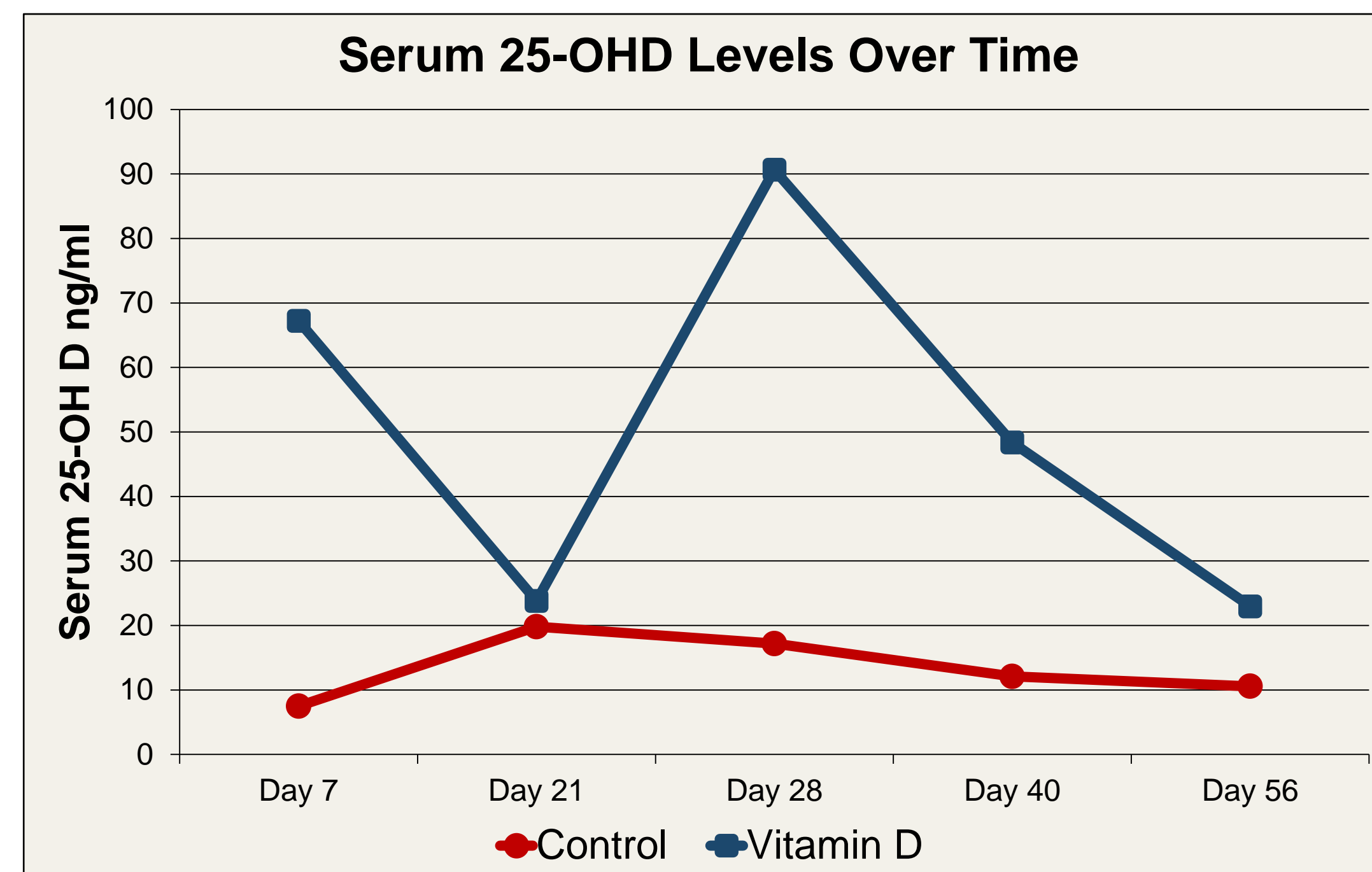


Figure 1. Serum 25-OHD Levels

