SWINE UPDATE

Spring 2001 Vol. 23, No. 2

K-STATE Kansas State University

Animal Sciences & Industry

L-Carnitine and Chromium Picolinate Improve Sow Reproductive Performance, study shows

Summary

A total of 599 sows were used to determine the effects of added L-carnitine and/or chromium picolinate on reproductive performance. Experimental treatments were arranged in a 2 x 2 factorial with main effects of added L-carnitine (0 or 50 ppm) and chromium picolinate (0 or 200 ppb). Starting on the first day of breeding, sows were provided a daily top dress containing the carnitine and(or) chromium along with the standard gestation diet. Dietary treatments were administered daily through the initial gestation, lactation, and through a second gestation period (2 parities). During the first parity, there was a carnitine ¥ chromium interaction for first service farrowing rate. Added dietary chromium increased first service farrowing rate, but not when carnitine was added. No differences were observed in number of pigs born alive, still born, mummies, or total born in the first parity. Added dietary L-carnitine decreased wean to estrus interval, and tended to increase the number of sows in estrus by d 7. In the second parity, adding dietary carnitine and chromium improved farrowing rate. When calculating the total number of pigs and number born alive based on all sows that were started on test, both added carnitine and chromium increased the number of pigs born and born alive. These results show that carnitine and chromium supplementation additively increased farrowing rate and, thus, total number born alive over two parities.

Introduction

Carnitine is a water soluble, vitamin-like compound that functions to transport fatty acids across the mitochondria membrane where they are processed to produce energy. However, carnitine may play a greater role in metabolism than just fatty acid transport. Recent studies have observed increases in the total number of pigs born and born alive by feeding L-carnitine during gestation or lactation.

Chromium is a trace mineral that is actively involved in the metabolism of carbohydrates, lipids, proteins, and nucleic acids in the body. Chromium potentiates insulin action by increasing the cellular uptake of glucose and intracellular carbohydrate and lipid metabolism. Studies have shown that feeding chromium in gestation and lactation increases number of pigs born alive, and some studies have observed increased farrowing rate. Because both of these nutrients influence sow reproductive performance, the objective of our study was to compare carnitine and chromium on sow reproductive performance. In addition, a second objective was to determine if the responses to carnitine and chromium were additive.

Procedures

This experiment was conducted on a commercial 1,500 sow farrow-to-wean operation in central Kansas and used 599 sows (PIC Line C22). Sows were started

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on test on the first day of breeding. Each sow remained on the same treatment through gestation, lactation, and through a second gestation period (2 parities). All sows were fed a milo-soybean meal-based diet formulated to contain 0.65% and 1.10% lysine during gestation and lactation, respectively. Dietary treatments were provided via a corn-based top dress fed with the meal to provide 50 mg/kg carnitine and 200 mcg/kg chromium when sows were fed 4 lb/d of the gestation diet and 11 lb/d of the lactation diet.

At farrowing, the number of pigs born alive (NBA), as stillborn (SB), as mummies (MUM), and total born (TB) were recorded. Sows were rebred after weaning (15 d lactation) and remained on the same treatment until farrowing a second litter. If a sow did not return to estrus within 18 days, she was taken off test. Sows that were bred at the start of the study, but were later found open, were taken off test when estrus was detected. Procedures and data collection were identical for the second gestation and lactation period. However, dietary treatments were not administered during the second lactation period.

Calculations were made to determine the total number of pigs born, born alive, as stillborns, or as mummies per sow for the two parities. Total number of pigs were calculated using only sows that initially farrowed, then completed the second parity, as well as calculated from all the sows that were actually started on test.

Results and Discussion

In the first parity, a carnitine ¥ chromium interaction ($P<0.01$) was observed for first service farrowing rate (Table 2). Added dietary chromium improved ($P<0.01$) first service farrowing rate, but there was no added benefit with adding carnitine. There were no differences ($P>0.10$) in the total number of pigs born, born alive, or born mummified. However, sows fed added chromium tended to have increased ($P<0.07$) number of stillborn pigs/litter. Adding dietary carnitine improved ($P<0.05$) wean to estrus interval and tended to increase ($P<0.08$) the number of sows in estrus by d 7.

In parity 2, feeding additional dietary carnitine and chromium improved ($P<0.04$) first service farrowing rate of sows. In parity 2, there were no differences ($P<0.19$) among treatments for total number of pigs born, born alive, stillborn, or born mummified. There were also no differences ($P>0.14$) among treatments for wean to estrus interval or percentage of sows returning to estrus by d 7 or 18.

