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PRODUCING HIGH QUALITY PIGLETS

1. Piglets are the future of the farm: it all starts with the sow

by Dr Christine Potthast, R&D Director, agromed Austria GmbH. www.agromed.at

In piglet production, genetic progress with highly prolific sows has led to a remarkable increase in litter size in the past few years. Such high litter sizes are a concern as they increase the risk for stillbirths and are associated with high piglet pre-weaning mortality.

So, there is a great potential to improve piglet survival with the sow having a major influence. Table 1 summarises the risk areas of large litters for both sows and piglets.

Improvement of piglet survival begins with the sow as there is a close link to farrowing. Farrowing is an important stress factor for sows and piglets, whereby a prolonged farrowing duration – especially with large litters – increases the number of stillborn piglets and reduces the vitality of the surviving piglets. Stillbirth rate in pigs varies between 5-10%, and up to 75% of the deaths appear during parturition caused by dystocia (weakness in labour) and intrauterine asphyxia (oxygen deficiency).

Stress at birth in context with a prolonged farrowing reduces colostrum and milk production in the first days after farrowing. This poses an additional risk to the piglets, especially as breeding for high litter yields have indirectly reduced the birth weight of the piglets and increased competition between littermates.

Besides the direct cost due to loss of stillborn piglets, the underlying causes may affect live-born pre-weaning mortality that can account for 10-20% of all live born piglets. A vital piglet quickly begins to suckle, which helps the newborns to maintain their body temperature and achieve a positive energy balance. Piglets with reduced vitality have often suffered oxygen deprivation at birth, which impairs their performance later in life.

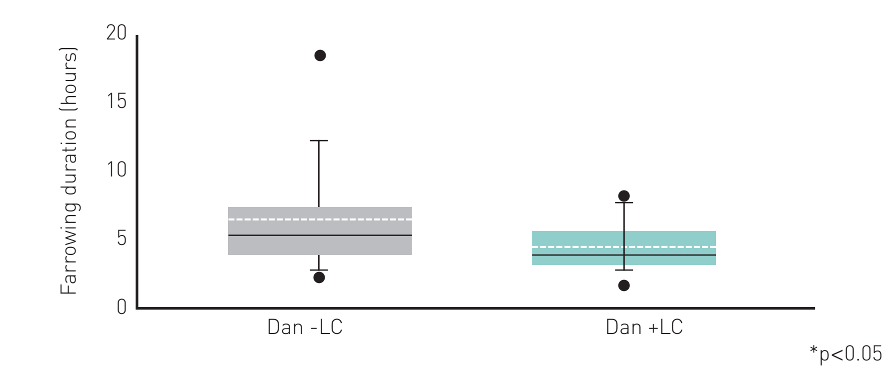

Fig. 1. Farrowing duration in highly prolific sows fed on a gestation diet with (Dan +LC) or without (Dan -LC) supplementation of eubiotic LC. Dotted line indicates mean value; black dots indicate minimum and maximum values (Hirtenlehner et al. 2021).

SAVING PIGLETS BY MANAGING THE SOW

So, the key to saving piglets that are at risk of death because of long farrowing lies in managing the sow before she gives birth. Causes of prolonged farrowing and increased stillbirth rate is maternal constipation as well as energy depletion during the energy demanding process of farrowing.

Supplementing the sow's diet with dietary fibre offers the opportunity to reduce the farrowing time and prevent constipation, whilst increasing colostrum intake and the performance of the piglets.

In general, fibre is considered in the context of avoiding constipation, but offers potential for an additional energy supply, provided that the fibre is fermentable. The sow can cover up to 25% of its maintenance energy requirement from the fermentation of dietary fibre in the colon.

The energy from the enzymatic digestion in the small intestine is available up to five hours after ingestion, while the fermentation products from the colon are provided over a period of 24 hours. For the sow this extra energy means the provision of energy for the birthing process.

CONVERTING STILLBORN TO LIVE-BORN PIGLETS

Research about the supplementation of eubiotic lignocellulose (LC) in gestation and lactation diets of sows showed positive effects on the farrowing duration as well as the piglet survival rate and the piglets' birth and weaning weights (Table 2).

