

# The Role of Dietary Fibre in Advancing Sow Nutrition

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Dietary fibre in sow nutrition has often been overlooked as an essential component of the diet – a statement supported by over half a century of evidence. A study dating from 1997 highlighted the 'mixed' results from more than 30 years of research on the effects of added fibre in gestation diets on sow and litter performance. It also examined the challenges producers and nutritionists face in deciding whether to include dietary fibre in sow diets.

Nearly three decades later, our understanding of dietary fibre in sow nutrition has finally, in recent years, started to evolve. Now recognised as a critical nutrient to the diet, it is understood that dietary fibre influences intestinal functionality, gut microbiota, and the modulation of animal digestion and metabolism.

Recent advancements in fibre nutrition and analytical methods have underscored the significance of dietary fibre in optimising sow lifetime productivity and welfare due to its impact on nutrient utilisation and overall health. This, in turn, has helped increase

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profitability for pork producers. Despite the positive evidence, the practical application of dietary fibre supplementation has often been lacking due to insufficient characterisation of fibre components in available ingredients.

However, this is changing due to advances in analytical methods such as NIR (near-infrared spectroscopy) and the development of specific feed additives stimulating microbial fermentation in the lower gut. Feed formulation targeting fibre components actively to obtain the best outcome is already a reality in commercial applications.

Here, we look at the effect dietary fibre has on the different production phases of the sow (including gestation, periparturient and lactation) and examine how producers can maximise the benefits of fibre in sows through stimbiotic supplementation – exploring the best solutions for feed and fibre analysis.

## The function of dietary fibre

Often defined as the indigestible portion of food derived from plants, dietary fibre forms a crucial component of many pig diets. The elements that cannot be digested by endogenous enzymes in the small intestine of non-ruminant species include non-starch polysaccharides (pectins, cellulose, hemicelluloses, β-glucans and fructans), as well as oligosaccharides, resistant starch and lignin.

Traditionally, these fibres have been categorised as soluble, which are mostly metabolised by the microbial populations in the small intestine; the more intransigent insoluble fibres, which are harder to digest, are fermented by microbes in the hindgut.

One reason the information around fibre requirements in the swine diet has traditionally been lacking may be due to the insufficient methodology that has historically been available to measure the indigestible fraction of the animal's diet; some methods still used today date back more than a hundred years.

The original measurement of crude fibre was developed in the latter half of the nineteenth century. It became well-established during the early twentieth century before being modified and adopted by the animal feed industry in the second half of the century. Measuring lignin, cellulose, hemicellulose and pectin, in the present day, crude fibre provides an incomplete idea of fibre quantity in pig feed and offers little information on fibre quality. Crude fibre does little to characterise fibre in ingredients and underestimates dietary fibre by 70 to 80%.

Acid detergent fibre (ADF) and neutral detergent fibre (NDF) were introduced to the industry in the 1960s; ADF measures all celluloses and lignin content, while NDF measures all hemicelluloses, celluloses and lignin. Although an improvement over crude fibre, both share limitations – they are unable to capture the soluble fibre component and still underestimate the total dietary fibre of feed.

Today, total dietary fibre (TDF) is the most accurate fibre assay. While there are limitations with higher costs, lower throughput, and methodology variation, TDF allows for the capture of the majority of the fibre fractions and provides both insoluble and soluble fibre values.

TDF is a crucial element in the feed formulation for monogastrics. It helps to improve feed efficiency and animal performance, supporting good gastrointestinal health through better hindgut fermentation. For swine specifically, an increasing body of evidence suggests that dietary fibre can have the potential to influence piglet health through the sow diet; even "modest" increases in the annual number of piglets weaned per sow boast considerable commercial advantages. In addition to improving reproductive outcomes, feeding dietary fibre to swine has a positive impact on the animal's well-being and health.

## The effect of dietary fibre on gestation

When applying fibre to sow diets, there are three phases to consider: gestation, peripartum, and lactation. Restricting feed intake in sows during gestation is important in preventing excess body weight gain and fat deposition, which can lead to low reproductive performance and detrimental effects at farrowing and during lactation. While increasing dietary fibre in the diet permits greater feed intake during gestation, it allows for the maintenance of a suitable body condition score.

Higher levels of TDF in gestation diets can reduce sow aggression, stress and other behavioural issues observed in group housing systems. Including additional dietary fibre at 30 days of gestation has been shown to reduce inflammation and further decrease stress levels. The benefits of dietary fibre supplementation extend beyond the well-being of individual sows; performance parameters are also positively influenced by increasing TDF.

These benefits include a reduction in the number of stillborn piglets, heavier piglet weights at birth, increased lactation feed intake, a higher number of piglets being weaned, reduced pre-wean mortality and increased litter weaning weight.

## Dietary fibre and the periparturient period

The modern sow has a high capacity for total-born piglets and milk production compared to almost 15 years ago; in the UK alone, the average litter size has increased from >12.5 in 2010 to 15.48 in 2023. The widespread adoption of hyper-prolific sows to increase total litter size and piglet production has led to side effects that may overburden sows, including constipation, longer farrowing durations and greater variation in litter birth weight.

