

ACCELERATE-P

Overview

Academic & Farm Results

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AXCELERA-P

- **Improves lifetime performance.**
- **Reduces pre-weaning mortality**
- **Pigs are heavier at weaning, nursery exit and finish heavier (or earlier at the same weight).**
- **Fewer small pigs to manage after weaning, at nursery exit and at slaughter.**
- **Reduces variation**

Axcelera-P is a revolutionary preweaning feed produced with a novel and unique process (Neo-tec) that has been shown to enhance lifetime pig performance. An overview of academic and farm trial results is given in the following pages.

Biosecurity

Axcelera-P is produced and packed in the EU in a facility guaranteed never to have used animal or fish proteins. It is supplied, palleted in plastic bags. AB Neo is committed to bio security and will work with all clients to ensure a delivery and packaging system that meets specific needs.

Improvements seen in University and Farm Trials

1. Reduced Pre-Weaning Mortality (0.5% to 5% improvements)
2. Increased weaning weight (+100g to 300g)
3. Increased nursery exit weight (+0.5 to 1kg)
4. Increased slaughter weight (+2.5 to 5kg)
5. Increased carcass yield (Killing Out +0.5%)

Cost Indication.

\$2,500 per 1000kg. Assuming 100g intake/piglet total costs are (\$0.25 per piglet, \$3.25/litter and \$7.5 per sow per year). If this diet replaces another creep feed then the incremental cost is less than the total costs above.

Return on Investment

With 1% mortality valued at \$1.50 to \$2.72/pig significant return on investment is available on this measure alone.

Breakeven is at 0.1-0.18% mortality or 0.15 -0.25kg liveweight at slaughter.

1a. Pre-weaning Mortality

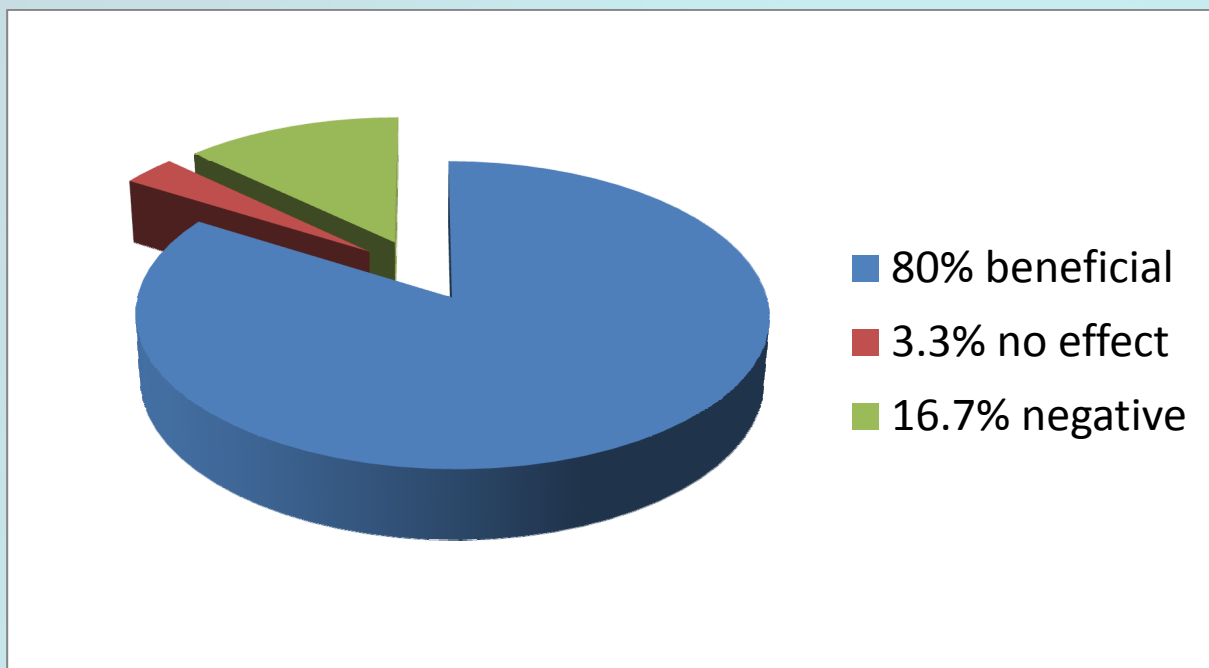
Pre-weaning mortality remains a source of significant financial loss and welfare concern.

Although around two thirds of pre-weaning mortality occurs in the first 4 days after birth a further third occurs between day 5 and weaning. The main cause of pre-weaning mortality is known to be energy deficit and this is particularly important after day 4.

Pre-weaning mortality is responsive to supplemental nutrition and to labour inputs. Supplying milk replacer has been shown to be effective in reducing pre-weaning mortality but is both expensive and labour intensive. Axcelera-P has shown itself capable of reducing pre-weaning mortality across a wide range of farm conditions in several different countries.

Effect of Axcelera-P on Pre-Weaning Mortality after day 4

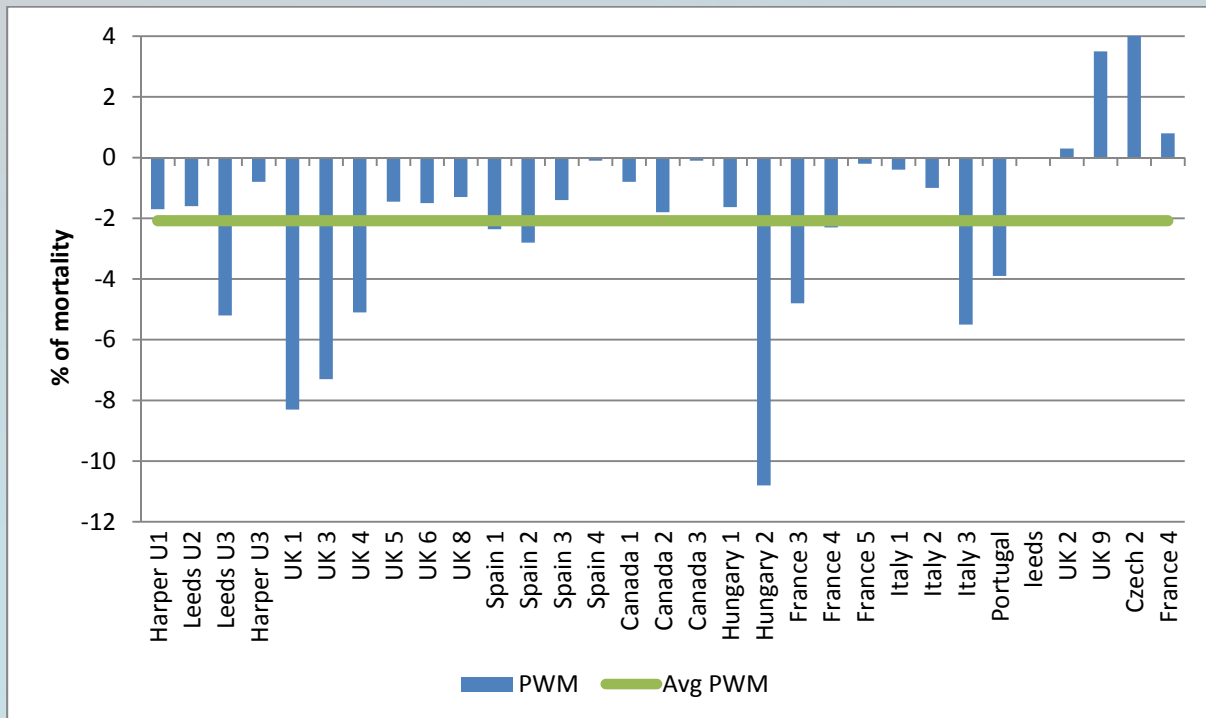
(4 Academic and 26 Commercial trials – 33,000 piglets)



