Better reproductive performance

by Klaus Eder, Institute of Agricultural and Nutritional Sciences, Martin-Luther-Universität, Halle-Wittenberg, Germany.

L-Carnitine is a naturally occurring substance with a chemical structure very similar to that of amino acids. The principal biological function of L-Carnitine in the body is to assist the breakdown of fats, and thereby provide energy. L-Carnitine can be formed to an equal extent in the bodies of humans and farm animals. It also occurs in feedstuffs. Animal based feedstuffs are rich in this substance, whereas plant based feeds contain little L-Carnitine (Table 1).

In the past, the prevailing view was that synthesis within the body and consumption via the feed provided sufficient L-Carnitine. However, recent studies indicate that supplementation of feed with L-Carnitine, particularly for pregnant and lactating sows, improves reproductive outcome. It appears that under these circumstances, endogenous synthesis and intake via the feed are not sufficient to meet this increased demand.

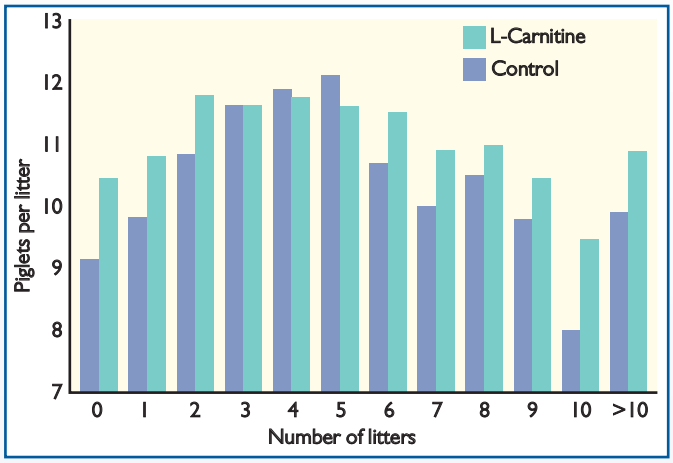


Fig. 1. L-Carnitine supplementation in feed increases the number of viable piglets (Author's own investigations, Strehle farm, Saxony).

Feed	L-Carnitine content (mg/kg)
Cereals (wheat, maize, barley, oats)	5-10
Bran (oat bran, wheat bran, barley bran)	10-15
Oilseeds	15-20
Extracted meals (soya, rapeseed, linseed)	10-15
Vegetable or animal fats	0
Meat and fish meals	80-150
Skimmed milk powder	130
Whey powder	300-600

Table 1. L-Carnitine contents in feedstuffs.

This article summarises the most important findings of a series of L-Carnitine feeding studies in breeding sows. It also discusses hypotheses concerning the underlying mechanism of action.

Pregnancy and farrowing

Various studies have shown that the number of sows becoming pregnant is higher in herds receiving L-Carnitine in the feed prior to insemination compared with herds receiving no additional L-Carnitine.

An evaluation of three trials, each covering a period of three reproductive cycles, revealed that 85% of the sows became pregnant in the sow groups receiving feed supplementation at 50mg L-Carnitine per kg, compared with just 74% in the control groups. The result for gilts conceiving for the first time was particularly impressive, with the pregnancy rate increasing from 75 to as much as 91%.

American studies suggest that this is probably due primarily to an increased release of leptin, an important fertility hormone that plays a crucial role in the onset of puberty in sows and the development and maturation of the ovarian follicles.

Our analysis also showed that the number of piglets delivered was higher, by 0.6 piglets per litter, in the gilts receiving L-Carnitine supplementation in the feed than in the control sows (11.1 vs 10.5 piglets per litter).

These results were recently confirmed in a large scale trial conducted in a sow unit with 3,500 cross bred German Landrace x Large White sows (Strehle farm, Saxony). In this trial, the farrowing rate in the gilts increased from 83 to 86% as a result of the L-Carnitine supplementation.

The number of viable piglets was increased by the L-Carnitine supplementation across the whole sow group, likewise by 0.6 piglets per litter, compared with the control group.

It was interesting to note, however, that L-Carnitine supplementation produced particularly good results on farrowing outcome in sows up to the third litter and in sows from the seventh litter (Fig. 1).

Litter weights at birth

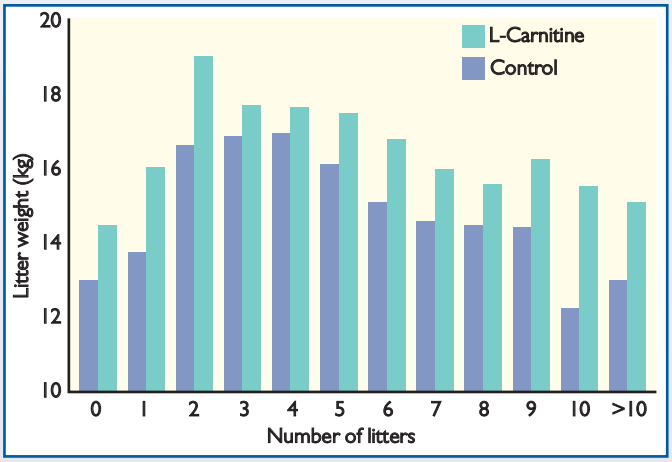
A series of study results are now available which consistently and clearly show that L-Carnitine supplementation of sow feed before and during pregnancy leads to higher litter weights. In an investigation with 227 Leicoma sows, the weights of the piglets increased from 1.38 to 1.48kg as a result of L-Carnitine supplementation (50mg/kg), while the litter weights rose from 14.5 to 16.3kg. The above mentioned large scale sow trial also showed increases of 8 and 11%, respectively, in piglet and litter weights as a result of L-Carnitine supplementation.