Such an eubiotic LC (OptiCell, agromed Austria GmbH, Austria) is, compared with standard non-fermentable lignocellulose, partly fermentable, and may generate extra energy that can contribute to the sow's energy

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Table 1. Impact of large litter sizes on sows and piglets.

Piglets	Sow
Reduced birth weight	Prolonged farrowing
Reduced uniformity	Less colostrum
Increased stillbirths	Less milk/piglet
Increased pre-weaning mortalilty	Reduced fertility
Reduced post-weaning performance	Increased risk for postpartum dysgalactia syndrome (PDS)

Parameter	Control	Eubiotic LC
Farrowing duration (minutes)	220	180
Total piglets born	16.0	15.9
Share of piglets born alive (%)	90.2	93.2
Average piglet birth weight (kg)	1.13[a]	1.24[b]
Average weaning weight day 27 (kg)	7.20[a]	7.50[b]

[ab] significant different $p<0.05$

Table 2. Influence of LC on farrowing and litter performance (Baarslag et al. 2013).

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supply – reducing hunger stress in gestation as well as supporting the farrowing process. Recent results evaluated the impact of eubiotic lignocellulose supplementation on the farrowing process depending on the sows' breeding line. The research compared the supplementation of eubiotic LC to sows of standard (Large White x Landrace) or high prolific Danish genetic.

The results showed a more pronounced reduction of the farrowing duration in higher litter sizes and thus a stronger effect of LC supplementation in highly prolific sows compared to standard hybrids (Table 3). Supplementation of eubiotic LC significantly reduced farrowing duration in highly prolific sows (Danish genetic) and caused a 26% shortening of the farrowing duration (Fig. 1). The advances of breeding companies in the development of highly prolific sows allow litter sizes of more than 20 piglets and, thus, strongly supports farms to achieve the highest profitability. Nevertheless, high litter sizes have risks for sows and piglets, often correlated to a prolonged farrowing process. This in turn has negative consequences for both sow and piglet.

The supplementation of eubiotic lignocellulose effectively reduces farrowing duration with a more pronounced impact in highly prolific sows compared to sows of standard genetics. Conclusively, diets for highly prolific sows supplemented with premium quality lignocellulose, as used in this trial, are an efficient prerequisite to produce vital piglets as the basis for farm profitability. ■

References are available on request

Table 3. Impact of eubiotic lignocellulose supplementation for sows of different genetic breeding lines (mean values; Hirtenlehner et al. 2021).

	Control		Eubiotic LC	
	Standard genetic	Danish genetic	Standard genetic	Danish genetic
Piglets/litter	14.8	22.9	14.6	21.5
Birth interval (minutes/piglet)	16.7	17.1	15.4	12.7
Liveborn piglets/litter	13.6	18.4	13.4	19.4
Stillborn piglets/litter	1.2	4.5	1.2	2.1
Live-born piglets (%)	92.6	83.0	93.0	90.7

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2. Only a healthy pig can be a happy pig

by Dr Christine Potthast, R&D Director, agromed Austria GmbH. www.agromed.at

Animal welfare is used as an umbrella term for the health, quality of life and well-being of farm animals and is also mentioned as a core element in the implementation of the European Green Deals. Animal welfare measures can also be implemented by feeding, as one of the overall objectives is to keep animals healthy through feeding. What can this mean for the fattening pig?

ANIMAL WELFARE AND THE LINK TO HEALTH

In the public's perception, animal welfare in fattening pigs is often reduced to housing, but the issue is much more complex than can be solved by providing more space per animal or offering straw or other roughage. The topic of 'animal welfare' is already mentioned in the European Green Deal but is not yet underpinned by concrete goals or measures.

The so-called 'Eco-Schemes' specify practices for the implementation of the Green Deal for agriculture – here exemplary measures are demanded such as 'prevention in relation to animal health: to reduce the risk of infections requiring antibiotic treatment' – with clear reference to feeding (European Commission 2021).