We then calculated the total number of pigs born, born alive, still born, and born mummified starting with the sows that initially farrowed (123, 140, 138, and 142, for control, added carnitine, added chromium, and both, respectively) and then completed the second parity. This calculation resulted in sows fed added carnitine having more ($P<0.05$) total pig, and pigs born alive. A second calculation using all the sows that were started on test, total pigs and pigs born alive were increased ($P<0.02$) for sows fed added carnitine, and(or) chromium. No carnitine ¥ chromium interactions ($P>0.10$) were observed for these response criteria suggesting that the response to carnitine and chromium are additive. It also suggests that the two nutrients may improve sow reproductive functioning by different mechanisms.

In conclusion, supplementing gestation and lactation diets with added carnitine and chromium minimal effects on number of pigs born alive per litter; however, the improvement in farrowing rate observed during both parities resulted in greater overall number of pigs born. These data are novel in that they are the first to examine the effects of combining added carnitine and chromium on sow reproductive performance. These data suggest that improvements in reproductive performance from the two nutrients is additive and that carnitine and chromium appear to be working via different mechanisms to improve sow productivity.

Table 1. Effects of L-carnitine and chromium picolinate on reproductive performance[a]

	Treatment					Probabilities, P<		
Item	Control	Carnitine[b]	Chromium[c]	Both[bc]	SEM	Carnitine	Chromium	Int.
First parity								
No. of sows								
Started on test	148	150	147	154				
Farrowed	123	140	138	142				
First service FR[dei]	82.9	91.9	95.5	92.2	2.38	0.22	0.01	0.01
No. of pigs								
Total born[e]	11.3	11.4	11.5	11.6	0.30	0.62	0.57	0.90
Born alive[e]	10.0	9.8	10.2	10.2	0.25	0.32	0.63	0.71
Still born[e]	0.95	0.98	1.26	1.13	0.130	0.68	0.07	0.52
Mummies	0.34	0.26	0.39	0.34	0.060	0.26	0.29	0.77
WEI[dgh]	4.9	4.6	4.7	4.5	0.01	0.05	0.23	0.75
% estrus by d 7[egi]	84.8	88.6	86.7	92.3	2.88	0.08	0.31	0.73
% estrus by d 18[egi]	88.1	91.5	91.7	94.4	2.49	0.20	0.17	0.89
Second parity								
No. of sows								
Started	123	140	138	142				
Farrowed	87	104	102	122				
First service FR[degi]	70.7	73.9	74.3	85.9	3.81	0.04	0.03	0.24
No. of pigs								
Total born[eg]	11.1	11.2	11.0	11.4	0.37	0.50	0.94	0.81
Born alive[eg]	9.7	9.9	9.5	9.8	0.33	0.53	0.62	0.89
Still born[e]	1.02	1.02	1.09	1.31	0.149	0.43	0.19	0.45
Mummies	0.35	0.33	0.40	0.25	0.071	0.22	0.88	0.29
WEI[dgh]	4.6	4.7	4.6	4.8	0.01	0.14	0.94	0.46
% estrus by d 7[efgi]	80.3	76.9	81.0	75.0	4.32	0.23	0.88	0.75
% estrus by d 18[efgi]	80.2	80.8	82.9	75.9	4.17	0.40	0.77	0.32
Total pigs per sow of sows farrowed in parity 1 and completed parity 2								
Total born[eg]	19.4	19.8	19.5	21.3	0.59	0.04	0.15	0.25
Born alive[eg]	17.1	17.6	16.8	18.5	0.53	0.03	0.55	0.24
Still born[e]	1.7	1.7	2.1	2.3	0.19	0.46	0.01	0.66
Mummies	0.6	0.5	0.6	0.6	0.08	0.17	0.43	0.85
Total pigs per sow of all sows started on test for two parities								
Total born[eg]	15.8	18.4	18.8	19.7	0.71	0.01	0.003	0.24
Born alive[eg]	13.9	16.3	16.2	17.0	0.63	0.01	0.02	0.23
Still born[e]	1.4	1.6	2.0	2.1	0.17	0.35	0.002	0.94
Mummies	0.5	0.5	0.7	0.5	0.71	0.27	0.16	0.42

[a]Initially 599 sows bred.
[bc]50 mg/kg L-carnitine and/or 200 mcg/kg chromium picolinate were provided as a daily top dress.
[d]FR = First service farrowing rate; WEI = wean to estrus interval.
[e]Parity as covariate; 6.0, 5.6, 5.2, and 5.5 for control, carnitine, chromium, and both, respectively.
[f]Previous lactation length as covariate; 15.2, 15.8, 15.7, and 15.4 for each treatment.
[g]Week of year sow farrowed as covariate; 23.6, 23.9, 23.7, and 23.9 for each treatment.
[h]WEI analyzed as inverse of means, previous WEI analyzed as log of means.
[i]P-values from chi-square statistic.

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