Here too, the effects observed in the gilts were much more pronounced, with increases in litter weights almost approaching 30% in some cases. However, increases in piglet and litter weights were also observed for sows from all age categories (Fig. 2).

Recent studies have shown that sows treated with L-Carnitine have larger placentas than control sows. Moreover, placentas from sows supplemented with L-Carnitine contained higher levels of substances

Continued on page 23

Fig. 2. L-Carnitine supplementation in feed increases litter weights at birth. Author's own investigations (data from Strehle farm, Saxony).



Continued from page 21
responsible for transporting glucose – the crucial nutrient for the growth of the foetus – from the mother to the foetus. These findings clearly show that L-Carnitine improves nutrient supply to the foetus during pregnancy, thereby resulting in better foetal development in the womb.

Faster piglet weight gain

A series of investigations have shown that the piglets of sows receiving L-Carnitine supplementation in the feed during pregnancy grow faster during the suckling phase and are heavier at weaning than piglets from control sows. In the aforementioned studies with Leicoma sows, the litters of the sows with L-Carnitine supplementation reached 57.9kg during a 28 day suckling period, compared with just 51.2kg for the litters of the control sows. These results were confirmed by the large scale study in Saxony, in which the litters of the sows supplemented with L-Carnitine weighed 55.7kg (on average) on the 21st day of suckling, whereas the litters of the control sows weighed just 47.5kg at the same point.

Piglets suckle for longer

Piglet growth during the suckling period is determined to a considerable extent by the quantity of milk that they are able to suck from the sow. We found that piglets of sows receiving L-Carnitine consume more milk than piglets of control sows (Fig. 3), which explains the faster growth of these piglets during the suckling period. The reason for this is that piglets born to sows supplemented with L-Carnitine are able to suckle for longer than those born to control sows.

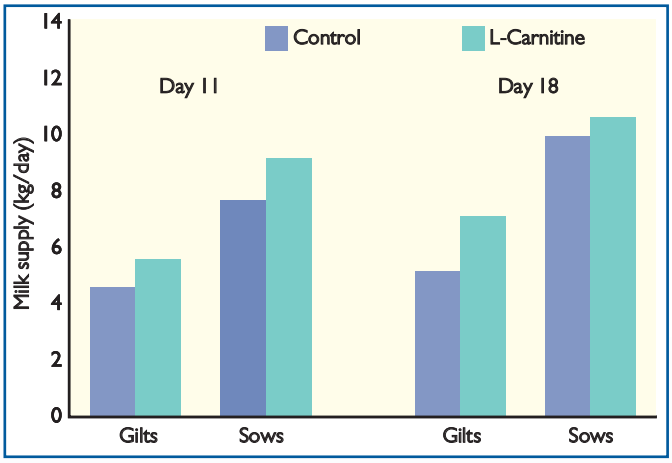


Fig. 3. L-Carnitine supplementation in feed increases milk supply to piglets. Author's own investigations (Ramanau et al. 2004).

Recommendations

As far as the use of L-Carnitine in sow feeding is concerned, we need to determine the appropriate supplementation dosage and time.

Most of the investigations showing positive effects of L-Carnitine on pregnancy rates, litter sizes and litter weights at parturition and weaning have used a dosage of 50mg L-Carnitine/kg of feed.

To establish whether smaller dosages can also produce positive performance results, we compared the effects of adding 25 and 50mg of L-Carnitine per kg of feed in more than 1,500 sows.

While the addition of just 25mg of L-Carnitine per kg produced positive effects, the effects on all investigated parameters were better with the addition of 50mg per kg (Table 2).

In order to obtain the best results from the L-Carnitine, supplementation should be started in the gilts before insemination, during synchronisation of oestrus. It should then be continued throughout the sow's useful life.

Supplementation before fertilisation is recommended since it yields higher pregnancy rates and higher numbers of new born piglets.

Treatment during pregnancy promotes better development of the foetuses in the womb, thus ensuring that the piglets are already heavier and livelier at the time of birth.

The increased vitality enables the piglets to suckle more effectively and grow faster during the suckling period.

The L-Carnitine supplementation during lactation forms the basis for the superior pregnancy rate and the higher number of piglets in the next cycle. In practice, L-Carnitine is often added only during lactation for cost reasons.

We now know with some certainty, however, that this has little effect, since the positive effects on the development of the piglets derive exclusively from the L-Carnitine supplementation during pregnancy.

Trials conducted with sows of differing ages show that the best effects on pregnancy rates and the number of viable piglets can be expected particularly in gilts, but also in sows with up to two previous litters and in older sows with six or more previous pregnancies.

Nevertheless, positive effects on litter weights at birth and at weaning were apparent in sows of all age groups.

On the basis of these findings, we recommend that sows should be given a feed supplemented with 50mg of L-Carnitine per kg throughout their entire useful life. ■

Table 2. Comparative effects of 25 and 50mg L-Carnitine per kg of feed on sow performance parameters. Author´s own investigations (data from Strehle farm, Saxony).

Parameter	Control	25mg L-Carnitine/kg	50mg L-Carnitine/kg
Piglets born per litter	11.5	11.8	12.0
Viable piglets per litter	10.6	11.1	11.2
Piglet weight, birth (kg)	1.40	1.48	1.51
Litter weight, birth (kg)	15.1	16.4	16.8
Litter weight, day 21 (kg)	47.5	53.4	55.7