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Effect of L-carnitine diets on performance and blood metabolites in sows

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ABSTRACT

Forty-seven multiparous sows were divided into two groups: control (24) and experimental (23). The sows in the experimental group received a supplement of 50 mg L-carnitine per 1kg of the diet during pregnancy and lactation. Blood samples were obtained from 8 sows of each group on the 21 and 110 day of pregnancy and 21 day of lactation. Glucose, total protein and cholesterol, HDL-cholesterol and triglycerides (TG) were determined. The results showed that the addition of L-carnitine to the diet significantly contributed to increasing in the piglets' weaning weight at 21 days of age and the level of HDL-cholesterol, as well as decreasing piglet losses and TG content in blood plasma.

KEY WORDS: sows, L-carnitine, performance, blood, lipids

INTRODUCTION

Recent studies showed that supplementing sow diets with L-carnitine during pregnancy and lactation elevated litter size and increased the weight of piglets at birth and weaning (Musser et al., 1999; Eder et al., 2001; Ramanau et al., 2002). L-carnitine has been shown to affect several key enzymes involved in protein and lipid metabolism in pigs; therefore, it has been hypothesized that L-carnitine may modify some indices of blood lipid metabolism (Woodworth et al., 2004). The purpose of the study was to evaluate the influence of L-carnitine in diets on the reproductive traits of sows and their blood lipid parameters.

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MATERIAL AND METHODS

The study was conducted with 47 multiparous sows during pregnancy and lactation. The animals were divided into two groups: control (24) and experimental (23 sows). The control group animals received standard full-feed mixtures during pregnancy and lactation. The sows of the experimental group additionally received 50 mg L-carnitine per 1 kg of the diet. Body weight at mating and weaning, backfat thickness of sows, litter size and weight at birth and weaning (21days), and feed intake were measured. Blood samples from 8 sows were obtained on days 21 and 110 of pregnancy and, from the same sows, on day 21 of lactation before the morning meal. The content of total protein and cholesterol, LDL- and HDL-cholesterol, triglycerides (TG) and glucose were determined colorimetrically. Data were subjected to statistical analysis using one-way factorial analysis of variance (Statistica, ver. 6.1).

RESULTS

The body weight of sows, number of piglets at weaning, and feed efficiency of sows were slightly better in animals fed the diet with L-carnitine (Table 1). Piglet losses from birth to weaning were decreased in the group with L-carnitine supplementation.

Table 1. Reproductive performance of sows ($\overline{X} \pm SD$)

Item	Feeding groups		P=
	control	L-carnitine	
Body weight at mating, kg	197.2 ± 3.4	196.9 ± 3.5	0.68
Body weight at weaning, kg	212.2 ± 4.8	217.7 ± 4.6	0.23
Backfat thickness in P_2 at mating, mm	23.4 ± 0.4	23.3 ± 0.4	0.42
Backfat thickness in P_2 at weaning, mm	17.2^{a} ± 0.3	21.3^{b} ± 0.4	0.04
Loss of body weight during lactation, kg	16.4^{a} ± 0.4	14.6^{b} ± 0.3	0.04
Number of liveborn piglets	11.70 ± 0.41	11.56 ± 0.38	0.16
Number of piglets at weaning	10.75 ± 0.29	10.95 ± 0.27	0.35
Total weaning piglets in 21 days of age	258	252	
Total cachectic piglets, weaned in 28 d of age	18	6	
Birth weight, kg	1.42 ± 0.20	1.41 ± 0.18	0.42
Weaning weight in 21 days of age, kg	5.92^{a}± 0.41	6.35^{b}± 0.32	0.03
Piglets losses from birth to weaning, %	6.8^{a} ± 0.84	4.1^{b} ± 0.42	0.03
Total feed intake during lactation, kg	5.58 ± 0.12	5.56 ± 0.12	0.22
Feed efficiency per 1 weaning piglet, kg	10.90 ± 0.57	10.66 ± 0.58	0.41

^{a,b} - means within rows with different superscripts differ at $P \leq 0.05$

Glucose and HDL-cholesterol contents were increased, and TG and total cholesterol were decreased in blood plasma of sows supplemented with L-carnitine (Table 2).

DISCUSSION

The reproductive performance in this experiment can be regarded as good. The supplementation of L-carnitine contributed to a noticeable improvement of productivity. It should also be stressed that there was a statistically significant difference in body weight and piglet losses between the control and experimental groups.

