



Are compensatory live weight gains observed in pigs following lysine restriction during the weaner phase?



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ABSTRACT

Despite a large amount of work on compensatory growth in pigs it continues to be poorly understood with many conflicting reports. The aim of this work was to conduct four similar trials using the same genotype of pig, facilities, feed and growth restriction period to determine whether it was possible to obtain consistent results using a constant trial set-up. A total of 576 pigs (Hampshire sire × (Large White × Landrace) dam) were used. Pigs were weaned onto trial at 26.8 ± 0.11 (mean ± SE) days of age at a mean weight of 8.1 ± 0.07 kg and remained on trial until slaughter, approximately 150.9 ± 0.66 days of age at a mean weight of 98.4 ± 0.65 kg. In each of the four trials the restriction period was for 3 weeks immediately following weaning. Pigs received either a high (Control; 17.5 g/kg) or a low (weaner restrict (WR); 8.0 g/kg) lysine diet during these 3 weeks, all pigs then received a high lysine diet up until slaughter, 15.5 and 12.0 g/kg of lysine for the grower and finisher diets respectively. Pigs from trial 1 ate ($P < 0.001$) and gained ($P < 0.001$) more throughout the weaner stage than all other trials. Growth performance was successfully reduced during the weaner phase. WR pigs grew more slowly ($P < 0.001$) and less efficiently ($P < 0.001$) than Control pigs. WR pigs from trial 1 demonstrated compensatory gains throughout the grower stage, growing 6% faster than Control pigs from trial 1 due to an improvement in feed efficiency ($P < 0.001$). WR pigs from trial 2 demonstrated compensatory gains during the finisher stage, increasing their rate of gain by 7.0% compared to Control pigs from trial 2 again due to an improvement in feed efficiency ($P < 0.1$). However previous lysine restriction did not result in compensatory growth in trials 3 and 4. WR pigs from trials 3 ($P < 0.05$) and 4 ($P < 0.1$) had a lower feed intake compared to Control pigs during the grower stage and an overall lower lysine intake throughout the trial ($P < 0.05$; $P < 0.05$). Although pigs from trials 1 and 2 demonstrated compensatory growth following a reduction in performance when dietary lysine levels as low as 8.0 g/kg lysine were fed for a period of 3 weeks immediately post-weaning, pigs from experiments 3 and 4 did not, thus compensatory growth was not consistently observed.

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1. Introduction

Economic efficiency is vital for long term profitability in pig production and hence improving growth rates and

feed efficiency are common goals in the pig industry. As compensatory growth has been associated with an increase in feed efficiency it is a mechanism that may help in reaching this goal. Compensatory growth is a phenomenon whereby an animal accelerates its growth after a period of suppressed growth, usually as a result of feed restriction (Hornick et al., 2000), however there is considerable disagreement in the

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literature on whether animals previously fed a low protein diet subsequently exhibit compensatory live weight gains. On the one hand the studies of Chiba (1995), de Greef et al. (1992), Fabian et al. (2004), Kyriazakis et al. (1991), Kyriazakis and Emmans (1991), Martinez-Ramirez et al. (2008b), and Whang et al. (2000) showed very clear compensatory live weight gains in pigs during realimentation. On the other hand the studies of Chiba et al. (2002), Fabian et al. (2002), Hogberg and Zimmerman (1978) and Martinez-Ramirez et al. (2008a) found that a period of protein restriction did not affect subsequent live weight gains. Wahlstrom and Libal (1983) reported both the presence and absence of compensatory live weight gains in a series of four experiments. Proposals for the differences observed in the literature have been based on a number of factors such as: age of the animal; length of feed restriction; severity of feed restriction; quality of feed; sex; genotype; and VFI of the pig (de Greef et al., 1992; Kamalakar et al., 2009; Millward et al., 1976; Martinez-Ramirez et al., 2008a; O'Connell et al., 2006).