This improvement in pre-weaning mortality in four out of five trials is most likely to be a nutrient intake effect. Axcelera-P has three to four times the lactose level of commonly used creep diets and almost double the level in sow's milk.

Magnitude of the benefits of pre-weaning effect seen in 80% of trials.

Absolute Reduction in Pre- Weaning mortality (4 University and 26 Commercial Trials - 33,000 piglet)

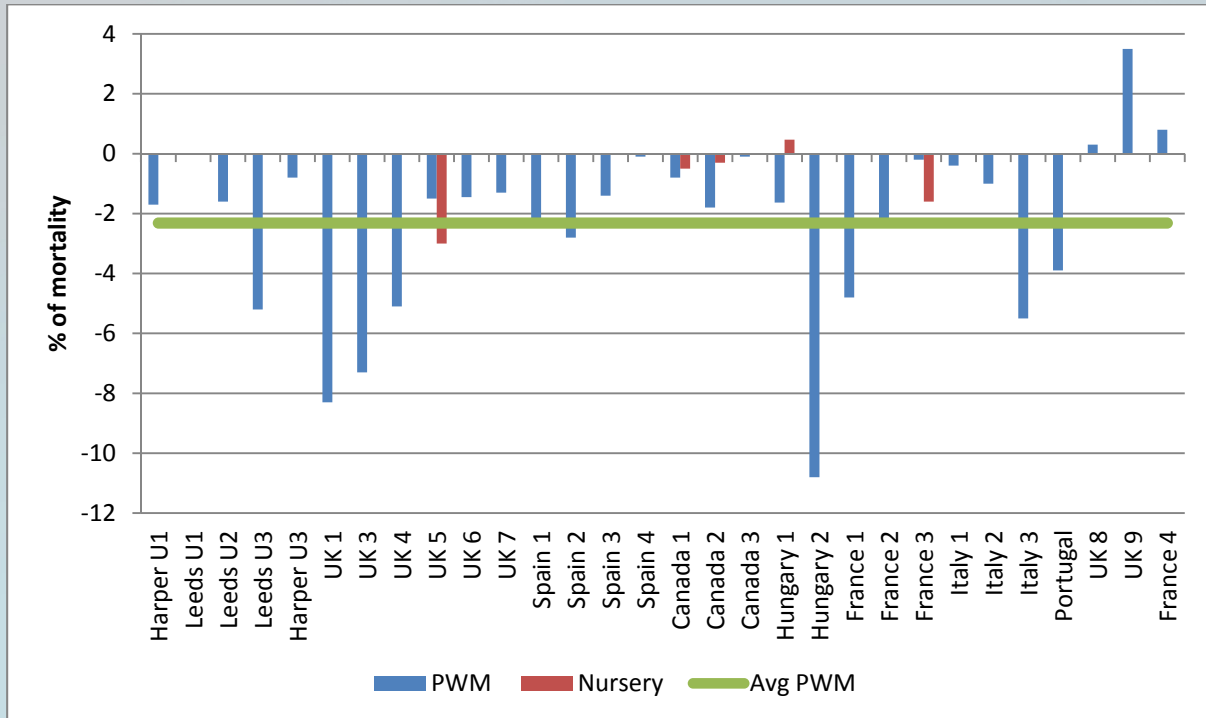


In the trials available, the mean pre-weaning mortality benefit was over 2% (2.08%). That is, farms with a 10% pre-weaning mortality would be expected to improve to around 8%. As expected with such a large number of trials on farms encompassing large differences in health status, genotype, litter sizes and husbandry there was a wide range in mortality reduction and some small increases in a few farms, as expected under commercial farm conditions.

One hypothesis, currently under investigation, regarding the mode of action for Axcelera-P improving lifetime performance is a favourable change in the microbiome, having positive effects through metabolic changes, the immune system and behavioural changes.

If this is the case, some residual mortality benefits would be expected after the feeding of Axcelera-P has ceased. If the data set is further analysed to see if there are mortality benefits after Axcelera P feeding has stopped there is an indication of residual benefit in terms of post weaning mortality. We have not included two Eastern European trials where significant mortality (greater than 10%) occurred in the control nursery and less than 2% in the Axcelera-P fed pigs as little is known about the rigour of the trials.

Absolute Reduction in Pre and Post Weaning mortality (4 University and 26 Commercial Trials)



(Red Bars represent Post Weaning Mortality)

Value of Mortality and Return on Investment (ROI)

There is no universally accepted value placed on mortality. Different countries give quite different values. In the USA it has long been said that 1% pre-weaning mortality is worth \$1.50 per pig. This assumption was challenged recently by Casey Neil of the Pipestone Company who had analysed significant amounts of data to show an inverse correlation between pre-weaning mortality and lifetime growth rates. Casey concluded that as pre-weaning mortality increased, growth to slaughter decreased. This loss of growth rate added extra cost making 1% pre-weaning mortality worth \$2.72/pig.

European pig production tends to be less profitable than US production and so it is not surprising to see values of €15-20/sow/year and £13-19/sow/year. This translates into 60-80 euro cents/pig or 50-75p/pig. As total cost per pig is around 25 US cents, 20 euro cents or 20p/pig, depending upon the country, quite high returns on investment can be expected even when the total cost of the product is used. On most, if not all farms, the Axcelera-P replaces an existing product and so it is the additional cost that counts and when this lower incremental cost is included in the ROI calculations the Axcelera P benefit becomes even more favourable.