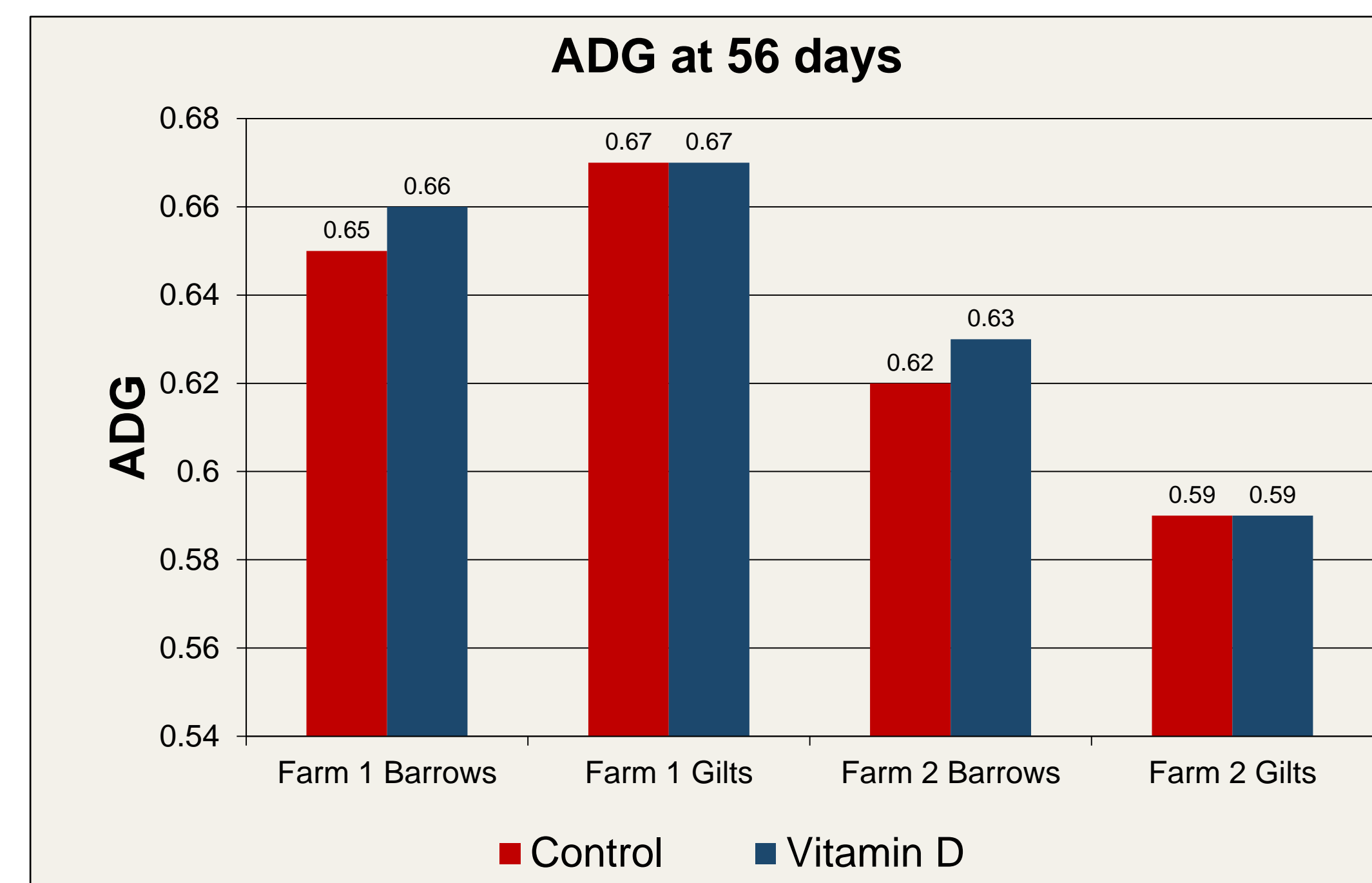


Figure 4. Average Daily Gain at 56 days.



Figure 2. Study Time Line.