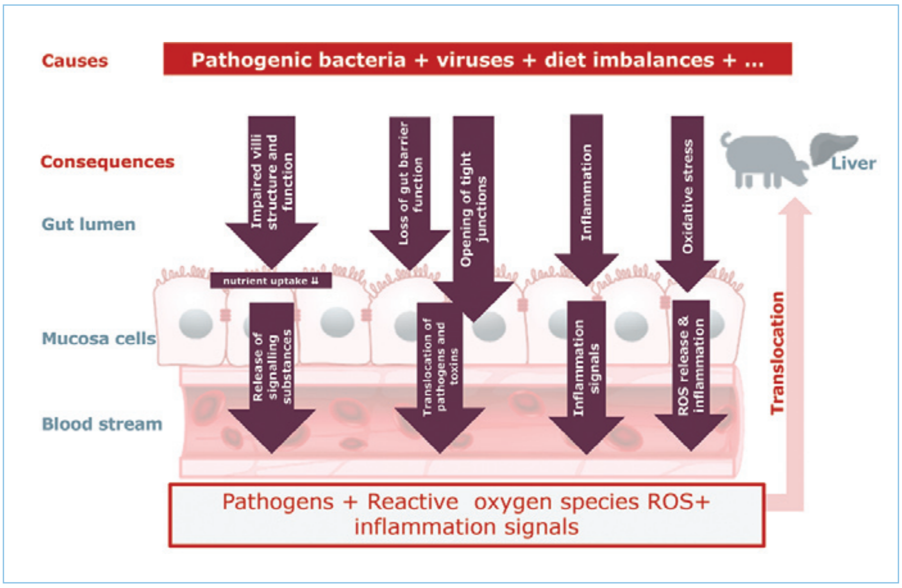

Fig. 1. Causes and consequences of diarrhoea in pigs.

Thus, feeding measures that serve to support the maintenance of healthy animals are also basic elements of animal welfare. Since healthy animals are also efficient, the conservation of resources and the avoidance of the emission of excess nutrients into the environment also have an effect.

Furthermore, this closes the circle to the definition of 'animal welfare' when assessed through the 'Five Freedoms Concept' (FAWC 1993), which lists the fundamental conditions of good treatment to ensure the animal's welfare, including 'freedom from hunger, thirst and malnutrition – to maintain full health and vigour' and 'freedom from pain, injury and disease – by prevention or rapid diagnosis and treatment'.

Table 1. Typical diarrhoeal diseases/pathogens in pigs, and affected age groups.

Disease pathogens	Suckling piglet	Weaning piglet	Fattening pig
Enterotoxic E. coli (ETEC)	++++	+++	+ (early fattening)
Rotavirus	++++	+++	+ (early fattening)
Transmissible gastroenteritis (TGE)	++++	+++	+++
Clostridium perfringens	++++	rare	rare
Coccidiosis	++++	++	+
Salmonellosis	+	++	++++
Dysentery B. hyodysenteriae	+	++	++++
Porcine intestinal adenomatosis (PIA) L. intracellularis	rare	++	++++

DIARRHOEA – ONLY A PROBLEM IN WEANED PIGLETS?

Diarrhoea causes considerable economic losses in pig production, even beyond the piglet sector.

The causes of diarrhoea are diverse and include pathogens, viruses and unbalanced nutrition, which often interact with each other ('non-specific colitis').

One of the most important diseases associated with diarrhoea is dysentery caused by Brachyspira hyodysenteriae, which leads to bloody diarrhoea and high mortality. In fact, many other infectious agents also affect fattening pigs, as shown in Table 1.

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HEALTH AS A PREREQUISITE FOR HIGH PERFORMANCE

There are no concrete figures that evaluate the worldwide economic costs caused by diarrhoea. Nevertheless, there is no doubt that diarrhoea in fattening pigs means losses/ reduced performance, which prolongs the fattening period, up to total failures. In the case of severe and persistent diarrhoea, the only option is to call the vet.

However, feed supplements can supportively intervene in the causes and consequences of diarrhoea. There is a close link between diarrhoea and inflammation as the diarrhoea itself as well as involved pathogens cause inflammation of the gut mucosa and damages the mucosa integrity and function, reducing the nutrient absorption and being a further entrance path for pathogens. Fig. 1 summarises the causes and consequences of diarrhoea.