Conclusion – Prewaning Mortality

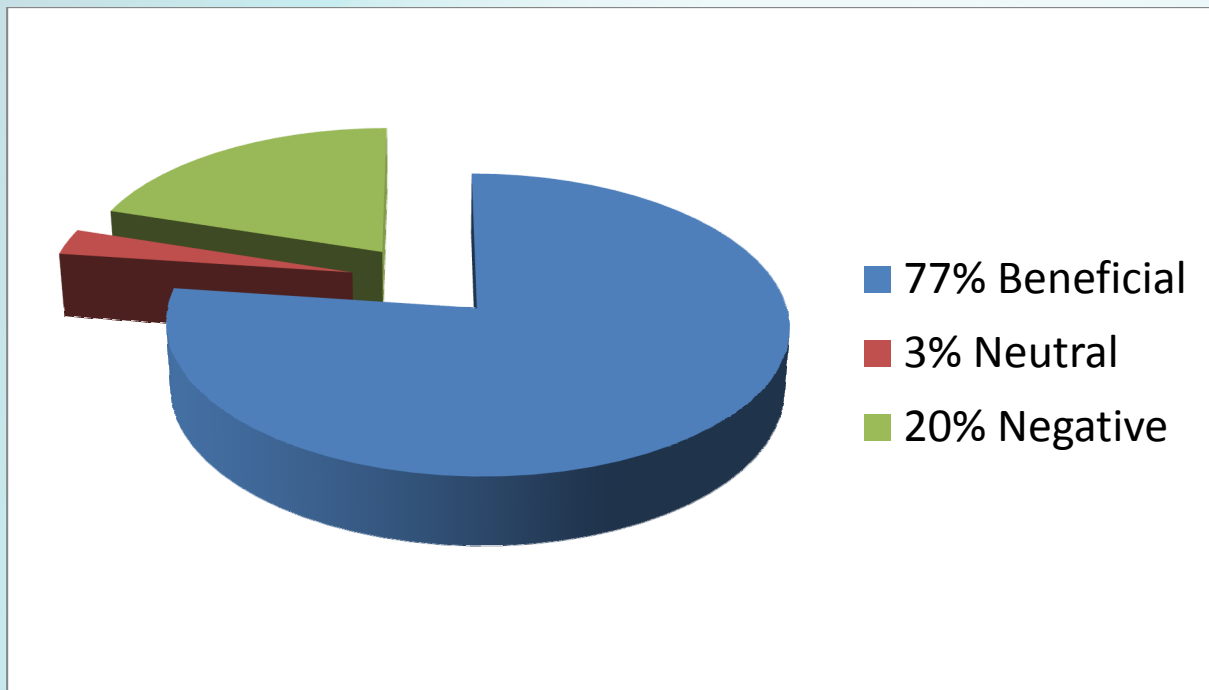
Axcelera-P has decreased, on average, preweaning mortality by 2%. An improvement has been seen on 4 out of 5 trials. Some farms saw what appears to be a carry-over effect with improved post weaning mortality after weaning after Axcelera-P had ceased to be fed.

1b. Weaning Weight Improvement

An increase in weaning weight has a number of benefits. There are fewer small pigs to deal with. Small pigs are prone to poor lifetime performance and increased mortality. In order to avoid poor lifetime performance and increased post weaning mortality it is common to invest in more labour, medication and improved diet quality for smaller pigs. By reducing the number of smaller pigs at weaning, savings are made in labour, medication and diet costs. Weaning weight is correlated to lifetime performance and so an extra 100g at weaning would be expected to yield around 300g at slaughter. Heavier piglets at weaning would be expected to be more robust, grow faster and suffer less mortality and morbidity to slaughter and utilise lower cost diets sooner than lighter peers.

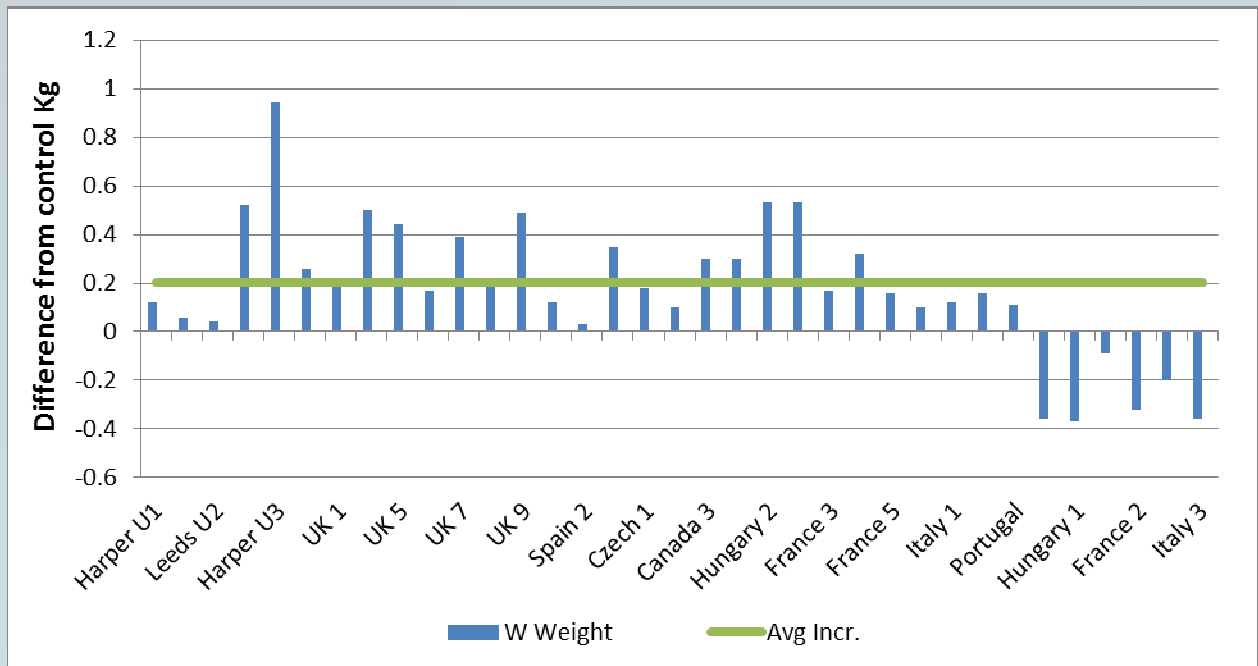
Improvements in weaning weight were seen in 4 out of 5 trials.

