

L-Carnitine and suckling behaviour

by C. Birkenfeld, H. Kluge and K. Eder, Institute of Nutritional Sciences, University of Halle, Halle, Germany.

Several studies have shown that supplementing sows with L-Carnitine during pregnancy and lactation increases their reproductive performance. Sows supplemented with L-Carnitine had fewer stillborn piglets, more piglets born alive and higher litter weights.

Moreover, it has been shown that the litters of sows supplemented with L-Carnitine gain more weight during the suckling period than the litters of control sows. Piglets' postnatal growth depends on their intake of energy and nutrients from sows' milk.

It has been shown that the piglets of sows supplemented with L-Carnitine are able to get more milk from the sow than the piglets of control sows, which may explain their higher growth rates during the suckling period.

The reason for the higher milk intake of piglets from sows supplemented with L-Carnitine is unclear. Sows' milk production is heavily influenced by the suckling behaviour of their piglets.

The hypothesis of the present study is that the piglets of sows supplemented with L-Carnitine are able to suckle more frequently or for longer periods by virtue of their increased L-Carnitine status.

To test this hypothesis, we performed two experiments with sows. Each experiment comprised three reproductive cycles. To study the suckling behaviour in the early suckling phase, the sows and their litters were filmed and the litters were evaluated for the number of times they suckled each

	Control	+ L-Carnitine
Number of sucklings/day		
Day 3	43.5	44.9
Day 6	38.0	37.5
Day 9	36.8	37.5
Average duration of one suckling (minutes)		
Day 3	4.73	5.82*
Day 6	3.27	4.62*
Day 9	4.19	5.01**
Total suckling time/d (hours)		
Day 3	3.45	4.36*
Day 6	2.07	2.85*
Day 9	2.56	3.17*
Weight gain (g/day)		
Day 1-14	236	260*
Day 1-28	274	298*

* $P < 0.05$ compared to control group. ** $P < 0.10$ compared to control group

Table 1. Experiment 1. Suckling behaviour and body weight gains of the piglets of the control sows and the piglets of the sows supplemented with L-Carnitine.

day, the average duration of one suckling and their total suckling time per day.

Materials and methods

Crossbred sows (German Landrace x Large White) were used in both experiments. In Experiment 1, 26 sows in their second reproductive cycle with an average body weight of 179kg were allotted to two groups of 13 sows each.

In Experiment 2, 40 gilts with an average body weight of 143kg were assigned to two groups of 20 animals each. The sows were

artificially inseminated with sperm from Pietrain boars. In the first experiment nine of the 13 sows in the control group and all 13 sows in the L-Carnitine group conceived.

In the second experiment 13 of the 20 sows in the control group and 16 of the 20 sows in the L-Carnitine group conceived.

The sows were kept in single crates until day 30 of pregnancy. From day 30 to 110 of pregnancy, they were kept in groups of five to eight in 45m² pens with fully slatted floors, nipple drinkers and electronic feeding stations. On day 110 of pregnancy, the sows were moved to the farrowing accommodation.

Continued on page 39

Table 2. Experiment 2. Suckling behaviour and body weight gains of the piglets born to the control sows and the piglets born to the sows supplemented with L-Carnitine which were suckled either by the control sows or the sows supplemented with L-Carnitine.

Litter born to	Litter suckled by	Number of sucklings/day	Average duration of one suckling (minutes)	Total suckling time per day (hours)	Body weight gain day 1-14 (g/d)
Control sow	Control sow	43.6	3.7 ^b	2.7 ^a	201 ^a
Control sow	L-Carnitine sow	45.1	3.7 ^b	2.8 ^{ab}	216 ^{ab}
L-Carnitine sow	Control sow	43.3	4.2 ^a	3.0 ^{ab}	241 ^b
L-Carnitine sow	L-Carnitine sow	44.3	4.3 ^a	3.2 ^b	232 ^{ab}
Litter born to					
Control sow		44.4	3.7 ^b	2.7 ^b	208 ^b
L-Carnitine sow		43.8	4.2 ^a	3.1 ^a	231 ^a
Litter suckled by					
Control sow		43.4	3.9	2.8	220
L-Carnitine sow		44.7	4.0	3.0	220

Means without the same superscript letters (a, b) were significantly different ($P < 0.05$)

Continued from page 37
tion, where they were housed in single farrowing pens.

Basal commercial diets for pregnant or lactating sows were used. The energy content of the diet for pregnant sows was 9.0MJ metabolisable energy/kg, while that of the diet for lactating sows was 12.6MJ metabolisable energy/kg.

The nutrient concentrations of each diet conformed to the recommendations for pregnant or lactating sows (National Research Council 1998).

The natural L-Carnitine concentrations of the diets were between 10 and 20 mg/kg. During pregnancy, the diet was offered for ad libitum consumption.

