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Summary and Implications

A vitamin-trace mineral mix (NCR-42 VTMM) and a vitamin B-safety pak (biotin, choline, folacin, thiamin and vitamin B_6) were formulated as possible common sources of nutrients for cooperative projects for the NCR-42 (North Central Regional) committee on swine nutrition. The adequacy of the NCR-42 VTMM and the vitamin B-safety pak were evaluated in a four-week growth trial with weanling pigs. The pigs (weaned 18-23d) were fed one of six diets: 1) NC, negative control, a common nursery diet with vitamins at minimum levels (VTMM OX); 2) treatment 1, a common nursery diet with VTMM vitamins at 100% of NRC 1998 requirements for 5 to 45 lb pigs; 3) treatment 2, a common nursery diet with VTMM vitamins at 300% of NRC 1998 requirements for 5 to 45 lb pigs; 4) treatment 3, a common nursery diet with VTMM vitamins at 100% of NRC 1998 requirements for 5 to 45 lb pigs and B-safety pak at 100% of NRC 1998 requirements for 5 to 45 lb pigs; 5) treatment 4, a common nursery diet with VTMM vitamins at 300% and B-safety pak at 300% of NRC 1998 requirements for 5 to 45 lb pigs; 6) UNL, a common nursery diet with the concentration of vitamins/minerals regularly fed in University of Nebraska (UNL) diets. Overall, there were no differences ($P > 0.10$) in average daily gain (ADG), average daily feed intake (ADFI), or feed efficiency (ADG/ADFI). However, numerically, there were increases in ADG and ADFI as the concentrations of minerals and vitamins increased. Pigs receiving the diet conforming to the typical University of Nebraska supplement had increased ADG, ADFI and feed efficiency compared to the negative control. Results from this study will be collectively examined with identical studies conducted at other research stations.

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Table 1. Composition of phase I and phase II diets.

	Phase[ab]						Phase II[ac]					
Ingredients, %	NC	Trt 1	Trt 2	Trt 3	Trt 4	UNL	NC	Trt 1	Trt 2	Trt 3	Trt 4	UNL
Corn	38.14	37.99	37.69	37.09	37.39	38.04	49.06	48.91	48.61	48.81	48.31	48.96
Soybean meal, 46.5% CP	22.77	22.77	22.77	22.77	22.77	22.77	24.82	24.82	24.82	24.82	24.82	24.82
Whey	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Blood plasma	6.00	6.00	6.00	6.00	6.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00
Blood cells	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	2.00	2.00	2.00	2.00
Lactose	10.00	10.00	10.00	10.00	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
Dicalcium phosphate	1.08	1.08	1.08	1.08	1.08	1.08	1.61	1.61	1.61	1.61	1.61	1.61
Limestone	0.83	0.83	0.83	0..83	0.83	0.83	0.61	0.61	0.61	0.61	0.61	0.61
Sodium Chloride	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Fat	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mecadox®	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
NCR-42 VTMM_03[d]	0.30	0.45	0.75	0.45	0.75	0.00	0.30	0.45	0.75	0.45	0.75	0.00
B-safety pak[d]	0.00	0.00	0.00	0.10	0.30	0.00	0.00	0.00	0.00	0.10	0.30	0.00
UNL vitamin mix[c]	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.25
UNL mineral mix[f]	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.15

[a] NC = negative control, Trt 1 = VTMM 100%, Trt 2 = VTMM 300%, Trt 3 = VTMM 100%/B-safety pak 100%, Trt 4 = VTMM 300%/B-safety pak 300% the NRC requirements for the 5- to 45-lb pig, UNL = University of Nebraska vitamin/mineral mix.

[b] Phase I diets formulated to contain: lysine, 1.35%; Ca, 0.80%; P, 0.70%; Available P, 0.39%; DE (digestible energy, kcal/lb), 1.557.

[c] Phase II diets formulated to contain: lysine, 1.20%; Ca, 0.85%; P, 0.75%; Available P, 0.50%; DE (digestible energy, kcal/lb), 1.547.