Weaning Weight (6 Academic and 29 Commercial Trials)



In terms of magnitude, the improvement in weaning weight averaged around 200g/piglet. There was a very large range across the farm trials including some trials with lower weaning weights however it is important to note reduced pre-weaning mortality led to increased numbers weaned and to increased litter weights but reduced individual weaning weights in some cases.

Absolute Weaning Weight Improvement (5 University and 29 Commercial Trials)

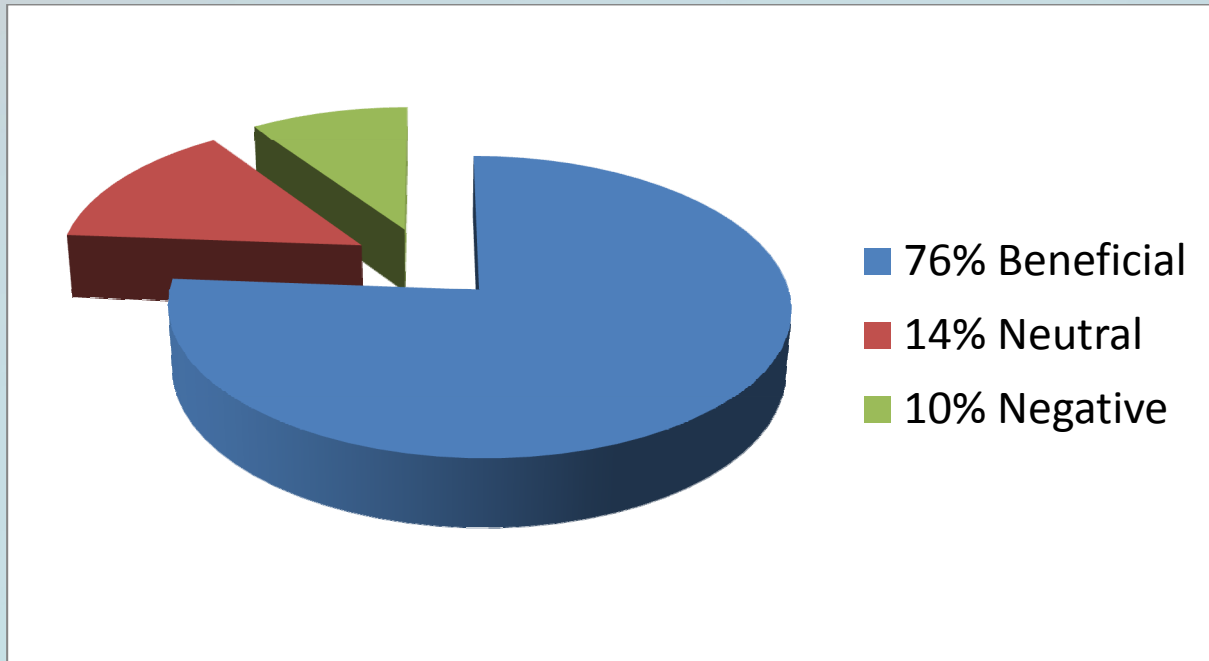


The direct financial value of extra weaning weight is not that high but it is a major factor in improving key performance factors which have large financial values (mortality, growth rates, and slaughter weight)

2. Nursery Exit Weights

Weight advantages gained early in the pigs life are generally kept and built on but not always as piglets short of milk or access to creep feed in farrowing can sometimes ‘catch up’ in the more favourable feeding conditions within the nursery. In the 21 trials where nursery exit weights were measured the majority went on to show substantial nursery exit weights benefits.

Nursery Exit Weights (4 Academic and 17 Commercial Trials)



It is at this stage that the ***Accelerator Effect*** is first seen clearly.

Conventionally, for each 100g improvement in weaning weight, a nursery exit improvement of a further 50 to 100g improvement would be expected (and 300g by slaughter).

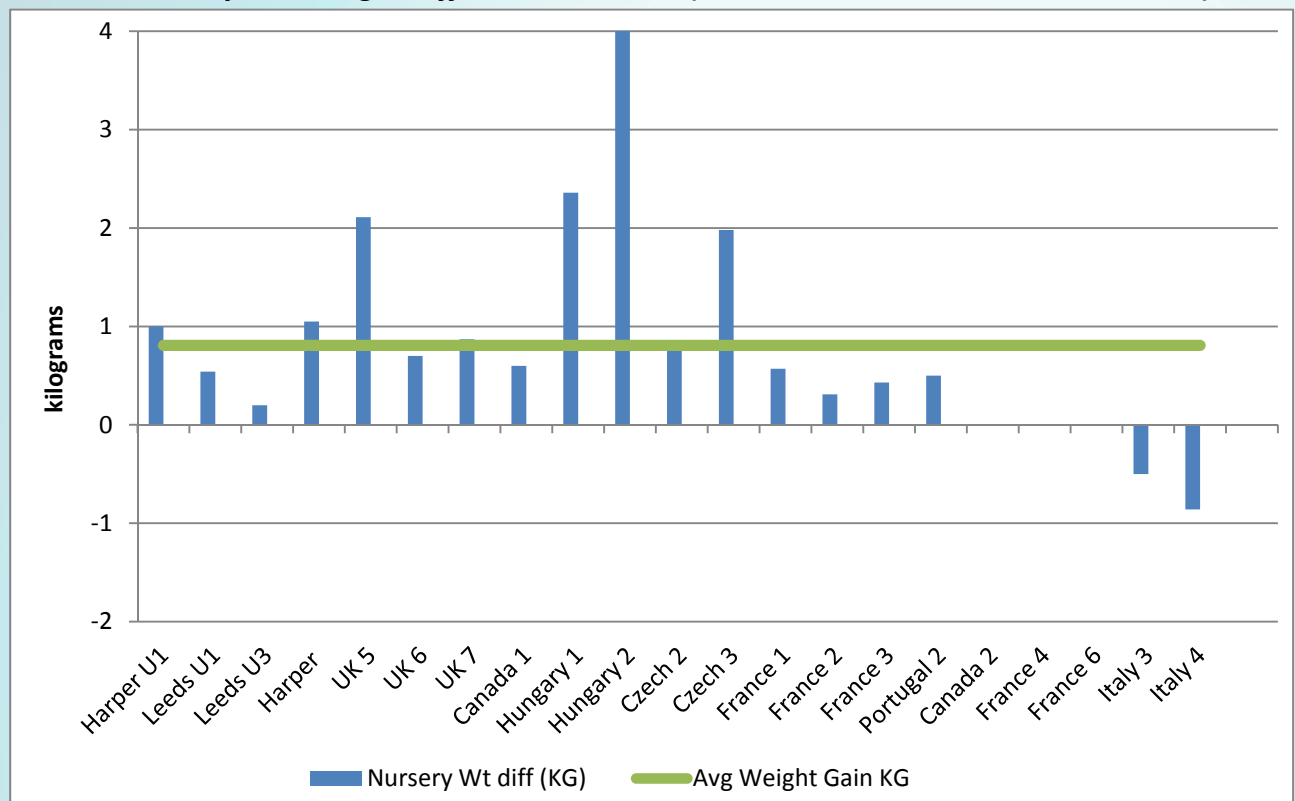
With Axcelera-P, in these trials we see improvements in nursery exit weights of 500g to 1000g or ten times the predicted gain - something clearly unique and different from what would be expected.