Treatment	Farm 1 - Barrows		Farm 1 - Gilts		Farm 2 - Barrows		Farm 2 - Gilts	
	C	D+	C	D+	C	D+	C	D+
0 day weight (lbs)	3.98	4.02	3.89	3.88	3.83	3.85	3.67	3.68
56 day weight (lbs)	46.9	47.17	47.50	47.53	38.1	38.9	36.35	36.13

Table 1. Production and Immune Function.

	Control	Vitamin D
IBR titer (serial dilution)	6.79 ± 0.78	7.63 ± 1.02
PI3 titer (serial dilution)	2492 ± 181	2286 ± 155
<i>M. hyo</i> titer (optic density)	0.173 ± 0.014	0.179 ± 0.018

Table 2. Production & Immune Function.

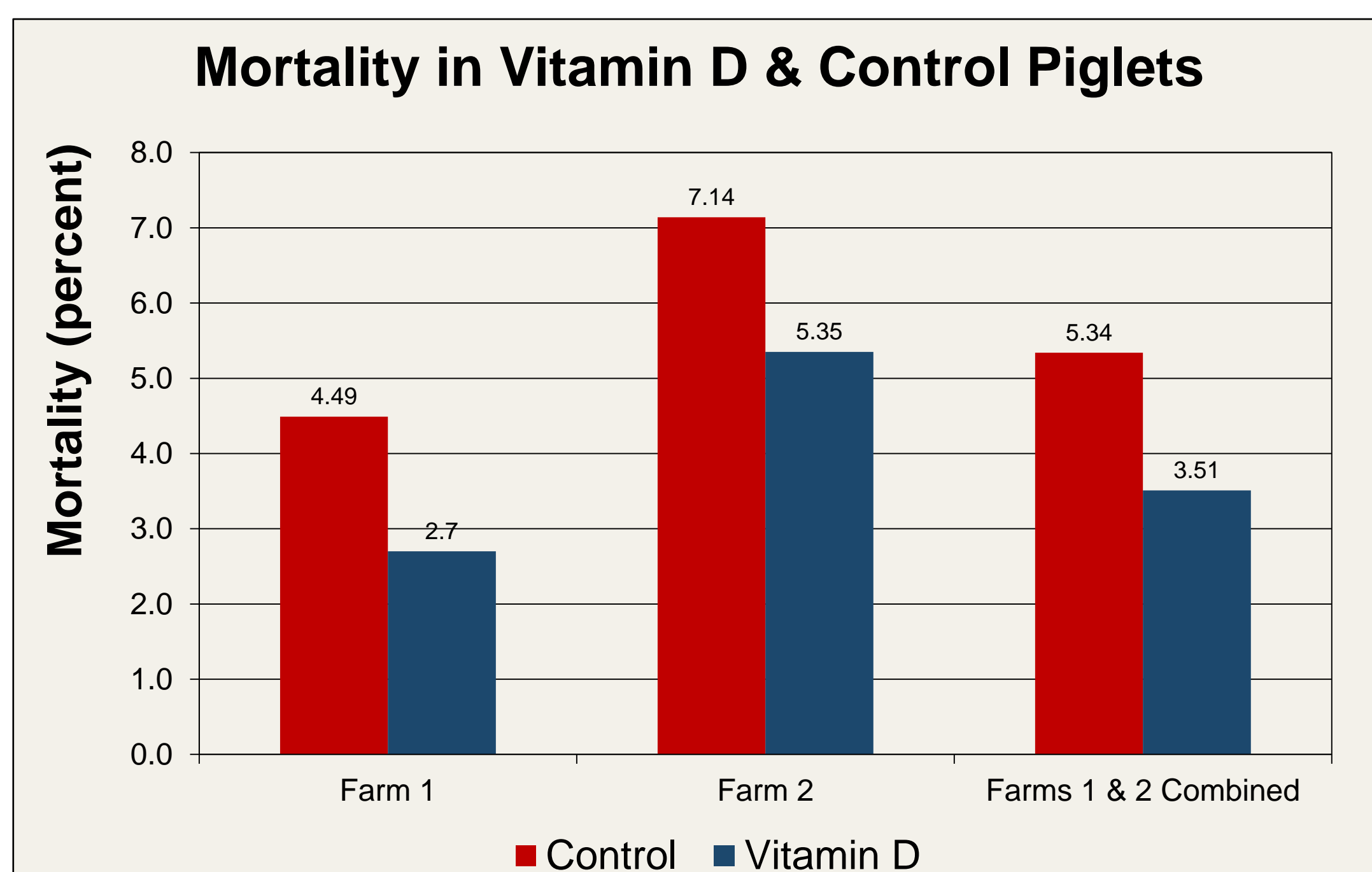


Figure 3. Mortality and Vitamin D Status.