During the periparturient phase, supplementing with higher levels of TDF in the diet can mitigate some of these side effects. Benefits include reduced farrowing duration and stillborn incidence, potential reduction in constipation, and enhanced sow energy status through greater availability of short-chain fatty acids (SCFA).

In a trial involving 567 gilts, researchers evaluated fibre supplementation, and its combination with yucca saponins and vitamin C, on the periparturient period of gilts, on constipation status, body condition score and farrowing performance. While yucca and vitamin C have been shown to improve antioxidant status, reduce hypoxia and increase farrowing performance, their interaction with fibre has not been closely examined.

The experimental diets consisted of three dietary treatments:

- The control top dress targeting a daily intake of 277g of TDF using ground corn (CON diet);
- A top dress targeting a daily intake of 440g of TDF (with 40g being soluble fibre), using wheat midds, beet pulp, soy hulls, rice hulls, ground corn and a stimbiotic (Signis, AB Vista) (FIB diet);
- A replication of the top dress diet (FIB), with an addition of 680mg of vitamin C and 2,500mg of yucca (PLUS diet).

The trial found that gilts treated with FIB or PLUS diets – those which included soluble fibre – were associated with a lower stillborn rate and pre-weaning mortality, equating to improved litter performance. Collectively, it was found that increasing TDF during the periparturient period may aid in alleviating constipation and improving litter performance, which also holds true for the lactation period.

## Sow lactation

When dietary fibre is incorporated during the gestation and periparturient periods, its positive effects extend into the lactation period as well.

Research has shown that lactation intake is increased when fibre is fed to the sow during gestation. Other recent studies have shown that a high-fibre gestation diet (TDF 18% for high-fibre diets and 9% for low-fibre diets) reduced weight loss during lactation. It is particularly important for hyper-prolific sows with high piglet numbers to maintain body weight during lactation due to the increased physiological demands.

In the aforementioned trial (fibre, yucca and vitamin C), positive results were also observed during lactation. Gilts whose diets were supplemented with soluble fibre tended to wean more pigs per sow – a key indicator of productivity and efficiency.

## Tools to maximise fibre benefits

Historically, fibre has primarily been seen as a dilution factor or binder for other nutrients, perceived to have antinutrient effects. Despite its many benefits, the polymeric networks of this complex compound are not particularly fermentable or soluble; limitations to its greater adoption – particularly in the US – include the high cost of readily fermentable fibre ingredients.

An adequate understanding of dietary fibre, its classification as soluble and insoluble, and its forming structure as monomeric sugars have been well-established in the literature for a long time. However, the high cost of such analysis has meant this knowledge has been difficult to implement commercially. The development of NIR technology and its ability to quickly, accurately and cheaply monitor these fibre characteristics has opened opportunities to successfully apply this information in a commercial environment.

Nutritional tools – such as stimbiotics – can improve fibre fermentation in sows in a cost-effective way. Stimbiotics are a product category developed to stimulate the establishment of a fibre-degrading and fermenting microbiome. In turn, SCFA and endogenous enzyme production are increased.

Trials have shown that an addition of 5% sugar beet pulp and a stimbiotic during gestation improves outcomes such as piglets born alive and stillborns, as well as lactation feed intake. In the periparturient period, supplementing the diet with >400g/d of TDF plus a stimbiotic for a minimum of three days before farrowing, through to lactation, reduced pre-weaning mortality by more than 1.5%.

A separate study focusing on the late gestation and lactation period found that stimbiotic supplementation may improve immune function in lactating sows and their piglets. This study indicated that stimbiotic supplementation could serve as a potential feed additive for improving the reproductive performance and immunity of sows during lactation.

Additionally, the use of a stimbiotic tended to reduce the oxidative stress of lactating sows by promoting the beneficial fibre-degrading bacteria to utilise dietary fibre and produce SCFAs. Thus, stimbiotics could be used as a feed additive in sow diets to improve the animal's resilience to stressors throughout this period. ■

## Conclusion

Dietary fibre continues to be a critically important and rapidly growing area of research for the swine industry. While understanding of its benefits in sow nutrition has developed significantly, incorporating fibre into swine diets to optimal effect is not always without its challenges, including variation in fibre analysis methods and a poor understanding of ingredient composition – a current limitation in the North American market.

Technologies such as NIR enable producers to gain a deeper understanding of fibre composition and consequently better leverage it in swine. For regions where ingredients are limited in TDF or soluble, fermentable fibre, stimbiotic supplementation can achieve the desired fibre profile and shift the intestinal microbiome to favour fibre fermentation for improved digestibility and resilience.

Using a combination of functional feed additives that target a fibrolytic microbiome, and tools to analyse and understand fibre in dietary ingredients, nutritionists can better utilise fibre in swine diets to achieve benefits in animal health, productivity, and performance.