OVULATION AND FERTILIZATION RATE OF GILTS PROVIDED ADDITIONAL L-CARNITINE AND CHROMIUM NICOTINATE [1]

C. J. Samland, R. E. Musser, J. K. Peters, J. T. Sawyer, K. Q. Owen [2], and D. L. Davis

Summary

We determined the effects of L-carnitine (200 ppm), chromium nicotinate (CrNic; 200 ppb), a combination of L-carnitine and CrNic, or flushing (11 lb/d of complete diet fed for 14 d prior to breeding) on ovulation and fertilization rates in gilts. All gilts (n = 105) were administered PG600 to aid in the synchronization of estrus. After detection of estrus, gilts were assigned randomly to dietary treatments and were fed at 4 lb/d with the exception of gilts on the flushing treatment. Treatments were continued until breeding at the third estrus. Surgeries were performed on d 2 to 3 after third estrus was detected to determine ovulation rate and collect embryos and unfertilized eggs. An increase ($P<.10$) in ovulation rate was observed for gilts in the flushing or L-carnitine treatment. Supplemental L-carnitine decreased ($P = .10$) fertilization rate of embryos recovered. No differences were observed for number of empty zonae or number of unclassifiable eggs. Increased ovulation rates for L-carnitine-treated gilts warrants further evaluation to determine whether L-carnitine increases number of pigs farrowed.

(Key Words: L-Carnitine, Chromium, Ovulation, Gilts.)

Introduction

An important factor influencing the productivity of swine operations is the rate of reproduction. Management for improved reproductive rates includes consideration of the interactions of growth and metabolism with ovarian function and supplying adequate energy to achieve full reproductive performance. Increased insulin in peripheral circulation has been shown to increase maturation of ovarian follicles and ovulation rate. These observations may explain effects of flushing, which requires increasing daily feed intake of gilts for approximately 2 weeks prior to breeding and increases ovulation rate and potentially increases litter size.

Insulin and IGF-1 are important regulators of growth, metabolism, and reproductive function. L-carnitine and chromium are two regulatory nutrients that influence insulin. Therefore, they may affect the number of follicles maturing and ovulating at estrus. Previously, we reported the addition of L-carnitine to the gestation diet caused an increase in circulating insulin and IGF-1. Chromium potentiates insulin action by increasing the cellular uptake of glucose and intracellular carbohydrate and lipid metabolism. Chromium is available in two forms, chromium picolinate and chromium nicotinate, and both are reported to increase insulin uptake.

Based on these considerations, we evaluated the effects of L-carnitine and chromium nicotinate (CrNic) on ovulation and fertilization rates in gilts. The ability of these nutrients to influence insulin suggests that they may affect the number of follicles maturing and ovulating at estrus. Because L-carnitine and chromium affect energy metabolism by different mechanisms, they potentially could

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act synergistically to promote follicular growth and ovulation rate.

Procedures

A total of 105 gilts (PIC C22 × 326) was used to evaluate the effects of additional dietary L-carnitine (200 ppm) and CrNic (200 ppb) on ovulation and fertilization rates. A positive control was provided by feeding gilts 11 lb/d of complete diet (flushing) for 14 d before estrus. Gilts were fed a .65% lysine diet, with the additions of L-carnitine or CrNic replacing corn. All gilts were fed 4 lb/d of diet with or without the various treatments, and gilts in the flushing treatment received a total of 11 lb/d for the 2 weeks prior to expected estrus. That treatment was included to evaluate the potential for nutrients to increase ovulation rate under our experimental conditions.

At approximately 250 lb body weight, gilts were moved to outside pens and monitored for estrus using an epididymectomized boar. After detection of estrus (d 0), gilts were assigned to dietary treatments and fed individually. The flushing treatment began on approximately d 6 of the second estrous cycle and continued through third estrus. Gilts were inseminated on the first (d 0) and second days of estrus.

On d 2 or 3 after breeding, gilts were anesthetized, and their reproductive tract was exposed by mid-ventral laparotomy. Number of corpora hemorrhagica (forming corpora lutea) was determined to establish ovulation rate, and embryos were recovered by flushing the oviducts and uterus. Cleaved eggs were considered fertilized, and uncleaved eggs were stained for evidence of fertilization and nuclear maturation of the oocyte.

Data were analyzed as a 2 × 2 factorial with a positive control. Day of surgery was used as a covariate in the analysis of data for all responses but ovulation rate.

Results

No L-carnitine × CrNic interactions were observed. An increase in ovulation rate was observed for gilts on either the flushing or added L-carnitine (P=.06) treatments (Table 1). No differences were observed for percentage of embryos recovered. However, there were tendencies for fewer eggs recovered from sows fed additional CrNic (P=.08), and a higher number of eggs recovered from gilts fed the flushing treatment (P=.07). The reduction in eggs recovered in the CrNic treatment seemed to be due to numerically fewer ovulations.

A decreased (P=.04) percentage fertilization of eggs was observed when gilts were fed added L-carnitine. No differences were observed for number of empty zonae or number of unclassified embryos. The unclassified embryos were single-cell eggs that either were lost during staining or damaged such that fertilization status could not be determined.

Discussion

Flushing gilts with additional feed is expected to increase ovulation rate and may increase number of pigs born alive per litter, although the latter trait may not be improved consistently. These increases may result in part from increased insulin and/or IGF-1 secretion because of increased feed intake.

Added L-carnitine also has been shown to increase the number of pigs born alive. Our data suggest that this effect may be due to increased ovulation rate. Further work is needed to determine the optimum dose of L-carnitine added to the diet and the potential for this treatment to affect litter size in pigs.

Table 1. Ovulation Rates and Characteristics of Eggs Recovered as Affected by L-Carnitine and(or) Chromium Nicotinate

Item	Control	Carnitine (200 ppm)	CrNic (200 ppb)	Carnitine + CrNic	Flushing (11 lb/d)	Probability (P <) Carnitine	CrNic	Carnitine + CrNic	Flushing	SEM
Number of gilts	20	20	20	22	23					
Day of surgery	2.46	2.22	2.42	2.33	2.44	.11	.74	.49	.50	.12
Avg. no. corpora hemorrhagica	15.2	15.6	13.9	15.5	17.1	.06	.20	.28	.01	.53
Avg. no. eggs recovered[a]	13.8	13.9	11.9	13.4	14.6	.24	.08	.30	.07	.72
Recovery rate, % [a]	91	90	85	86	85	.98	.21	.77	.36	3.5
Avg. no. fertilized eggs[a]	12.9	11.9	11.2	11.2	11.9	.62	.18	.61	.95	1.0
Percent fertilized, % [a]	95	84	100	85	84	.03	.41	.45	.32.	7.7
Avg. no. unfertilized eggs [a]	.62	1.91	.30	1.37	1.69	.09	.52	.87	.38	.71
Avg. no. unclassified eggs [a]	.19	.08	.17	.89	.48	.40	.27	.69	.25	.37
Avg. no. empty zonae [a]	.01	.05	.19	.10	.02	.75	.15	.40	.44	.09

[a]Data were analyzed using day of surgery as a covariate.