Figure 5. Administration of Vitamin D.

Methods continued

- Random blood samples obtained periodically allowed monitoring of serum 25-OHD, calcium, and phosphorus.
- Additional outcome variables included weight at weaning and at 56 days of age, and mortality.

Results

Serum 25-OHD levels for C pigs were below levels considered adequate to prevent rickets (15 ng/ml), while levels in D+ pigs were 2-3 fold above this level. No significant differences were observed in weight, mortality, or antibody titers. When mortalities for both farms were combined, vitamin D treatment reduced mortality (P<0.075).

Conclusions

Anecdotal evidence suggests improved growth and morbidity in vitamin D supplemented piglets. In this study, we observed no significant effects in any parameters measured. Both sow farms were PRRS negative, and mortality through the nursery periods were exceptionally low. Serum 25-OHD was low in C pigs; pigs stressed by disease exposure might exhibit greater changes in production parameters. This will require further studies in pigs facing greater morbidity challenges.

Acknowledgments

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Effect of vitamin D supplementation on plasma 25-hydroxyvitamin D concentrations in suckling and nursery piglets

Introduction

Clinical/subclinical rickets is increasingly observed in piglets. Piglets often do not have access to sunshine, making them dependent on ingested vitamin D to meet requirements. Transfer of vitamin D from the sow to the piglet is known to be poor and there is very little vitamin D in sow milk. Surveys reveal serum 25-OHD levels below “ideal” values (15ng/ml for bone health) in all suckling, and many nursery pigs. The purpose of this study was to test several vitamin D dosing regimens for their effect on serum 25-OHD concentrations from birth till 44 days of age.

Study Aims

To determine serum 25-OHD levels after varying levels of vitamin D supplementation.

Methods

- 1 day old Piglets were allocated to one of six treatment groups within a litter
- There were 1-2 reps / litter
- Piglets were given the designated amount of vitamin D in peanut oil orally (Table 1)
- Blood samples were obtained from each pig periodically thru 44 days of age
- Serum 25-hydroxyvitamin D (25-OHD) concentrations were determined by RIA (Heartland Labs, Ames, IA).
- The nursery diet was determined to contain 2714 IU vitamin D / kg (NCR recommendation =200 IU / kg).