The academic evaluations shown below are from pigs fed identically from weaning with the *only difference* being the diet fed pre-weaning. An identical trial was replicated under differing health status show large nursery exit weight benefits.

Note weaning weight was balanced on entry to the nursery.

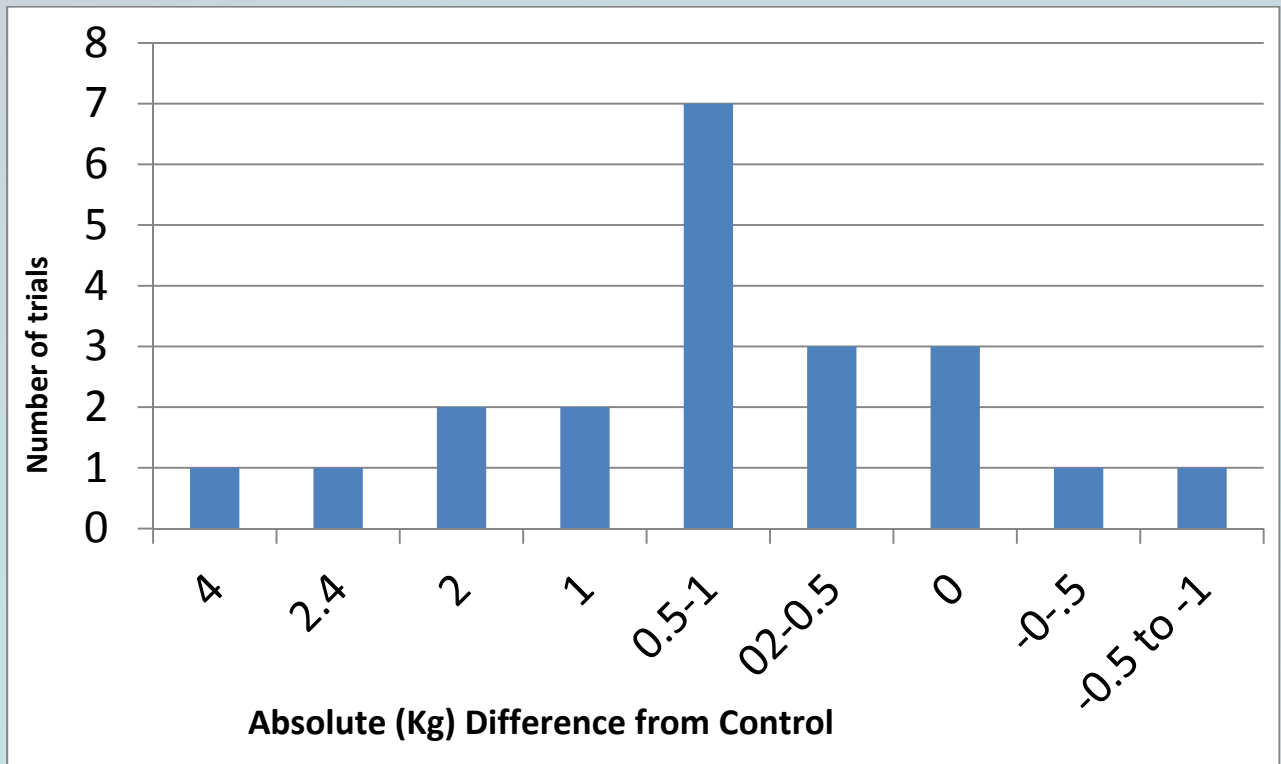
Pre weaning diet only	High Health University 1		Poor Health University 2	
	Baby Start	Axcelera-P	Baby Start	Axcelera-P
No. of pens of pigs	18	18	12	12
Wean weight (kg)	9.42	9.36	7.64	7.66
Trial length (days)	22	22	20	20
Daily Intake (g/d)	381 ^a	418 ^b	358 ^x	381 ^y
Daily Gain (g/d)	296 ^a	344 ^b	309 ^x	339 ^y
FCR	1.29 ^a	1.22 ^b	1.16	1.12
End Weight (kg)	15.92 ^a	16.92 ^b	13.87	14.43

Absolute Nursery Exit Weight Difference v Control (4 Academic and 17 Commercial Trials)



The 21 trials which measured nursery exit weights have a mean advantage of almost 1 kg and not the 0.3kg predicted from the increase in weaning weight. To see the range of increased nursery exit weights across the trials we need to plot the data by weight band increase.

Nursery Exit Weight Difference from Control (4 Academic and 17 Farm Trials)