An effective support for the pig by a feeding strategy will intervene in this vicious circle. One solution can be found using agromed Protect which is a novel feed supplement containing highly active phytonutrients from wood. Phytonutrients are naturally occurring bioactive compounds produced by plants. They keep plants healthy and protect them from, for example, insects and the sun.

Widely known examples for such secondary plant compounds are vitamins or polyphenols. The phytonutrients contained in agromed Protect are highly active in the intestine, where they can strengthen the intestinal barrier, protect the intestinal mucosa from oxidative stress and mitigate diarrhoea-related inflammation.

PHYTONUTRIENTS DERIVED FROM WOOD AS A NATURAL GUT SUPPORT

The wood phytonutrients constrain bacterial growth by detraction of essential substances for the bacteria's development, and inhibit the bacterial efflux pumps, allowing a pathogen inhibitory effect.

They are effective in the gut barrier support as they prevent pathogenic bacteria from docking on to the mucosa cells and increase the transepithelial resistance (TER) of gut epithelial cells to improve the intestinal barrier properties. A further property is the inhibition of various inflammatory responses or signalling molecules involved in inflammatory cascade (for example NF-kappa-B, pro-inflammatory cytokines) and the direct radical scavenging (reactive oxygen species).

These effects help to keep the gut healthy to maintain its absorptive capabilities while reducing the energy expenditure that inflammation causes.

Data from a practical farm in Austria (Fig. 2) show the positive effects of the use of agromed Protect – the daily gains increased with an improvement in feed conversion and a marked reduction in mortality, at the same time the final weight also increased from 107.9 to 109.5kg.

The high mortality rate in the test farm indicates that there were underlying health problems. However, the test results demonstrate the positive effects of agromed Protect in particular under suboptimal conditions.

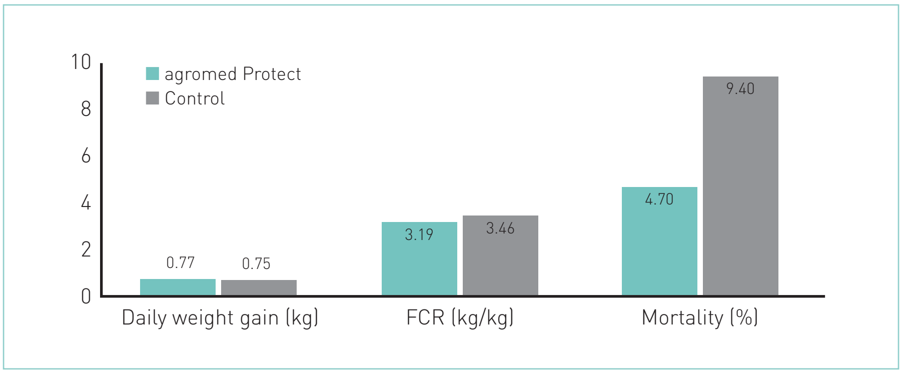
The phytonutrients in agromed Protect effectively support the fattening pings and help to maintain the intestinal barrier. Thus agromed Protect may offer a next level of protection to the pigs and helps them to keep their performance when confronted with subclinical gut health problems.

As shown, there is a close link between animal welfare and health. Globally, the trend continues to reduce the use of antibiotic performance enhancers and therapeutic antibiotics.

The EU has set clear targets in the Green Deal: to reduce sales of antimicrobials for farmed animals and in aquaculture by 50% by 2030. Feeding in general offers a broad spectrum for interventions and health prevention, specific support may come from novel supplements like agromed Protect and its phytonutrients, helping the pig to maintain gut health. ■

References are available on request

Fig. 2. Practical test on feeding agromed Protect to fattening pigs.



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PRODUCING HIGH QUALITY PIGLETS

3. Eubiotic lignocellulose and hyperprolific sows: a dream team

by Dr Christine Potthast, R&D Director, agromed Austria GmbH. www.agromed.at

Litter size is a crucial parameter for evaluating the profitability of swine farms. High-quality nutrition combined with improved reproductive management and enormous advances of genetic companies are the main drivers for the trend of a rapid rise in the number of piglets per sow per year.

With the commercialisation of those hyperprolific sows, on the one hand farms are able to increase their number of born piglets per sow per year, but on the other hand they are faced with some unfavourable side effects: large litters are closely related to a prolonged farrowing duration, which in turn is an enormous stress factor and the basis of several negative consequences for both sow and piglets.

