Post-weaning lactose supplementation 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 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.

A meta-analysis involves using statistical techniques to synthesise the data from several studies into a single quantitative estimate of the effect of an intervention.

Meta-analysis approach

So why use a meta-analysis approach to consider the impact of lactose supplementation on post-weaning pig performance?

A key reason to use a meta-analysis is that it increases the power to detect the real effect of the intervention, in this case lactose supplementation.

Often individual studies are too small to detect treatment effects, but when many studies are combined there is a higher chance of detecting and quantifying the effect.

Therefore a meta-analysis can provide the strongest evidence of the effect of an intervention.

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 raw mean differences for average daily gain (ADG) of lactose treatment with a control that had 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 above.

Each line in the figure represents an individual experiment. The location of the blue square represents the magnitude and direction of 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 blue box represents the weight given to the experiment and the horizontal lines represent the 95% confidence interval (CI).

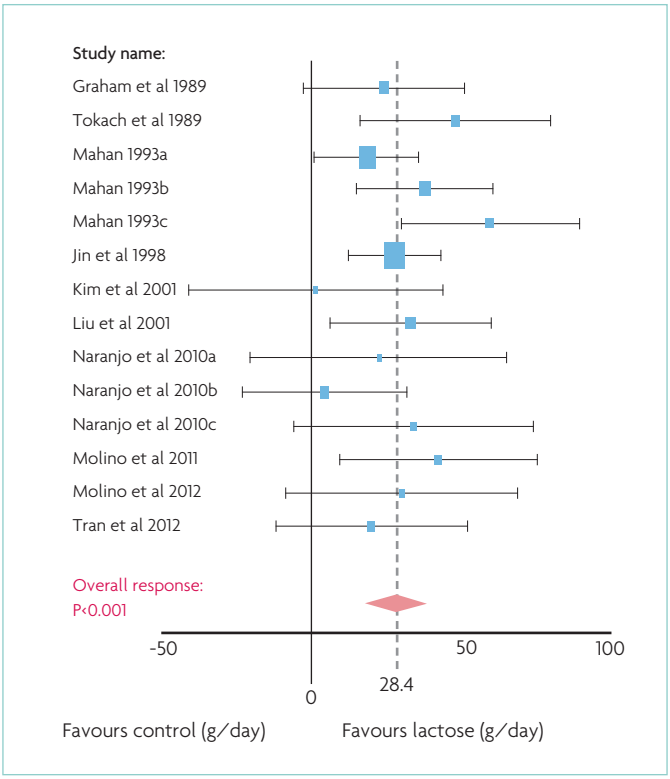

Fig. 1. Forest plot of the mean difference in pig growth rate after weaning for lactose and control treatments. Values ‹0g/d represent greater ADG for the control vs lactose treatment (favours control) and values ›0g/d represent greater ADG for the lactose vs the control treatment (favours lactose).

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 summarised in the database increased ADG by 28.4g/day relative to the control diets (95% CI: 20.8-36.0g/day).

This response was consistent across the dataset, with mean responses to lactose greater than 0g/day in all of the individual experiments. To evaluate the impact of lactose supplementation over time, a subset of the experiments in the database that reported ≥3 measures of performance in the first five weeks post-weaning were summarised.

This dataset also 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 in pigs supplemented with lactose post-weaning are likely to explain some of the observed increase in ADG.

In studies that have reported beneficial effects of lactose supplementation on pig performance increased energy and nitrogen digestibility were measured.

Additionally, lactose provides the pig with highly digestible energy post-weaning and research suggests that supplementation of lactose can slow the reduction in the activity of lactase.

De Souza et al. (2002) investigated the impact of lactose supplementation on enzyme activity and intestinal mass for pigs weaned at 21 days of age. The authors reported that the addition of different lactose sources to starter diets increased

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lactase activity and small intestine weight by 68% and 46%, respectively, relative to non-lactose supplemented controls during the first 14 days after weaning.

The weaning induced compromise in intestinal mucosa structure does not appear to be prevented by lactose supplementation, with villus length and crypt depth not different, relative to controls, in pigs over the first two weeks post-weaning.

Alternatives to lactose

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 substituting lactose with corn after 14 days the animals had ADG, intake, feed conversion and feed digestibility over the next three weeks comparable to animals that were supplemented with lactose for an additional week.

These observations contrast with the findings of Mahan et al. (2004) when also replacing lactose with corn, in this case after 21 days post-weaning.

The authors evaluated the effect of 0, 5, 10, 15 and 20% lactose in the diet from 21-35 days post-weaning and found a linear increase in average daily gain and intake with increasing dose.

Interestingly, the response to lactose was only significant in groups of pigs that were lighter (15.0kg) at 21 days of age and not in heavier animals (17.7kg).

Based on these results and other experiments in the study 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.

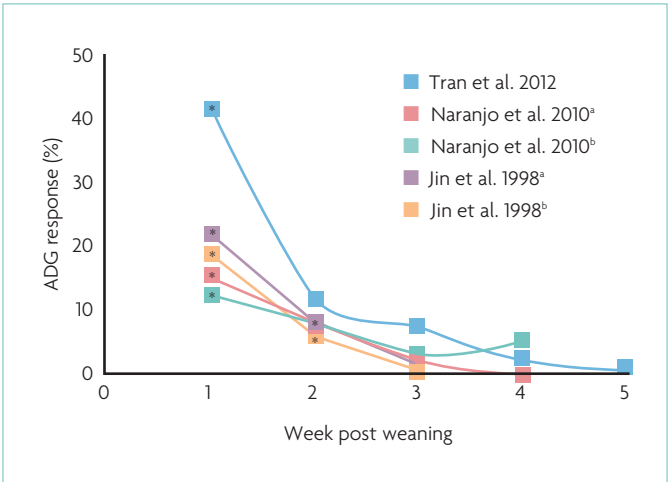

Fig. 2. Average daily gain (ADG) response to lactose supplementation, percent relative to control, in individual experiments measuring performance over the first three to five weeks post-weaning. Significant differences within a study are denoted by * (only two Jin et al., 1998 experiments were significant at week 2).

Summary

Lactose supplementation post-weaning increases gain in pigs, with a meta-analysis finding a 28.4g/day 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 suggest that digestible carbohydrate sources other than lactose may be just as effective at supporting pig growth from two weeks post-weaning.

Therefore the strategic feeding of highly digestible carbohydrate sources allows the pig to successfully transition the period post-weaning. ■

References are available from the author on request