[d] Composition shown in table 2.

[e] Supplied per kilogram of diet: retinyl acetate, 4,400 IU; cholecalciferol, 440 IU; α-tocopherol acetate, 24 IU; menadione sodium bisulfite, 3.5 mg; riboflavin, 8.8 mg; d-pantothenic acid, 17.6 mg; niacin, 26.4 mg; vitamin B_{12}, 26.4 µg.

[f] Supplied per kilogram of diet: Zn (as ZnO), 128 mg; Fe (as $FeSO_4 \bullet H_2O$), 128 mg; Mn (as MnO), 30 mg; Cu (as $CuSO_4 \bullet H_2O$), 11 mg; I (as $Ca(IO_3) \bullet H_2O$), 0.26 mg; Se (as Na_2SeO_3), 0.3 mg.

Table 2. Composition of NCR-42 VTMM and B-safety pak.

Vitamin/Mineral	Units/lb	Amount/lb of VTMM	Amount/lb of B Safety Pak
A	IU	338,800.00	0.00
D	IU	33,880.00	0.00
E	IU	1,452.00	0.00
K	mg	110.00	0.00
Biotin	mg	0.00	11.00
Choline	mg	0.00	66,000.00
Folacin	mg	0.00	66.00
Niacin	mg	2,420.00	0.00
Pantothenic Acid	mg	726.00	0.00
Riboflavin	mg	484.00	0.00
Thiamin	mg	0.00	220.00
B_6	mg	0.00	220.00
B_{12}	mg	2.90	0.00
Copper	mg	145.20	0.00
Iodine	mg	30.80	0.00
Iron	mg	3751.00	0.00
Manganese	mg	0.00	0.00
Selenium	mg	24.20	0.00
Zinc	mg	12,100.00	0.00

Introduction

Cooperative-regional research studies investigating nutrient (e.g., lysine) utilization or management practices often rely on specific station (location) ingredients and/or vitamin/mineral premixes. Because significant variability exist among stations, the following study was conducted to develop a vitamin-trace mineral premix to be used as a common source of nutrients in cooperative projects for the NCR-42 (North Central Regional) committee on swine nutrition. The adequacies of the vitamin-trace mineral premixes (NCR-42 VTMM and the vitamin B-safety pak) were evaluated based on growth responses of weanling pigs. Only the results recorded for the UNL portion of the study are presented. Ultimately this data set/results will be combined with results collected at several other stations and presented collectively.

Materials and Methods

Experimental design

Seventy-two pigs were allotted based on initial weaning weight and litter-of-origin, and randomly assigned to one of six dietary treatments. There were three replications per treatment and four pigs per pen. Pigs were weaned at 18 to 23 days of age with an average initial weight of 11.9 lb. At the conclusion of the 28-day trial, the average weight was 34.2 lb. The trial was divided into two 14-day phases.

The six treatments included (Table 1): 1) negative control (NC), common nursery diet with vitamins at minimum level (0% of NRC 1998 requirements for 5 to 45 lb pigs); 2) treatment 1 (VTMM1X), common nursery diet with vitamin-trace mineral mix (NCR-42 VTMM) added at 100% (1X) of NRC 1998 requirements for 5 to 45 lb pigs; 3) treatment 2 (VTMM3X), common nursery diet with NCR-42 VTMM added at 300% (3X) of NRC 1998 requirements for 5 to 45 lb pigs; 4) treatment 3 (VTMM 1X/B 1X), common nursery diet with NCR-42 VTMM added at 100% and B-safety pak added at 100% of NRC 1998 requirements for 5 to 45 lb pigs; 5) treatment 4 (VTMM 3X/B 3X), common nursery diet with NCR-42 VTMM added at 300% and B-safety pak added at 300% of NRC 1998 requirements for 5 to 45 lb pigs; 6) UNL, common nursery diet with UNL standard vitamin-trace mineral premixes (all of the diets had trace minerals added at 100% of the NRC 1998 requirements for 5 to 45 lb pigs). The NCR-42 B-safety pak included: biotin, choline, folacin, thiamin and vitamin B_6 which were excluded in the NCR-42 VTMM premix. (Table 2). Phase I diets contained 1.35% lysine, 0.80% calcium and 0.70% phosphorus. Phase II diets contained 1.20% lysine, 0.85% calcium and 0.75% phosphorus.