MAJOR CHALLENGE TO MANAGEMENT

Farrowing duration and birth intervals are key factors for a successful farrowing influencing stillbirth rates, piglets' survival rate, and colostrum intake.

Thus, the recent genetic progress achieved in sows poses a major challenge to management.

	Control		Eubiotic LC	
	Austrian standard	Highly prolific	Austrian standard	Highly prolific
Number of litters	14	24	15	26
Farrowing length (min)	247	392	225	272
Piglets/litter	14.8	22.9	14.6	21.5
Birth interval (min/piglet)	16.7	17.1	15.4	12.7
Liveborn piglets/litter	13.6	18.4	13.4	19.4
Stillborn piglets/litter	1.2	4.5	1.2	2.1
Liveborn piglets (%)	92.6	83.0	93.0	90.7

Table 1. Impact on eubiotic lignocellulose supplementation for sows of different genetic breeding lines (mean values).

On farms, increased litter size often results in low piglet birth weights and increased piglet mortality.

A prolonged farrowing time increases the proportion of stillborn piglets: a birth time extended by 100 minutes means the loss of an additional two piglets and more. Each additional minute of farrowing duration significantly reduces the sow's colostrum yield and a long farrowing, causing hypoxia in piglets, will likely decrease their vitality and chance of surviving.

Additionally, a substantial proportion of sows suffer from low-energy status at the onset of farrowing which prolongs the farrowing process. Hence, when increasing litter sizes, additional tools are needed to compensate for these negative side effects.

A balanced fibre supply turns out to act as a simple and efficient tool to provoke such compensatory effects: Supplementing the sow's diet with dietary fibre offers the opportunity for reducing the farrowing time,

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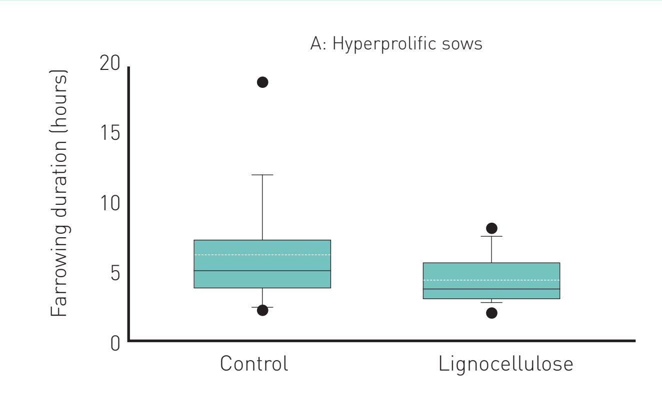
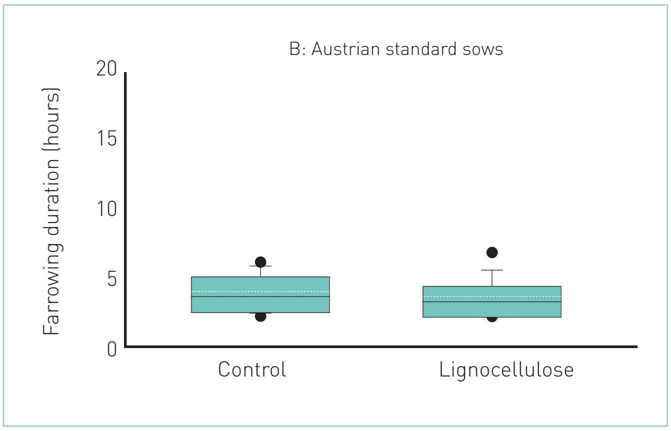
Fig. 1. Farrowing duration in (A) highly prolific sows and (B) Austrian standard sows with or without supplementation of eubiotic lignocellulose. Dotted line indicates mean value; black dots indicate min and max values.





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preventing constipation whilst increasing colostrum intake and performance of the piglets. In general, fibre is considered in the context of avoiding constipation, but offers potential for a specific energy supply, provided that the fibre is fermentable.