On the day of farrowing the sows were fed 1.5kg of the lactation diet, which was then successively increased to 3kg/day on days one and two of lactation, 4.5kg/day on days three and four and ad libitum consumption from day five to weaning. Water was provided from nipple drinker systems.

The L-Carnitine group commenced supplementation 21 days before insemination, receiving 125mg L-Carnitine per day until insemination and throughout the entire pregnancy. During lactation the dose was increased to 250mg L-Carnitine per day. The supplements were supplied as tablets.

Farrowing was induced on day 115 of pregnancy. In the first experiment the litters of eight randomly selected sows from each group were standardised to 11 piglets/litter. In the second experiment the litters of ten sows from each group were standardised to nine piglets per litter within two days of farrowing. To study whether piglets' suckling behaviour is affected by whether their mothers receive L-Carnitine supplements during pregnancy or during lactation, litters were switched between sows in the second experiment.

Half of the control sows and half of the sows that received L-Carnitine supplements were given litters born to control sows, the other half of each group was given litters born to sows supplemented with L-Carnitine during pregnancy.

Blood samples were collected from the piglets immediately after birth to determine their plasma L-Carnitine concentrations.

In Experiment 1, video film was taken of the sows and their litters on days three, six and nine; in Experiment 2, the sows and their litters were filmed on day three of lactation. The tapes were viewed to study the suckling behaviour of the piglets. The results are as follows:

● L-Carnitine status of piglets at birth.

L-Carnitine supplementation of the sows during pregnancy increased the plasma L-Carnitine concentrations of their piglets at



birth. In the first experiment, the piglets of L-Carnitine supplemented sows were found to have a total plasma L-Carnitine concentration of 20.0 $\mu\text{mol/L}$ compared to 15.1 $\mu\text{mol/L}$ for the piglets of the control sows ($P < 0.05$).

In the second experiment, the figures were 21.2 and 13.3 $\mu\text{mol/L}$ respectively ($P < 0.05$).

● Suckling behaviour and body weight gains of the piglets

In Experiment 1, the piglets of both the control sows and the L-Carnitine suckled the same number of times per day on days three, six and nine of age. But the average duration of each suckling session and the total suckling time per day on days three, six and nine were significantly higher in the piglets of the sows supplemented with L-Carnitine than in the piglets of the control sows (Table 1).

Moreover, the piglets of the L-Carnitine supplemented sows exhibited higher daily body weight gains between days one and 14 and days one and 29 than those of the control sows.

In Experiment 2, the litters born to the control sows and the litters born to the sows supplemented with L-Carnitine both suckled the same number of times per day at three days of age (Table 2).

There was also no difference between the litters suckled by the control sows and the litters suckled by the L-Carnitine supplemented sows as regards the number of sucklings.

However, the average duration of one suckling session and the total suckling time per day were higher in the litters born to the sows supplemented with L-Carnitine than in the litters born to the control sows.

This was the case irrespective of whether the piglets were suckled by the control sows or by the sows supplemented with L-Carnitine (Table 2).

The piglets born to the L-Carnitine supple-

mented sows also exhibited higher body weight gains between days one and 14 than the piglets born to the control sows (Table 2). In contrast, there was no difference between the litters suckled by the control sows and the litters suckled by the sows supplemented with L-Carnitine in terms of the average duration of one suckling session and the total suckling time per day.

Moreover, the piglets suckled by the control sows and those suckled by the sows supplemented with L-Carnitine did not differ in their postnatal growth.

Conclusion

This study clearly demonstrates that piglets born to sows supple-

mented with L-Carnitine are able to suckle for longer in the early stage of the suckling phase than piglets of control sows. This might be the reason why they obtain more milk and grow faster during this phase than piglets born to control sows.

The study also shows that this effect is due to the sows receiving L-Carnitine supplements during gestation. We assume that the improved suckling behaviour of piglets born to sows supplemented with L-Carnitine is due either to the increased L-Carnitine status of the piglets at birth or to increased intrauterine nutrition of the foetuses which, in turn, enhances their prenatal development.

The practical implication of this study is that if L-Carnitine is administered to sows during gestation, this will have beneficial effects on the growth of their litters during the suckling phase.

Recommendation

At this point the question arises as to whether L-Carnitine supplementation can be omitted during the lactation phase. However, the large body of scientific evidence suggests that omitting supplementation is not to be recommended.

The best long term performance was observed in sows that were given L-Carnitine supplements throughout gestation and lactation.

Sows that receive L-Carnitine during lactation as well are better prepared for their next reproductive cycle. This is reflected in a better farrowing rate and a higher litter weight in the following cycle.

Scientific and real life feeding studies thus suggest that sows should be supplemented permanently. The recommended level is 50mg of L-Carnitine per kg of feed. Gilts should start to receive supplements when they are being introduced into the sow herd. ■