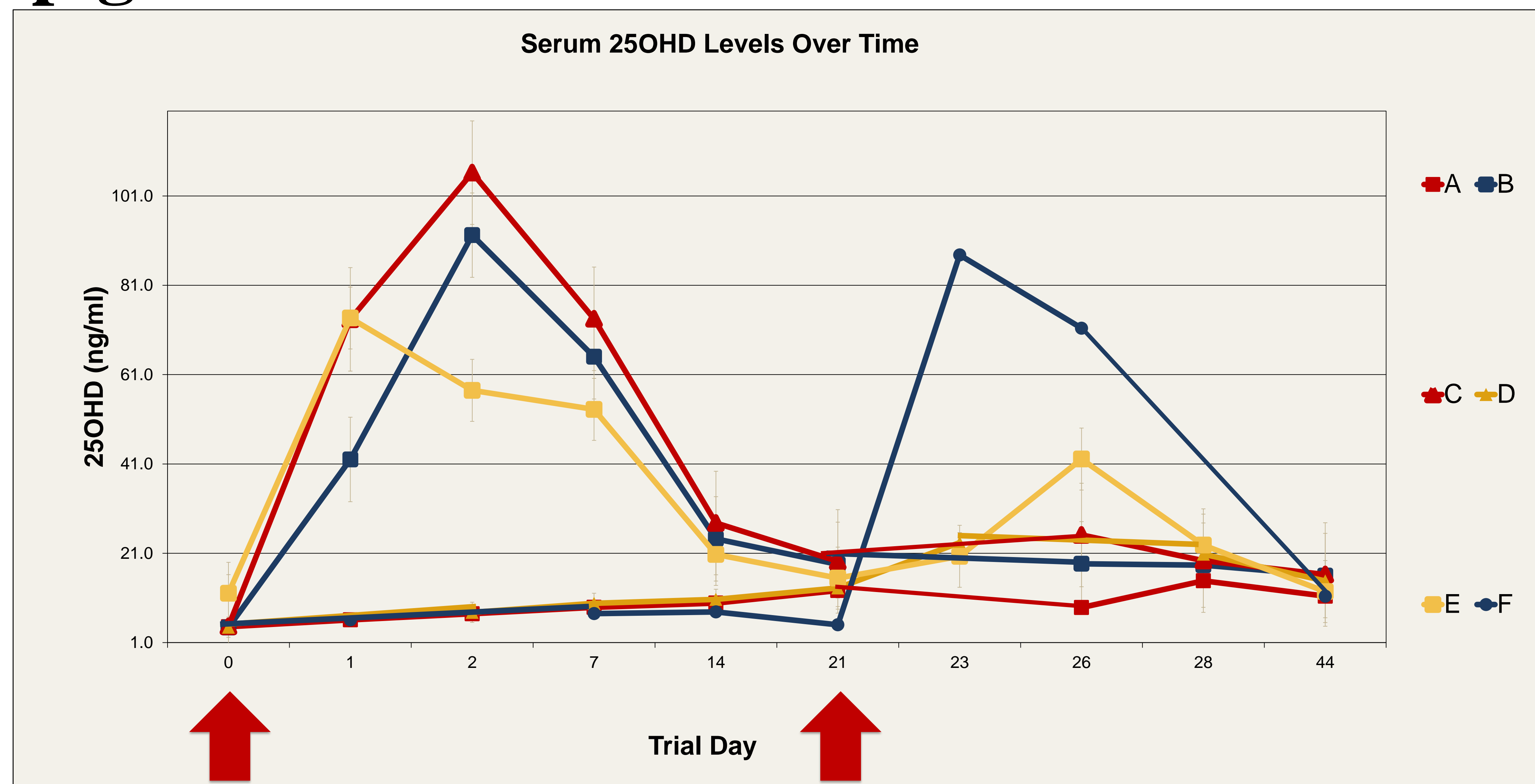


Figure 1. Serum 25OHD levels over time.

Treatment Day	A (N=8)	B (N=8)	C (N=8)	D (N=8)	E (N=8)	F (N=1)
0	Placebo	40,000 IU D	80,000 IU D	Placebo	40,000 IU D	Placebo
21	Placebo	Placebo	Placebo	40,000 IU D	40,000 IU D	120,000 IU D

Table 1. Treatment Groups.



Figure 2. Dosing Day 0.



Figure 3. Dosing Day 21.

Results

Figure 1 depicts serum 25-OHD changes observed over time with the various treatments. Control piglet (Treatment A) serum 25-OHD concentrations were below levels considered adequate to prevent rickets thru day 44, despite being fed well above “NRC required” levels of vitamin D. The 25-OHD levels in D treated pigs were generally 2-3 fold above this level thru the suckling period, no matter the level of vitamin D received at day 1 of age. However, these data suggest, without a 2nd treatment at 21 days of age, 25-OHD levels decrease during the nursery phase.

Conclusions

- Piglets raised indoors have low serum 25-OHD concentrations, leaving pigs susceptible to rickets.
- A single dose on day 1 sustains serum 25-OHD only until weaning.
- 80,000 IU on day 1 is slightly more effective than 40,000 IU.
- A 2nd dose of D should be given at weaning
- It appears much more than 40,000 IU (perhaps 120,000 IU, N=1) is needed at weaning to achieve adequate 25-OHD levels.
- Surprisingly, diet vitamin D at 12 fold NRC recommended levels does not achieve adequate 25-OHD levels during the first 3 weeks of the nursery period.