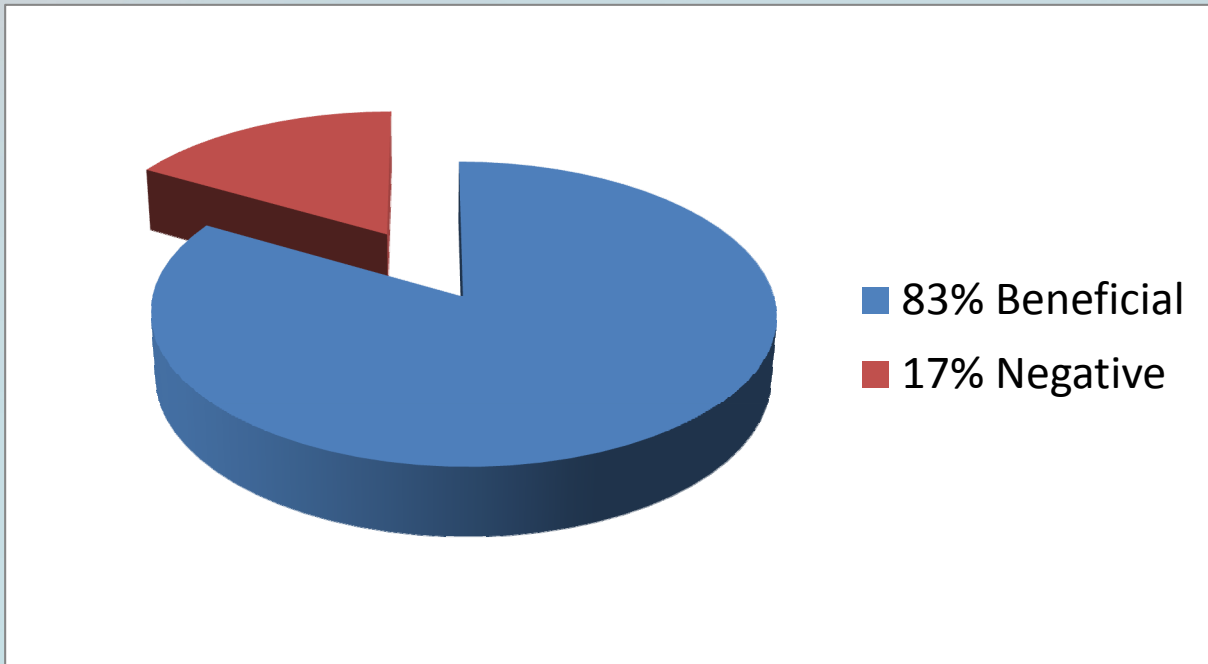
The analysis by weight band shows a strong bias towards weight gain with 16 trials showing a weight advantage with Axcelera-P fed pigs and only two with lower weight gains than the control.

Not only did the majority of trials show Axcelera-P fed pigs gained more weight than predicted from their weaning weight advantages but that the weight advantages were greater (13 trials with 0.5kg or greater) when compared to the number of trials with a weight disadvantage (one trial only where Axcelera-P fed pigs had nursery exit weights 0.5kg-1kg lower than the control)

3. Slaughter Weights

Trials from birth to slaughter are constrained by their high cost in an academic institution and their difficulty to control with accuracy and rigour on commercial farms. We have completed six trials through to slaughter, two academic trials and four trials in commercial facilities. Five trials have been positive and only one trial (commercial farm) has been negative.

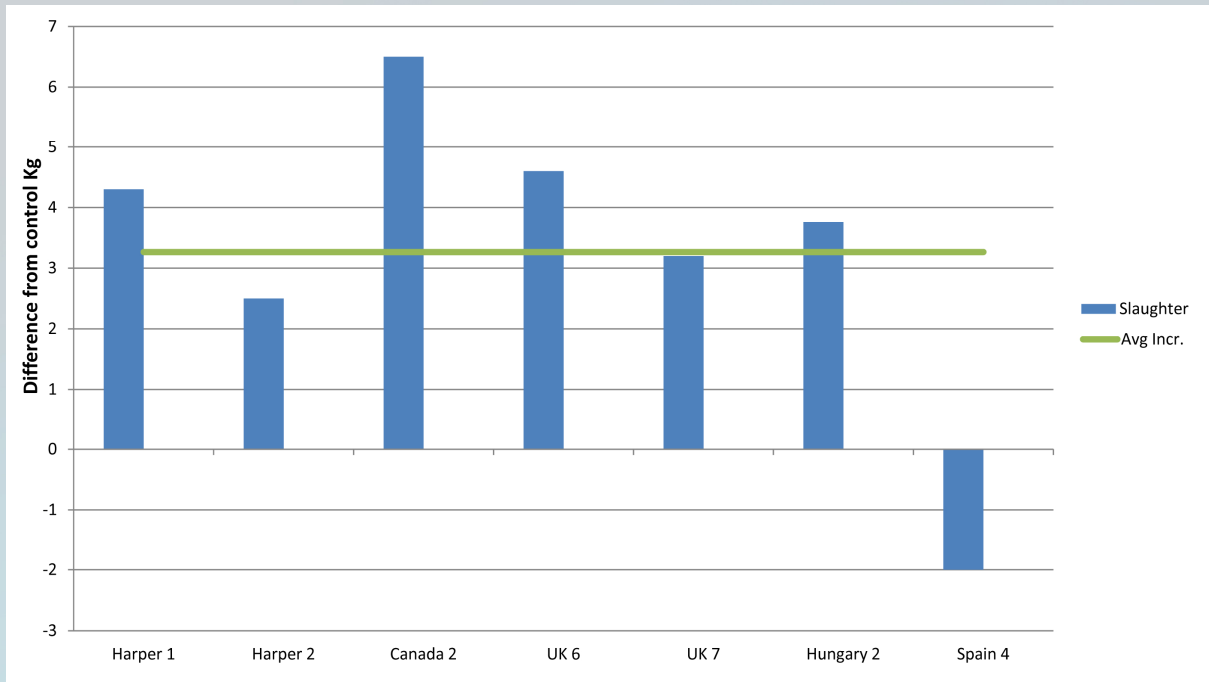
Slaughter Weights Summary (2 Academic and 4 Commercial Trials)



The predicted weight advantage at slaughter from the weaning weight advantage would be 300g to 600g and so it is illuminating to look at the weight gain advantage at slaughter in the six completed trials. Weight advantages are approximately ten times what would be predicted in five of the six trials.

The one trial which failed to show any advantage was associated with very low feed intakes of Axcelera-P prior to weaning.

Absolute Slaughter Weight Improvement in Kg (7 trials)



Killing out%

Killing out percentage or yield is economically significant. In one of the academic trials a full carcass evaluation was undertaken and this showed a statistically significant increase in killing out % (yield) for the pigs fed Axcelera-P before weaning.

Origins & R&D Summary

Axcelera-P has its origins in a programme of work seeking replacements for Antibiotic Growth Promoters which began a few years ahead of the EU wide ban on January 1st 2006.

A key experiment (H.M. Miller , P. Toplis , R.D. Slade - *Livestock Science* **125 (2009) 121–131**) was a comparison of post weaning nursery performance when fed nursery diets with and without AGP on piglets reared from birth to weaning in indoor versus outdoor rearing environments. This showed when all other factors were carefully balanced outdoor rearing not only boosted post weaning growth performance when pigs were fed the same diet in the same nursery room but also reduced the detrimental impact of AGP removal. Outdoor rearing produced improved performance and increased robustness.