Statistical analysis

Data were analyzed as a completely randomized block design using the PROC MIXED procedure of SAS. The main effect of the statistical model was dietary treatment. Pen was the experimental unit used for analyses.

Live animal care and measurements

Pigs had ad libitum access to feed and water throughout the experiment. Pigs and feeders were weighed weekly to determine average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (ADG/ADFI). Heat lamps and mats were utilized during phase I and removed for phase II.

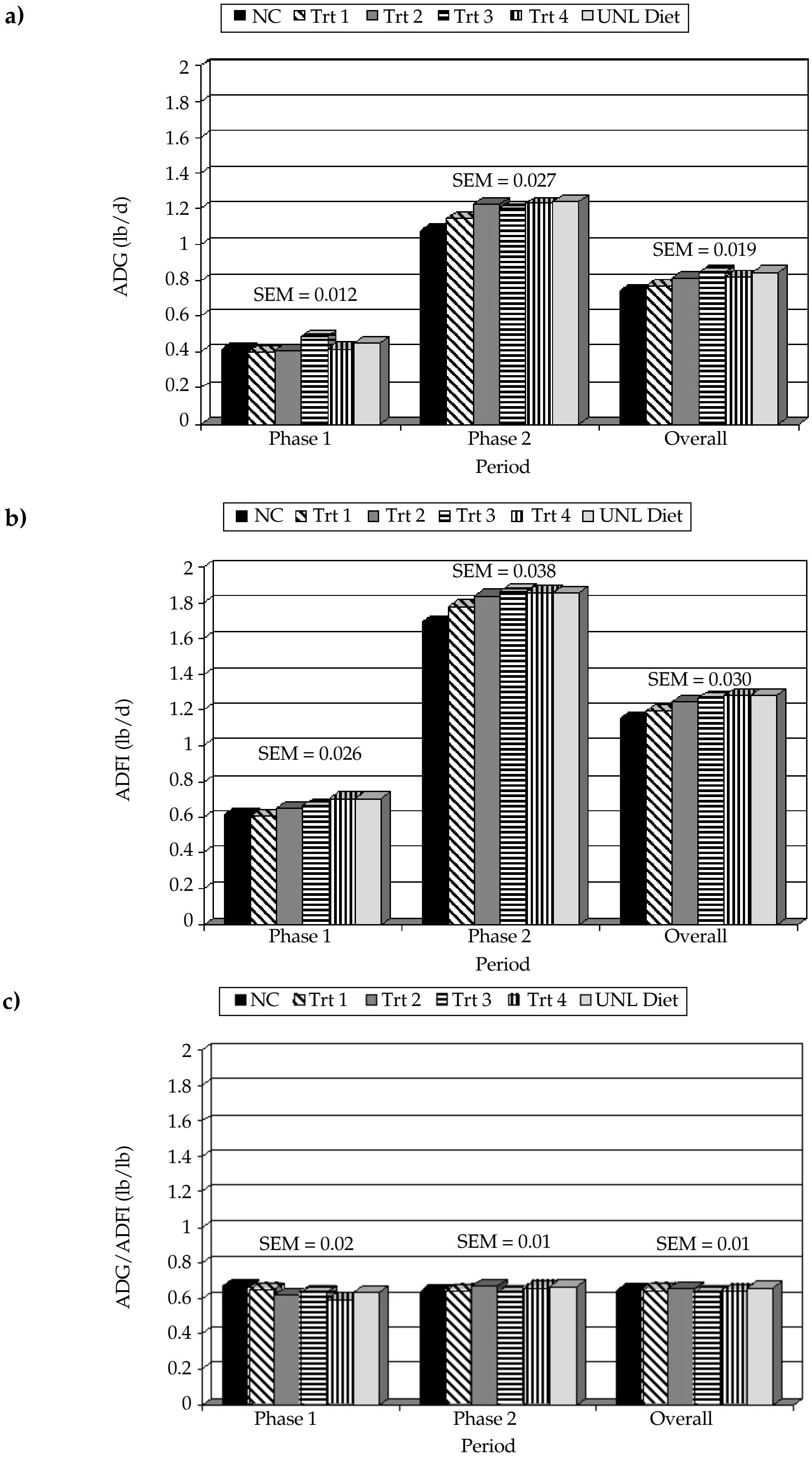

Figure 1. Phase I, phase II, and overall responses of 12 to 34 lb weanling pigs. a) ADG (average daily gain), b) ADFI (average daily feed intake), c) ADG/ADFI (feed efficiency). NC = negative control (common nursery diet with VTMM at 0% of NRC 1998 requirements for 5 to 45 lb pigs), Trt 1 (common nursery diet with VTMM at 100% of NRC 1998 requirements for 5 to 45 lb pigs), Trt 2 (common nursery diet with VTMM at 300% of NRC 1998 requirements for 5 to 45 lb pigs), Trt 3 (common nursery diet with VTMM at 100% and B-Safety Pak at 100% of NRC 1998 requirements for 5 to 45 lb pigs), Trt 4 (common nursery diet with VTMM at 300% and B-Safety Pak at 300% of NRC 1998 requirements for 5 to 45 lb pigs), UNL Diet (common nursery diet with University of Nebraska vitamin/mineral mix).

Results and Discussion

Figures 1a-c show the growth criteria responses to dietary treatments. Due to illness during the first week of the trial, one pen receiving treatment 3 was excluded from the data analysis. There were no significant statistical differences (P > 0.10) for ADG, ADFI or feed efficiency among treatments

