Probiotics for pigs – reliable solutions

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In 1907 Metchnikoff hypothesised that micro-organisms in fermented milk products affected longevity among humans. In the 1960s the term probiotic was introduced for live micro-organisms that, as food or feed supplements, beneficially affect the intestinal microbial balance of humans or animals.

Starting in the 1980s the probiotic concept in animal nutrition developed from a novel concept to proven solutions and provides new means to improve animal production. Nevertheless, pig producers expect products with reliable and consistent effects and probiotics are no exception.

The constraining regulatory environment in the European Union has substantially influenced the development of a new generation of probiotics that can fullfil the most constraining feed additive legislation in the world. Well documented and reliable products gain dominance in Europe and show the future landscape of probiotic feed additives worldwide. This article looks at the drivers behind the development of in-feed probiotics for pigs and the requirements that have to be fullfilled before a probiotic is ready to be launched as a feed additive.

Stability is the key

It is not sufficient to prove that a product works under artificial laboratory conditions. Probiotics are live micro-organisms that must reach the intestinal tract of the pig in a viable form. The producers of probiotic feed additives have to ensure that their products actually reach the site of action – the gastro-intestinal tract.

Stability is the key challenge when considering the long route from physical product to the gastro-intestinal tract of pigs. The stability challenge starts with shelf-life under storage conditions and continues with the survival through feed processing, pelletising, storage of feed, ingestion by the animal and overcoming the gastric barrier.

There are technical solutions to secure longevity of probiotic products and protect probiotic strains against external stress, but the most sustainable and safe solution to the application challenge has proven itself to be nature's own solution. Selecting probiotic microbes with indigenous stability substantially helps to bridge the stability gap between laboratory and field applications.

	Probiotic group	Control group
Litter size at weaning	9.7	9.0*
Pre-weaning mortality (%)	7.0	12.1*
Piglet diarrhoea score[1]	0.08	0.24*
Piglet weight at weaning (kg)	8.40	8.02*
Total creep feed intake per litter	6.4	5.9*

** Indicates a statistical significant difference (P<0.05). [1](0 = no diarrhoea, 1 = slight; 2 = middle; 3 = acute) Pen based score; average of daily score over the suckling period.*

Table 1. Probiotic effect on pre-weaning piglet performance.

Pig production challenges

When developing a probiotic for pigs the first challenge is to identify suitable microbial strains that have a specific effect on pig production. The efficacy of a pig probiotic is determined by the efficacy of the selected strain and the physiology of the pig. It is known with certainty that not all probiotics work with pigs, therefore selecting the right one is the most time consuming phase of developing a probiotic feed additive that is particularly tailor-made for pigs.

Once the match between the probiotic and the pig is established the efficacy of the product has to be proven beyond doubt in order to provide a sustainable product for the market, one that pig producers can rely on. The reliability of probiotic feed additives can be measured by the consistency or repeatability of their effect.

Nevertheless, the benefits must be measurable and of economic relevance to pig producers.

In the sow unit productivity is highly dependent on the loss of piglets until weaning. About 85% of all mortality losses in pig production occurs during the first three weeks after birth and the causes have their foundation mainly in starvation.

As a consequence the number of produced piglets per sow/year is the most important factor causing variation in earnings in piglet production (Fig. 1).

In Denmark in 2004, variation in produced piglets per sow/year caused 45% of the variation in contribution margin in piglet producing units. The corresponding figures for variation in feed cost, piglet price and other factors were 25, 8 and 22%, respectively.

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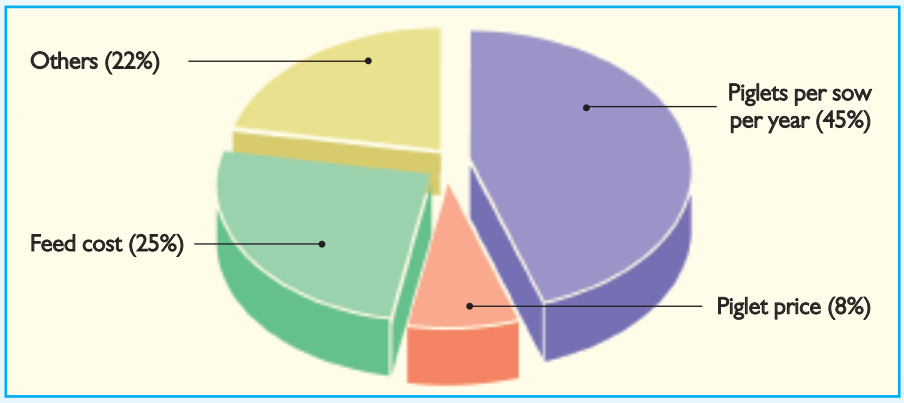
Continued on page 9

Fig. 1. Relative importance of factors affecting contribution margins in piglet production in Denmark, 2004.