The sow can cover up to 25% of its maintenance energy requirement from the fermentation of dietary fibre in the hindgut. The energy from the enzymatic digestion in the small intestine is available up to five hours after ingestion, while the fermentation products from the hindgut are provided over a period of 24 hours. For the sow this extra energy means the reduction of hunger, stress and, above all, the constant provision of energy for the birthing process.

The energy supply has a strong influence on the duration of the farrowing time, which significantly impacts the number of stillborn and weak piglets.

There is scientific evidence that this reduction of farrowing duration as well as an improvement in number of liveborn piglets can be achieved by a supplementation of eubiotic lignocellulose (LC), which is an insoluble but partly fermentable fibre concentrate.

FIELD STUDY UNDER COMMERCIAL CONDITIONS

A field study conducted under commercial conditions in Austria aimed to compare the impact of LC supplementation on the farrowing process depending on the sows' breeding line. Therefore, highly prolific sows were compared to a local standard breed in two runs: A total of 38 sows (23 Danish genetic vs. 15 standard Austrian genetic [large white x landrace]) and 41 sows (27 Danish genetic vs. 14 Austrian standard) was equally allocated to two treatment groups according to their breed and parity.

The sows in the control group were fed on a diet based on barley, oat and maize, whereas the sows in the test group received the standard gestation diet supplemented with LC (OptiCell, agromed Austria GmbH, Kremsmünster Austria) on top without balancing of nutrients.

The evaluation of the farrowing process influenced by LC supplementation and breeding line, is summarised in Table 1. Both highly prolific sows as well as the standard genetics did benefit from the supplementation of the LC used in this trial, manifested in a reduction of the parturition length.

Moreover, in highly prolific sows the supplementation of lignocellulose increased the number of liveborn piglets per litter from 18.4 to 19.4, whilst lacking this effect for sows with Austrian standard genetics.

As Fig. 1A demonstrates, the supplementation of lignocellulose significantly reduced farrowing duration in highly prolific sows and caused a 26% shortening of the farrowing duration (Table 2). The same effect, albeit to a lesser extent, for sows of standard Austrian genetics is visualised in Fig. 1B.

	Median of farrowing duration in minutes			
Breeding line	**Control**	**Eubiotic LC**	**Difference**	**p-value**
Highly prolific	323	240	-83 min (-26%)	0.036
Austrian standard	233	210	-23 min (-9%)	0.357

Table 2. Farrowing duration influenced by breeding line and eubiotic lignocellulose supplementation.

As hypothesised, the results of this field trial reveal that the positive effect on reducing parturition length has a more pronounced impact in highly prolific sows producing large litter sizes.

Although the reduction in parturition length was less marked in sows of standard genetics, the reduction of farrowing time due to LC supplementation is of physiological importance and improves the welfare of every individual, suffering less from a painful and stressful period.

The results demonstrate a LC-dependent increase of liveborn piglets in highly prolific sows. Again, this finding indicates, that farms housing highly prolific sows will benefit from the supplementation of eubiotic lignocellulose.

Conclusively, highly prolific sows supplemented with premium quality lignocellulose, as used in this trial, are an efficient tool to cover improved animal welfare and health as well as farms' profitability. ■

References are available on request

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4. Heat stress: when your profit melts away...

by Stefan Hirtenlehner,
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Heat stress not only affects the profitability of pig farms in tropical or sub-tropical regions: even in temperate climate zones, unfavourable climatic conditions lead to impaired performance and cause production losses.

However, these losses are only the tip of the iceberg: the underlying health impairments are manifold – but a sophisticated feeding concept including products based on wood can compensate for impaired production performance.

Put simply, the risk of suffering from heat stress can be described as a combination of ambient temperature and relative humidity. Using sows as an example, an ambient temperature of 24°C at 75% relative humidity is already sufficient to detect performance losses.

The farmer may notice the consequences in lower incomes, however, the animal experiences them much more drastically: heat stress impairs the welfare of farm animals and puts a strain on their state of health, with the negative effects being directly as well as indirectly interrelated (summarised in Fig. 1).