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(treatment main effect) during phase I, II and the overall experimental period. However, there were numerical increases in ADG, ADFI and feed efficiency with the additions of the VTMM premix and B-safety pak. Increases in ADG and ADFI were observed as the VTMM premix was added at 100% of the NRC 1998 requirements for 5 to 45 lb pigs (ADG: NC = 0.744 lb/d, trt 1 = 0.770 lb/d; ADFI: NC = 1.152 lb/d, trt 1 = 1.194 lb/d). Numerically, ADFI and ADG were maximized at the 300% premix addition (ADG = 0.822 lb/d, ADFI = 1.281 lb/d). Pigs receiving the UNL diet performed equal to or slightly greater than pigs receiving treatment 4 (VTMM 300%, B-safety pak 300% of the NRC 1998 requirements for 5 to 45 lb pigs). Feed efficiency (ADG/ADFI) was improved with the addition of the VTMM premix at 300% of the NRC 1998 requirements for 5 to 45 lb pigs (ADG/ADFI = 0.641). Overall, pigs receiving higher concentrations of the VTMM premix and the B-safety pak or the UNL diet had numerically greater ADG and ADFI than pigs receiving the negative control.

Conclusion

Overall, there were no significant differences in ADG, ADFI or feed efficiency when adding supplemental vitamins to the diet. However, there were numerical increases in ADG and ADFI as the supplemental premixes were added to the diet. These numerical differences suggest that growth performance is increased as the VTMM and B-safety pak premixes are supplemented to the diet. In addition, results suggest that the concentration of vitamins/minerals used in diets at the University of Nebraska is adequate given that the pigs consuming this diet performed as well as those consuming other dietary treatments. Data from other stations and data from this trial will be combined in order to form premixes with concentrations sufficient to support maximal growth performance. Collectively, these results will help identify vitamin and mineral premixes that can be used in future multi-site cooperative swine nutrition projects.

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