A similar trial in the USA looking at rearing environment impact on nursery performance gave almost identical results (Davis,E., C.V. Maxwell,J.D. Spencer, R.L.Moser, J.Rehberger and T.Rehberger 2009a (Abstr.) *J.Anim. Sci* **87 (Midwest Abstract suppl.)**)

One of the questions this type of work was raising was ‘Did early microbial colonization of the gut reduces the incidence of infectious, inflammatory and autoimmune diseases? It was decided to address this important question using the pig as a model to evaluate the impact of early-life environment on microbe/host gut interactions during development. (Environmentally-acquired bacteria influence microbial diversity and natural innate immune responses at gut surfaces Imke E Mulder^{1†}, Bettina Schmidt^{1†}, Christopher R Stokes², Marie Lewis², Mick Bailey², Rustam I Aminov¹, James I Prosser³, Bhupinder P Gill⁴, John R Pluske⁵, Claus-Dieter Mayer⁶, Corran C Musk¹ and Denise Kelly^{1*} *BMC Biology* **2009, 7:79**)

They concluded that early-life environment significantly affects both microbial composition of the adult gut and mucosal innate immune function. They observed that a microbiota dominated by lactobacilli may function to maintain mucosal immune homeostasis and limit pathogen colonization

The benefits of the outdoor rearing environment were brought into sharpest contrast in the UK where the breeding herd rapidly rose to 40% outdoor production driven largely by the perception of welfare benefits by UK consumers. Research in other countries confirmed the link between early life environment and differences in gastrointestinal ecology (Pluske et al **2005 & 2007**). These changes caused by GIT microbiota were confirmed to have whole lifetime effects on growth and production. This effect has been repeated most recently by daily exposure of indoor pigs to topsoil between birth and weaning at a university in the USA.(abstract given at AASA Midwest 2016)

Seeking an Alternative to the outdoor environment

Using soil to try and influence microbiome development increased the incidence of unwanted infections such as worms, salmonella, myco-bacteria (head condemnation due to false TB lesions in the neck lymph nodes). The UK authorities judged the ‘feeding’ of soil to achieve environmentally acquired microbiota to be legally dubious and carry significant risks as well as benefits.

The significant economic benefits of the “outdoor effect” persuaded AB Neo to commit to evaluating alternative methods to increase Lactobacilli domination of the early microbiota. The breakthrough was made a few years ago when a new formulation was manufactured through a totally unique manufacturing process (Axcelera-tec) and then tested at the University of Leeds. The product was named Axcelera P. Weaned piglets, which had been fed on the new diet from 4 days of age until weaning, had a significant improvement in feed intake and growth rate (9.7% & 6.4%) and an improving trend in FCR (4.4%) **on the same nursery diets** compared to those pigs reared to weaning on the market leading creep diet. Piglets fed on the same nursery diets were 0.56kg heavier after only 20 days when offered Axcelera-P in farrowing.

This was a unique result in the ongoing piglet research programme which we have run for almost 20 years at the University of Leeds.

The Trial was repeated at a university with different genotype and health status. The results were confirmed by a massive 16% improvement in daily gain and 10% improvements in feed intake and FCR (**all significant**) . In this second academic experiment pigs left the nursery a full 1kg heavier after only 22 days post weaning. All piglets **were fed the same nursery diets**. A proportion of these piglets were followed through to slaughter where they were 4.3kg heavier than the pigs fed conventionally prior to weaning. All pigs received identical treatment after weaning being fed the same diets in the same building (carefully balanced design in university facilities) and identical to all other pigs after weaning.

After these remarkable academic results there was a shift in emphasis to test Axcelera P on different commercial farms to gauge how repeatable these results might be under a variety of commercial circumstances. There was success in 4 out of 5 farm trials.

Axcelera-P improved performance in 4 out of 5 trials, giving overall benefits **at weaning** of:

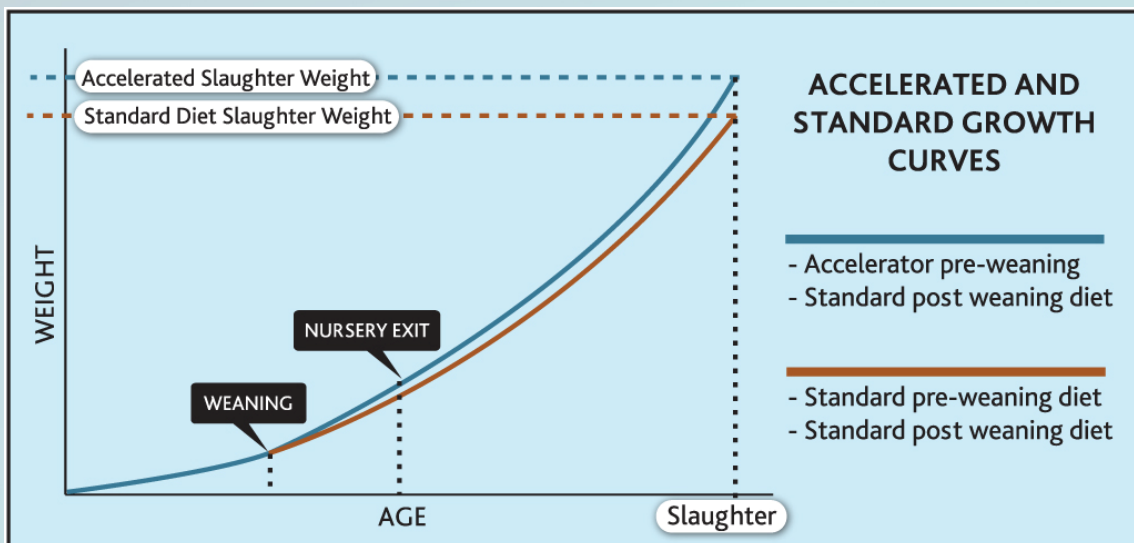
- **-5 % mortality** (36 % reduction)
- **+ 8 kg litter weight** (12.2 % heavier litters)
- **+ 400 g piglet weight** (4.8 % heavier piglets)
- **+ 0.6 kg/litter (+ 56 g/piglet) Axcelera-P eaten (31 % more)**
- The return on investment is likely at least 10:1

Further nursery trials on different commercial units confirmed improved nursery exit weights and one was followed to slaughter where pigs were 3.2kg heavier and 5 days younger at slaughter. In another commercial trial on a different unit 2000 pigs were fed

identically from weaning to slaughter. The 1000 pigs offered Axcelera-P in farrowing were 4.6kg heavier at slaughter.

