A new look at post-weaning lactose requirements in the pig

The transition in nutrition and environment that occurs at weaning results in significant physiological changes in the pig. The period after weaning is characterised by low feed intake and feed efficiency, slow growth and high incidence of intestinal disturbances.

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When formulating diets for the post-weaning pig, Tokach et al. (2003) proposed three key considerations.

- Firstly, the nature of the swine industry demands that the pig is adjusted as quickly as possible to low-cost diets.
- Secondly, the newly weaned pig is in a very active period of development and maximising energy intake is critical for promoting growth.
- Thirdly, there are major changes in digestive physiology occurring at this time and it is best to formulate initial diets with highly digestible ingredients that complement the pattern of digestive enzymes in the gastrointestinal tract (GIT).

To tackle these considerations different feeding strategies have been introduced, one of which is the inclusion of lactose in starter diets. Over the last 30 years a number of published studies have reported the effects of supplementing lactose on post-weaning pig performance and so to make sense of this research a meta-analysis was conducted.

Often individual studies are too small to detect treatment effects, but when many studies are combined there is a higher chance of quantifying the effect. Therefore a meta-analysis can provide the strongest evidence of the effect of, in this case, lactose supplementation.

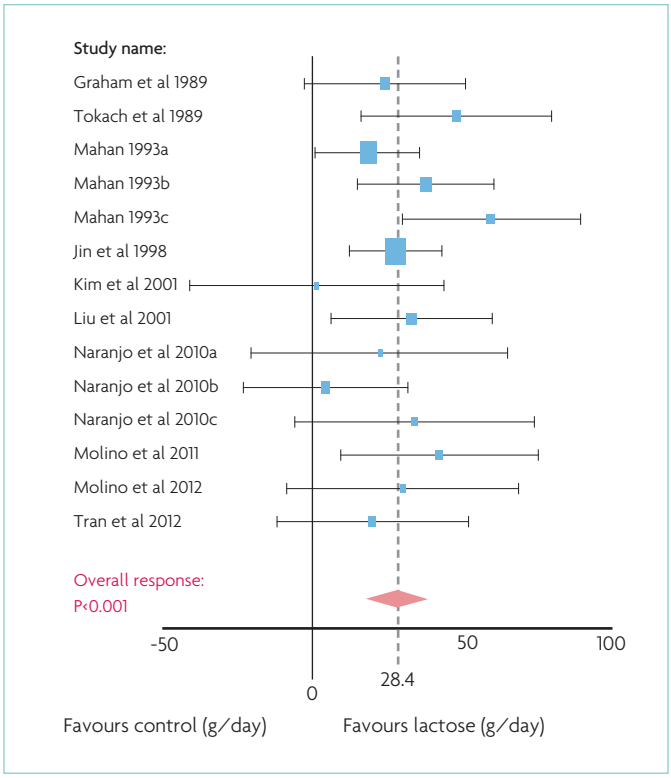

Fig. 1. Forest plot of the mean difference in pig growth rate after weaning for lactose and control treatments. Values <0g/d represent greater ADG for the control treatment (Favours Control) and values >0g/d represent greater ADG for the lactose treatment (Favours Lactose).

Lactose effects on growth

To estimate the effect of lactose supplementation on growth of the post-weaning pig a meta-analysis was conducted from a database of 14 experiments in the published literature that encompassed 83 treatment means.

These experiments compared differences for average daily gain (ADG) of lactose treatment with a control (no lactose supplemented) during the first five weeks post-weaning.

A graphical representation of the meta-analysis results assessing the impact of lactose supplementation on growth rate is provided in Fig. 1.

Each line represents an individual experiment. The location of the blue square represents the response to lactose supplementation compared to the control, with a value >0 representing an increase in ADG with lactose and a value <0 representing a decrease in ADG with lactose. The size of the square represents the weight given to the experiment and the horizontal lines represent the 95% confidence interval (CI).

The centre of the red diamond represents the overall response to lactose supplementation, with the diamond's width representing the 95% CI.

The meta-analysis found that lactose supplemented diets increased ADG by 28.4g/d relative to the control diets (95% CI: 20.8-36.0g/d).

This response was consistent across the dataset, with mean responses to lactose greater than 0g/d in all of the individual experiments.

To evaluate the impact of lactose supplementation over time, a subset of the experiments in the database (reported ≥3 measures of performance) were summarised.

This dataset showed that the main benefit of lactose supplementation took place over the first two weeks post-weaning for ADG (Fig. 2), with no benefit reported in any of the studies after the pigs passed beyond two weeks post-weaning.

Overall, these results support the inclusion of lactose-based ingredients in the first two weeks post-weaning.

Effects on digestion

Improvements in feed digestibility due to lactose supplementation post-weaning are likely to explain some of the observed increase in ADG. In studies that have reported beneficial effects of lactose supplementation, increased energy and nitrogen digestibility were measured in the second week post-weaning.

Lactose provides highly digestible energy to the piglet, with lactose representing the main energy source. In the piglet's small intestine, the disaccharide lactose is broken down by lactase into monosaccharides, which can easily be absorbed.

