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MARGINS OF SAFETY CAN BE LOWERED FOR SUPPLEMENTAL COPPER, ZINC, IRON, AND MANGANESE IN FINISHING DIETS WITHOUT AFFECTING GROWTH PERFORMANCE

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Summary

Finishing pig diets are commonly supplemented with copper, zinc, iron, and manganese with large margins of safety compared to those suggested by NRC requirements. In this study, pigs were fed a control diet that provided these minerals supplemented at concentrations similar to current KSU recommendations, diets containing 50 and 25% of the recommendation, or a combination of 50% of the recommendations until 145 lb and no added trace minerals from 145 lb until market. The trial used pigs from 100 lb until market weight at 265 lb. No differences in growth performance or carcass characteristics were observed as a result of trace mineral supplementation. These results suggest that the margins of safety for copper, zinc, iron, and manganese can be lowered significantly in swine finishing diets.

Introduction

Supplemental trace minerals typically are added to swine diets with large margins of safety. These are used because minerals are relatively inexpensive compared to other ingredients in the diet, and few research trials have been conducted to define trace mineral requirements for modern swine production. However, the large margins of safety may result in the excretion of excess trace minerals into swine manure. Therefore, our objective was to determine if lower supplemental trace mineral levels (copper, zinc, iron, and manganese) could be fed during the finishing phase without loss of growth performance.

Procedures

A total of 1,100 barrows (PIC C-22× 337) was used in this experiment. Pigs (25 per pen) were housed in 44 pens of a 1,200-head finishing barn equipped with 48 pens. Pens were blocked according to average pig weight on d 28 after arrival and randomly assigned to treatment within block. Average initial weight was 100.6 lb.

The finishing barn was a double curtain sided, deep pit barn. The barn operates on natural ventilation during warm weather and is equipped with automatic ventilation for cold weather. The floor was totally slatted concrete. Pens were equipped with one four-hole self-feeder and one cup waterer. Pen dimensions were 10 ft × 18.5 ft and provided 7.4 sq ft per pig.

Group weights of all the pigs in each pen were obtained every 2 weeks. Diet phase changes occurred at 4-week intervals. Feeders were vacuumed on the day that diet phases were changed, and the remaining amounts of feed recorded. Pigs in all pens were weighed at market before shipping to the processing plant. The pigs in each pen were marked with a different tattoo prior to marketing to allow carcass data to be collected and calculated back to each pen. Standard plant carcass criteria were measured including carcass weight, fat depth, loin depth, lean percentage, and fat-free lean index.

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The trial was a randomized complete block design with four treatments per block. (Table 1). All diets were corn-soybean meal based. Diets were formulated in four phases (105 to 145, 145 to 180, 180 to 210, and 210 to market). The diet fed from 105 to 145 lb contained 6% added choice white grease. Diets fed during the other three phases did not contain any added fat. The total dietary lysine levels fed were 1.05, .83, .72, and .62 for the four phases, respectively. Supplemental selenium and iodine were provided at a rate of .3 ppm for the first phase and .2 ppm for the two remaining phases. All other nutrients met or exceeded the requirement estimates provided by NRC (1998). Vitamin levels were similar to KSU recommendations. Supplemental copper, zinc, iron, and manganese were provided as listed in Table 1. The levels provided in the control diet were similar to current Kansas State University recommendations. The next two diets provided 50 and 25%, respectively, of the current recommendations. The last experimental treatment provided 50% of the recommended mineral levels during phase 1, and then no added supplemental trace minerals were provided in the last three phases.

Table 1. Amount (g/ton) of Supplemental Trace Minerals[a]

	Dietary Treatment			
Mineral	Control	50%	25%	Combination
Phase 1 (105 to 145 lb)				
Copper	15	7.5	3.75	7.5
Zinc	150	75	37.5	75
Iron	150	75	37.5	75
Manganese	36	18	9	18
Phases 2, 3, and 4 (145 to Market)				
Copper	10	5	1.25	0
Zinc	100	50	12.5	0
Iron	100	50	12.5	0
Manganese	24	12	4	0

[a]All diets contained 0.3 ppm of iodine and selenium during phase 1 and 0.2 ppm of iodine and selenium for subsequent phases.

Results and Discussion

No differences (P>.10) were observed for growth performance or carcass parameters (Table 2). Growth performance for this trial was excellent, with control pigs actually having the numerically lowest ADG and highest feed efficiency. The NRC (1998) recommendations for total dietary copper, zinc, iron, and manganese are 3, 45, 45, and 2 g per ton, respectively. Using the ingredient values listed for copper, zinc, iron, and manganese listed in the NRC (1998), a typical corn soybean meal-based finishing diet provides approximately 100% of the copper and iron requirements, 4 to 5 times the manganese requirement, and 40 to 50% of the zinc requirement. The lack of response in this experiment illustrates that the NRC requirements probably were already adequate for typical corn-soybean meal finishing diets. These results suggest that margins of safety for copper, zinc, iron, and manganese can be lowered significantly in swine finishing diets

without negatively affecting growth performance or carcass characteristics. Trials to confirm these results may need to be conducted with higher levels of disease or stress. Additionally, we did not measure any potential impact of the trace minerals on meat quality traits.

Table 2. Influence of Trace Mineral Supplementation on Growth Performance and Carcass Characteristics[a]

	Dietary Treatment				
Item	Control	50%	25%	Combination	SEM
ADG, lb	1.67	1.71	1.72	1.69	.03
ADFI, lb	4.50	4.50	4.53	4.52	.06
F/G	2.70	2.63	2.64	2.68	.04
Market weight, lb	254.1	253.9	256.9	255.8	3.6
Fat depth, in	.74	.75	.75	.75	.02
Loin depth, in	2.23	2.27	2.22	2.24	.04
Percent lean, %	54.1	54.1	54.0	54.1	.3
Fat-free lean index, %	49.1	49.0	49.1	49.1	.2

[a]Values represent the means of 11 pens (observations) per treatment with 25 pigs per pen. Pigs averaged 100.6 lb initially. No differences were observed among treatment groups (P>.10).