This is new & unique

We have 20 years of independent in-house feeding trials carried out by university staff to a high level of accuracy and integrity. These studies have given ongoing improvements in diet performance through placing the pig further up the growth curve by weaning. A better pig at weaning continues to grow along the same growth curve but with the benefit of being further up the curve at weaning. Our data shows these traditional benefits at weaning are tripled by slaughter.



The effect of Axcelera-P on the growth curve is remarkable. With no change in management other than feeding Axcelera-P pre-weaning the performance of the pig is changed. This is not moving the pig up the growth curve through weaning weight improvement but rather setting the pig up for more efficient use of nutrients throughout its lifetime. Improving weaning weight by a massive 10%, which is very hard to achieve, will only increase slaughter weight by around 1.5kg at best which bears no comparison with the magnitude of response seen in Axcelera-P trials.

One further academic study exploring alternative methods of changing the microbiota in early life reduced weaning weight by 7% (7.4kg down to 6.9kg) but improved slaughter weights by 4.6kg (slaughter weight 135kg). In conventional pre weaning nutrition and feeding studies slaughter weight has only ever been increased by a treatment that increase weaning weight. This confirms the unique nature of Axcelera-P and mode of action. Our own work with milk replacer supplementation in the farrowing house increased weaning weight by 0.33kg/pig but failed to increase slaughter weight reinforcing our view that this is not a nutritional effect but a microbiota effect.

Mode of Action

The body of empirical data within the UK is overwhelming and has resulted in the product becoming market leader. Empirical data in Western Europe is increasingly convincing. The scale of these improvements and the novel nature of the responses recorded within a long established research programme created a desire to understand the mode of action. A birth to slaughter trial was run at the high health university with serial slaughter used to supply samples to begin mode of action analysis.

Mechanistic research has begun with University of Bristol Veterinary School (headed by Professor Mick Bailey) to understand the mode of action of Axcelera-P. The areas under consideration:

1. The extent to which early diet in piglets programs long-term changes in composition and function of intestinal microbiota. Specifically, to what extent does early-life diet influences the succession (rather than short-term composition) of microbial communities
2. The extent to which diet and microbiota program long-term effects on the developing metabolic system of the piglets. Specifically, can these be manipulated only early in life, or can they be manipulated later? To what extent are pathways involving breakdown, absorption and energy/protein/lipid metabolism affected.
3. The extent to which diet, microbiota and metabolism program long-term effects on the piglet immune system. Specifically, does it change the cost-benefit ratio for expression of immune responses to acute, clinical pathogens; to subclinical infections; and to dietary changes.

AB Neo currently believes the results so far point towards a mode of action where changes to the microbiota fueled by an exceptionally high lactose pellet lead too

1. Reduced dysregulation of the immune system after weaning.

Resulting in

2. Nutrient repartitioning since the increased growth rates do not increase carcass fat.

Further general background reading

1. Reciprocal interactions of the intestinal microbiota and immune system

Craig L. Maynard, Charles O. Elson, Robin D. Hatton & Casey T. Weaver

13, September 2012 Volume 489 NATURE pp 231-241

2. Innate immune memory: implications for development of pediatric immunomodulatory agents and adjuvanted vaccines

Ofer Levy and Mihai G. Netea.

Pediatric Research Volume 75 | Number 1 | 2014 pp 184-188

3. Effects of synbiotics injected in ovo on regulation of immune-related gene expression in adult chickens *Anna Sławinska, PhD; Maria Z. Siwek, PhD; Marek F. Bednarczyk, PhD*

2014 Am J Vet Res ; 75:997–1003

4. In ovo injection of prebiotics and synbiotics affects the digestive potency of the pancreas in growing chickens

E. Pruszyńska-Oszmerek, P. A. Kolodziejcki, K. Stadnicka, M. Sassek, D. Chalupka, B. Kuston, L. Nogowski, P. Mackowiak, G. Maiorano, J. Jankowski, and M. Bednarczyk

2015 Poultry Science 94:1909–1916

An abstract describing the production data from this trial has been submitted to AASA Midwest 2016 and is included below.

High lactose pellets fed from 4 days of age convey lifetime benefits when compared to a standard pre-weaning diet

P. Toplis,¹ I.J. Wellock,² L.Salmon³ M.Bailey⁴ A.Stewart⁵

¹AB Neo, Peterborough, UK; ²Primary Diets, Melmerby, UK; ³Premier Nutrition Rugeley, UK; ⁴Bristol, UK; ⁵Harper Adams University College, UK.

An experiment was conducted to assess the lifetime response and carcass characteristics of feeding a high lactose complex diet (HL) versus a standard commercial diet (C) from 4 days of age until weaning. The litter performance of piglets from day four of age was measured using a total of 32 sows with 16 litters per dietary treatment. Post weaning, a subset of 240 of the 370 pigs were allocated to 48 pens (n = 24 per trt). All pens were fed and managed the same way from wean to slaughter. Pigs were first taken for slaughter at week 20 (140 days) with slaughter weight, age and treatment recorded individually. All remaining pigs were slaughtered the following week 21 (147 d). Analysis of variance was used to determine treatment effects with repeated measures analysis undertaken to assess the effect of time upon results. There were no performance differences pre-weaning. In the nursery phase HL piglets had a higher DLWG during days 0-7, 7-14 and 0-28 compared with C piglets (P=0.0068, P=0.0389 and P=0.0302 respectively). Over the whole 36 day nursery

phase the HL piglets grew at +31 g/d more than the C piglets (+ 1.05 kg; P=0.0075). During the grower-finisher phase HL pigs remained significantly heavier compared with the C fed pigs with HL pigs being +2.58kg heavier at week 20 (104.25 vs 101.67kg; P=0.0190). Although not significantly different (P=0.0521) HL pigs tended to have heavier slaughter weights compared with the C pigs (107.8 kg vs 105.6 kg respectively). This tendency of the HL pigs being heavier became a significant increase in both hot (81.45kg vs 79.31kg P=0.0015) and cold carcass (79.83kg vs 77.72kg P=0.0014) weights due to an increased killing out % (75.69% vs 75.14% P=0.0035). Backfat and estimated lean meat % were not affected by treatment. The failure to retain statistical significance at slaughter may say more about the level of replication than the performance. In conclusion this trial corroborates previously recorded lifetime performance benefits from HL fed from four days of age. Over the course of the study, faecal, blood, tissue, digesta and gut histology samples were collected to test the hypothesis that early lifetime nutrition can have a persisting and beneficial effect on microbiota, host immunity and metabolism which in turns leads to an improved in lifetime performance.