	Probiotic group	Control group
Sow feed consumption (kg)		
Farrowing until two weeks after farrowing	79	76*
Two weeks after farrowing until weaning	105	104
Sow weight loss during lactation (kg)	15	19*
Total litter growth (kg)	67	59*
Content in milk two weeks after farrowing (%)		
Fat	6.3	6.1*
Protein	4.7	4.5*
Weaning to heat interval (days)	6	6
Return to heat (frequency)	6	20*
MMA (frequency)	6	13

** Indicates a statistical significant difference (P<0.05).*

Table 2. Probiotic effect on lactating sow performance.

Continued from page 7

lenges are related to the piglet being exposed to the most dramatic event in its life – weaning. The single most stressing external factor is the change from liquid (sow milk) to solid feeding. All alimentary functions are thus in a transition phase, especially during the first week after weaning.

The highly stressed gastro-intestinal tract and the maturing immune system easily leads to malfunctioning of the gastro-intestinal tract and affects sub-clinical disease status with reduced feed intake and utilisation, elevated morbidity and mortality.

In the slaughter pig unit feed cost and feed consumption are the most important factors affecting earnings. Optimal functionality of the alimentary tract is, therefore, also essential. The main cause of non-optimal earnings in pig production is continuous disease pressure and gastro-intestinal malfunctioning.

Furthermore, to provide a sufficient amount of nutrients, it is the role of nutrition management to maintain an optimal environment for feed degradation and nutrient absorption in the intestinal tract.

Micro-flora and health

Micro-organisms begin to colonise the sterile gastro-intestinal tract of the newborn pig right after birth and a fully developed gut micro-flora is established within weeks. The normal gut micro-flora is a complex ecosystem, habituated by up to 400 different species, which has a balanced co-existence with the host. The composition of microbial community has a major influence on the degradation of the feed and builds a natural barrier against undesired micro-organisms.

The species in the gut micro-flora have stimulating and/or depressing effects on each other and interact with the host animal in different ways and with different magnitude depending on age, feed composition, stress level and other environmental factors.

Any change in composition or density of the gut micro-flora, either during its development or when already matured, increases the likelihood of unbalance and can affect sub-optimal production results.

Probiotics with scientifically proven efficacy and documented stability can provide reliable solutions to maintain gastro-intestinal integrity and thereby improve pig production.

Measurable benefits

The gastro-intestinal tract of the newborn piglet is immature, but develops very fast and undergoes dramatic changes during the first three weeks. Thus, the gastro-intestinal tract is exposed to substantial stress during the entire suckling period.

At the same time, the gut flora is under establishment and easily upset in this period. Disturbed digestion and starvation are often seen consequences and starvation is the most important single factor causing pre-weaning mortality.

In a European efficacy study with gilts and sows on a commercial farrow-to-finish pig farm sows have been supplemented with a probiotic (BioPlus 2B) from two weeks before expected farrowing to weaning and compared with a negative control.

The probiotic group showed statistically significant 42% reduction in pre-weaning mortality compared to the control group as proof of the probiotic concept with sows and piglets (Table 1).

As a consequence the probiotic group weaned 0.7 piglet/litter more than the control group, corresponding to an increase of at least one piglet per sow/year.

Furthermore, the reduction in pre-weaning mortality was associated with a significantly improved diarrhoea score in the probiotic group. The improved health status of the gut in the probiotic group led to a significantly increased piglet weaning weight of 5% compared to the control.

An important factor behind the extra productivity in the probiotic group was a prolonged period with a significantly higher fat and protein content in the sow milk compared to the control group (Table 2).

The probiotic supplemented group of sows had a lower frequency of MMA and a higher feed consumption, especially during the first two weeks post partum, than the control group. Sows in the probiotic group showed a significant 21% lower body weight loss during lactation than sows in the control group and the improved energy balance of the sows in the probiotic group led to a significant reduction in the proportion of sows returning to heat compared with the control group.

A further element of proven efficacy is repeatability or consistency, as illustrated in Fig. 2. This summarises the pre-weaning mortality obtained in three subsequent trials evaluating the efficacy of probiotic supplementation of sows during lactation.

Conclusion

The regulatory environment in the European Union has substantial influence, in that only well documented products can remain on the market.

The above trials submitted to the EU commission show that statistically significant results can be achieved with probiotics under field conditions with pigs.

This legal requirement of significant production improvements is, therefore, the major driving force behind the growing interest in probiotic feed additives, ensuring that only reliable products with consistent results remain available. ■

Fig. 2. Pre-weaning mortality in three trials with a control group and a probiotic supplemented group of lactating sows.