Studies exploring compensatory growth during the weaner phase are limited, which may be due to the fact that the period immediately post-weaning is a sensitive period in a pig's life. Following weaning, pigs experience a reduction in feed intake and weight gain as a result of a sudden and abrupt change of diet (moving onto solid feed) and the stress of being mixed with other pigs (Whang et al., 2000). Chiba (1995) found that weaner pigs fed a simple weaner diet (11.7 g/kg lysine) in comparison to a complex starter diet (13.7 g/kg lysine) from 6.8 ± 0.4 kg (25 ± 3 days) for 4 weeks were unable to compensate. Pigs previously fed the simple diet did not show compensatory gains as feed intake remained lower than that of pigs fed the complex starter diet when moved onto a high amino acid diet, suggesting that they were not ready to accept a higher amino acid diet or that their amino acid requirements were met at a lower feed intake. However Kyriazakis and Emmans (1991) observed compensatory gains when pigs were fed a low (134 g) crude protein diet from weaning to 16.0 kg followed by a high crude protein diet up until 33 kg.

In order to reduce variability between studies and thus aid our understanding of compensatory growth the current study carried out four experiments to determine whether or not compensatory live weight gains were consistently observed following lysine restriction during the weaner phase, using the same age and genotype of pig, and the same level and length of lysine restriction. As mentioned above, there are many factors that affect compensatory growth, however it was hypothesised that consistent findings would be observed if the trial set up and the aforementioned factors remained constant.

2. Materials and methods

Trial 1 was conducted from March to October 2008, trial 2 from December 2008 to July 2009, trial 3 from

December 2009 to July 2010 and trial 4 from May to December 2011.

2.1. Animals and housing

At weaning, pigs were moved to conventional flat deck accommodation. Each pen measured 1.5 m × 2.4 m and contained two nipple drinkers, one feeding trough (with 10 feeder spaces) and a hanging chain for environmental enrichment. Heating and ventilation was controlled at all times, with temperature reducing over 21 days from 30 °C at weaning to 22 °C (Dicam system). After 3 weeks (7 weeks of age) the multi-space feeder was replaced with a single space feeder until 15 weeks of age. Pigs were moved into finishing accommodation at 15 weeks of age, remaining in their original pen groups, until slaughter. Finisher pens were 1.7 m × 4.2 m. Each pen contained a nipple drinker, two single-spaced feeding troughs and a hanging chain for environmental enrichment.

At weaning, all pigs were weighed and allocated to pens on the basis of live weight, litter origin and sex. Eight replicates were used in each trial. Each replicate had the same number of pigs per pen, 8 and 9 pigs per pen for trials 1 and 2, 10 pigs per pen for trial 3 and 8, 9, and 10 pigs per pen for trial 4. All pens within replicate had similar total weights (within 0.3 kg) and a similar live weight range. Litter origin was distributed such that pigs in the same replicate were equally derived from the same combination of litters and had a similar sex ratio with the exception of trial 4 wherein pigs were housed in single sex pens.

2.2. Experimental diets and measurements

Throughout each experiment pigs were fed *ad libitum* receiving either a high (17.5 g/kg) or a low (8.0 g/kg) lysine diet during the first 3 weeks post-weaning. Preliminary experiments had previously been carried out at Spens Farm (University of Leeds) to establish two diets, high and low in lysine, capable of creating differences in growth performance (data not published). A dose response was used with diets consisting of four different lysine levels; 8.0 g/kg, 11.5 g/kg, 14.5 g/kg, and 17.5 g/kg. Pigs showed a linear increase in performance as dietary lysine increased. Pigs fed the three lower lysine diets showed compensatory growth, thus the diets that created the greatest difference during the weaner stage were used. The high lysine diet exceeded BSAS (2003) recommendations (14.0–16.0 g/kg) whereas the low lysine diet was below that recommended by BSAS (2003). Both weaner diets were followed by a high lysine diet up until slaughter, 15.5 and 12.0 g/kg lysine for the grower (7–12 weeks of age) and finisher (12 weeks of age to slaughter) diets respectively. Lysine levels above those recommended by BSAS (2003) were used as Whang et al. (2003) and O'Connell et al. (2006) suggested that pigs that have previously been fed a low protein diet with associated reduced growth performance utilise higher protein diets during realimentation more efficiently than pigs previously fed a higher protein diet. This created two dietary treatments, Control versus Weaner Restrict (WR).

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