Table 2. Protein, glucose and some lipid parameters of sow plasma

Indices	Days of reproductive cycle	Feeding groups		P=
		control	L-carnitine	
Total protein, g dl^{-1}	21 P *	9.04 ± 1.81	8.47 ± 0.36	0.28
	110 P *	8.64 ± 0.40	8.33 ± 0.91	0.25
	21 L **	7.44 ± 0.29	7.54 ± 0.55	0.39
	$\bar{X}$	8.37 ± 0.83	8.11 ± 0.61	0.34
Glucose, mmol l^{-1}	21 P *	4.97 ± 0.47	5.29 ± 0.39	0.12
	110 P *	4.74^{a} ± 0.56	5.26^{b} ± 0.91	0.03
	21 L **	2.89^{a} ± 0.29	3.22^{b} ± 0.43	0.02
	$\bar{X}$	4.20 ± 0.44	4.59 ± 0.58	0.14
Total cholesterol, mmol l^{-1}	21 P *	2.37 ± 0.26	2.65 ± 0.47	0.49
	110 P *	2.42 ± 0.69	2.08 ± 0.29	0.48
	21 L **	3.04^{b} ± 0.27	2.67^{a} ± 0.25	0.04
	$\bar{X}$	2.61 ± 0.41	2.47 ± 0.34	0.19
HDL - cholesterol, mmol l^{-1}	21 P *	0.99 ± 0.17	1.15 ± 0.19	0.33
	110 P *	0.61^{a} ± 0.08	0.80^{b} ± 0.16	0.03
	21 L **	1.23 ± 0.17	1.30 ± 0.15	0.24
	$\bar{X}$	0.94 ± 0.14	1.08 ± 0.17	0.09
LDL - cholesterol, mmol l^{-1}	21 P *	0.91 ± 0.25	1.08 ± 0.59	0.09
	110 P *	1.41 ± 0.65	1.01 ± 0.40	0.07
	21 L **	1.43 ± 0.35	1.09 ± 0.24	0.06
	$\bar{X}$	1.26 ± 0.42	1.06 ± 0.41	0.09
TG, mmol l^{-1}	21 P *	1.03 ± 0.19	0.93 ± 0.17	0.11
	110 P *	0.87^{b} ± 0.10	0.61^{a} ± 0.08	0.03
	21 L **	0.84^{b} ± 0.09	0.63^{a} ± 0.09	0.04
	$\bar{X}$	0.91^{b} ± 0.13	0.72^{a} ± 0.11	0.03
HDL, % of, total, cholesterol	21 P *	41.75 ± 5.79	43.41 ± 9.23	0.38
	110 P *	25.21^{a} ± 4.08	38.46^{b} ± 8.22	0.01
	21 L **	40.47^{a} ± 6.99	48.69^{b} ± 5.54	0.03
	$\bar{X}$	36.02^{a} ± 5.62	43.72^{b} ± 7.66	0.03

P* - pregnancy period, L** - lactation period

^{a,b} - means within rows with different superscripts differ at $P \leq 0.05$

Numerous publications point out that L-carnitine affects the energy aspect of metabolism, mainly with reference to lipids (Borum and Bennet, 1986; Woodworth et al., 2004). The findings of this experiment have also shown the influence

of L-carnitine on the glucose contents, as well as the parameters of the lipid profiles in blood plasma of sows. The glucose level was considerably higher in the experimental group, and the differences between the two groups on days 110 and 21 were statistically significant.

The TG content showed the opposite tendency, as it was substantially lower in the group that received a L-carnitine supplement. The total cholesterol content in this group was lower in the lactation period, whereas the contents of HDL-cholesterol was higher both during pregnancy ($P \leq 0.05$ on day 110 of pregnancy) as well as during lactation. The increase of HDL-cholesterol, as well as the increase of its share in total cholesterol is desirable, especially in humans.

CONCLUSIONS

The addition of L-carnitine to the sows' diet significantly contributed to increasing of the piglets weaning weight at 21 days of age and HDL-cholesterol content, and decreasing piglet losses and TG content in blood plasma.

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STRESZCZENIE

Wpływ dodatku L-karnityny w diecie dla macior na wskaźniki produkcyjne i metabolity w krwi

Doświadczenie przeprowadzono na 47 lochach wieloródkach, podzielonych na dwie grupy: kontrolną (24) i doświadczalną (23 zwierzęta). Lochy grupy doświadczalnej otrzymywały dodatek 50 mg L-karnityny do 1 kg mieszanek podawanych w okresie ciąży i laktacji. Krew pobierano od 8 loch z każdej grupy w 21 i 110 dniu ciąży oraz w 21 dniu laktacji. W krwi oznaczono zawartość glukozy, białka oraz cholesterolu ogólnego i frakcji HDL oraz TG.

Dodatek L-karnityny przyczynił się do istotnego zwiększenia masy ciała prosiąt odsadzanych w 21 dniu życia i zmniejszenia liczby upadków oraz wzrostu zawartości HDL-cholesterolu, a zmniejszenia trójglicerydów w osoczu krwi loch.