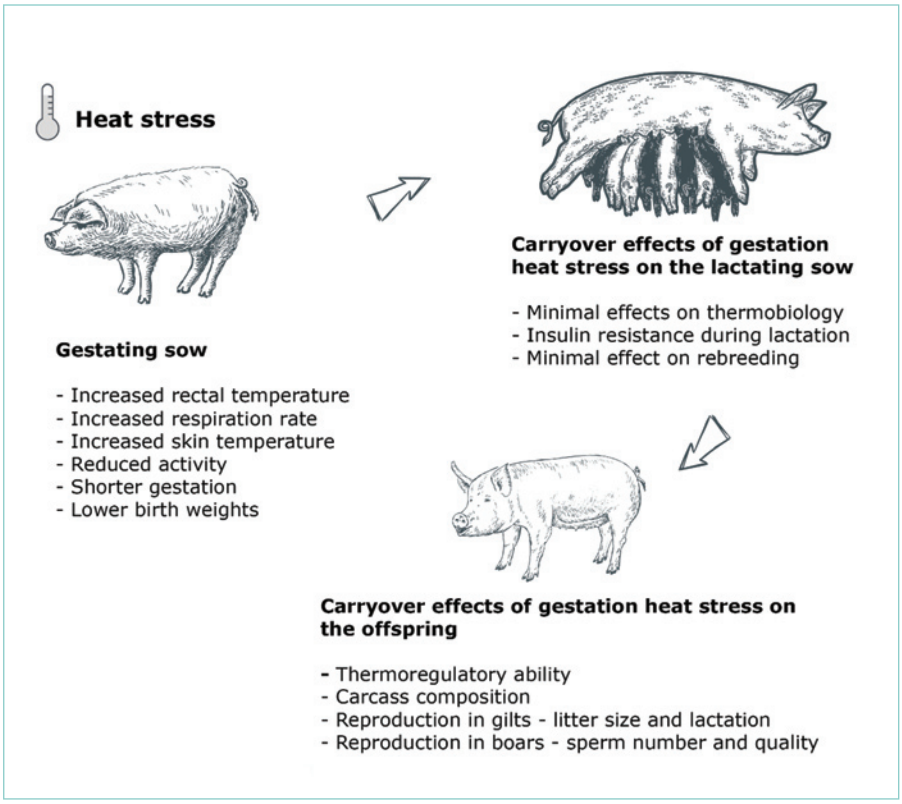

Fig. 1. Heat stress related effects on sow performance (adapted from Lucy & Safranski 2017).

BEHAVIOURAL CHANGES

Under heat stress, animals change their behaviour in order to dissipate heat and lower their body temperature, which translates into reduced feed intake and exercise during the day, as well as increased water consumption and heavy panting. In growing pigs, reduced daily weight gain and poorer product quality are the result.

PHYSIOLOGICAL ADAPTATIONS

In terms of thermoregulation, blood circulation is altered so that extremities and body parts in the periphery are supplied with more blood to dissipate body heat to the environment in a targeted manner. A process that is energy-intensive for the animal and therefore again detrimental to production performance.

Moreover, heat-induced increased oxidative stress leads to an increased risk of infection.

IMMUNE DEFENCE

Finally, the above-mentioned reasons for a high susceptibility to infections and a high risk of infection cause a strong strain on the immune system.

This defence against infections and inflammations is extremely energy-intensive – the more energy that must be used for the immune defence, the less energy is available for growth or reproduction.

IMPAIRED INTESTINAL FUNCTION

Intestinal integrity is reduced by unfavourable climatic conditions, so that pathogens and endotoxins can penetrate more easily and cause inflammation in the intestinal tract.

In addition, heat stress leads to a shortening of the intestinal villi and thus reduces nutrient absorption, and consequently represents another factor in reduced performance.

FIBRE FOR HEAT-STRESSED SOWS

Regarding reduced feed intake and impaired nutrient absorption in heat-stressed sows, the status quo feeding strategy is to offer a high-energy diet dense in nutrients and to keep the proportion of indigestible dietary fibre as low as possible.

Quite the contrary, the fibre supply should not simply be minimised but needs to be paid extra attention to find the proper quality of fibre sources: the reason is that the usual strategy focuses only on impaired nutrient intake, whereas the fibre strategy focuses on gut integrity and health and consequently, optimises nutrient intake as a side effect.