The transition from a milk-based diet to a cereal-based diet at weaning leads to substantial changes in the proportion and absolute levels of digestive enzymes produced in the pancreas and released into the GIT and a long-term increase in active small-intestinal absorption. Montagne et al. (2007) reported changes in specific activity of pancreatic and intestinal enzymes post-weaning for pigs weaned at 21 days of age (Fig. 3).

Understandably the change from a milk-based diet to a cereal-based diet caused a significant decrease in the activity of lactase (80%) from pre-weaning to 15 days post-weaning. Although activity of amylase decreases directly after weaning, the activity increased as from five days after weaning.

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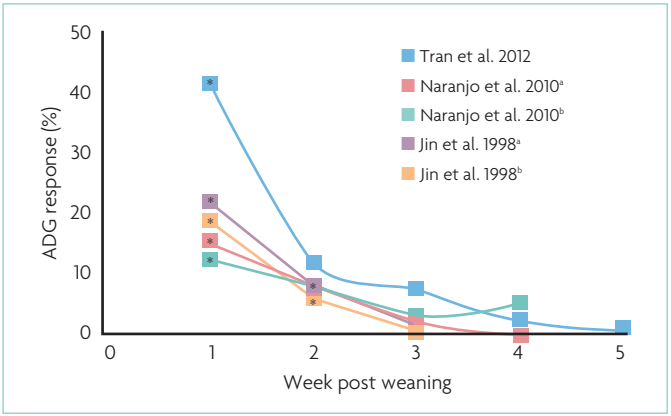

Fig. 2. Average daily gain (ADG) response to lactose supplementation, percent relative to control. Significant differences within a study are denoted by * (only two Jin et al., 1998 experiments were significant at week 2).

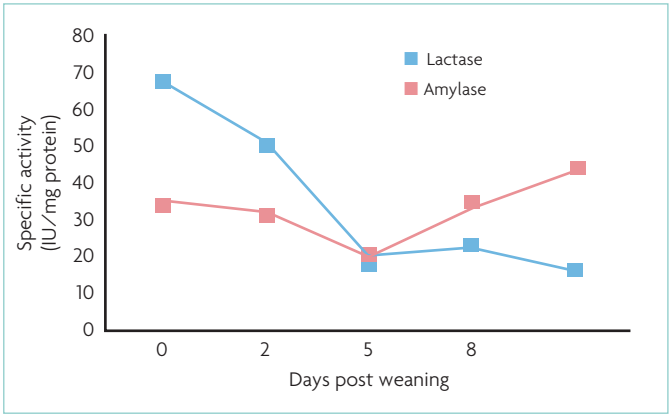

Fig. 3. Change in specific activity of amylase and lactase post-weaning (adapted from Montagne, et al., 2007).

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Prior to weaning the main intestinal enzyme responsible for carbohydrate digestion is lactase. To aid the transition for newly weaned pigs, lactose is commonly added pre-weaning as it can stimulate intake through taste and provide highly digestible energy.

Removing lactose 14 days post-weaning

So if the benefit of lactose supplementation appears to be mainly confined to the first two weeks post-weaning, what happens when the lactose is replaced with other digestible carbohydrates at this time?

This is an important consideration as there is interest in finding alternative ingredients that allow a lower cost diet to be formulated.

Kim et al. (2010) evaluated various three phase feeding programs for pigs from weaning and reported no benefit of supplementing lactose from 15-21 days post-weaning compared to non-lactose supplemented animals. In one of their experiments Kim et al. (2010) weaned pigs at age 28 days and found when removing lactose after 14 days the animals had ADG, intake, feed conversion and feed digestibility over the next three weeks comparable to animals that were supplemented lactose for an additional week.

Moreover, Mahan et al. (2004) concluded that the effect of lactose diminishes with age of the pig and that other simple carbohydrates may be just as effective as lactose. In this stage however, the carbohydrates need to be readily digestible to support the piglet's developing GIT. Piglets benefit from these readily digestible carbohydrates until their digestive system is fully capable of utilising raw starch.

Summary

Lactose supplementation post-weaning increases gain in pigs, with a meta-analysis finding a 28.4g/d increase in ADG relative to pigs receiving a control diet. When evaluating the influence of the length of time lactose was supplemented, the main benefit was observed during the first two weeks post-weaning.

Finally, studies show that digestible carbohydrate sources other than lactose are just as effective at supporting pig growth from two weeks post-weaning. Therefore the strategic feeding of highly digestible carbohydrate sources post-weaning allows the pig to successfully transition from lactose to raw starch as an energy source. ■

References are available from the author on request

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Applied research

Joosten Young Animal Nutrition applied this research to develop a new product in its Delac range. Successive to the dairy-based concentrate for young piglets, Delac Dulce, Joosten introduced a new Delac version with processed carbohydrates: Delac Max.

Both types of Delac, together with Nutrilac Plus (high performance sow milk replacer) form the Trilac concept of supplying the right energy at the right time.