However, the quality of the fibre source is important. Recommendations for fibre intake under heat stress conditions consider the reduction of soluble fibre, which leads to excessive fermentation. Wheat bran, soy hulls or sugar beet pulp contain high amounts of soluble fibre with additional high amounts of fibre-bound protein that supports unfavourable protein fermentation in the large intestine.

The supplementation of a concentrated fibre source, such as eubiotic lignocellulose, does not dilute the energy dense diet, provides purely insoluble fibre, but moreover acts as a fermentation management tool.

PROVING THE CONCEPT

The above-mentioned assumption is nicely validated in a feeding trial conducted recently on high prolific sows in Brazil.

A total of 164 mixed-parity sows were allocated to one of two treatments. The control group was fed on gestation and lactation diets based on corn, soybean meal and soybean hulls, whereas in the test group (LC) 2.5% of soybean hulls were substituted by eubiotic lignocellulose (OptiCell; agromed Austria GmbH) in gestation diet and 1% substitution in lactation diet, respectively.

The average minimum and maximum ambient temperatures and relative humidity were 22.2 and 31.0°C, and 73 and 97%, respectively. During the experimental period the sows were exposed to temperatures above 26°C on average 97% of the time. As for temperatures above 30°C sows were exposed 64% of the time.

Table 1 summarises the effects of soybean hulls substitution by LC on sow performance. The data reveal that LC did not negatively affect feeding behaviour or the body conditions of the sows: both groups were equal in body weight and backfat thickness at start and end of gestation as well as the feed intake was almost identical.

Quite the opposite, a better condition of sows' due to eubiotic lignocellulose inclusion is expressed in an improved farrowing performance.

Litters of sows fed on eubiotic lignocellulose were characterised by a significantly higher number of total-born piglets and a significant increase in live-born piglets.

	Control	LC	p-value
Sows (n)	60	64	–
Gestation length (d)	114. 7	114.3	0.104
Sow body weight day 1 (kg)	201.1	201.9	0.983
Sow backfat thickness day 1 (mm)	18.6	18.6	0.853
Sows body weight day 110 (kg)	251.7	250.7	0.858
Sows backfat thickness day 110 (mm)	21.9	21.7	0.931
Average daily feed intake (kg/d)	2.23	2.23	0.449
Total born piglets (n)	16.15^{b}	17.83^{a}	0.029
Mummified (n)	0.32	0.42	0.567
Stillborn (n)	1.0	1.3	0.623
Total piglets born alive (n)	14.83^{b}	16.09^{a}	0.035
Average piglet weight (g)	1,254	1,271	0.744
Average litter weight (kg)	18.6	20.5	0.188

^{ab} significantly different $p<0.05$

Table 1. Effects of eubiotic lignocellulose supplementation on sow performance during gestation and farrowing.

Although the number of total and born alive piglets was increased, there is no rise of within-litter birthweight variation, which indicates that sows of the LC group were capable of increasing the number of piglets without negative impact on their birth weight.

Table 2 shows the litter performance during the lactation period. Because of the higher number of born alive piglets, the sows fed eubiotic lignocellulose had a significantly higher litter size at 48 hours and litter size at weaning tended to increase.

Sow voluntary feed intake was not influenced by the treatments, but since the sows of the LC group weaned more piglets, they were more efficient than the sows fed the standard diet (1.76 vs. 1.78kg/kg, respectively, for LC and Control).

It may be concluded that any condition improving gut health during a heat stress period helps sows to improve performance.

Eubiotic lignocellulose may kill two birds with one stone by supporting gut functionality: it delivers an adequate fibre supply to manage fermentation processes in the hind gut and avoids excessive soluble fibre. ■

Table 2. Litter performance for sows on lactation diets with and without eubiotic lignocellulose.

	Control	LC	p-value
Sows (n)	60	64	–
Litter size 48 hours (n)	13.88^{a}	14.06^{b}	0.004
Average litter weight 24 days (kg)	80.24	81.21	0.467
Litter size 24 days (n)	12.90	13.10	0.089
Piglet average daily gain (g/d)	210	211	0.341
Sows average daily milk yield (kg/d)	14.62	15.69	0.169

^{ab} significantly different $p<0.05$

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5. Sustainable meat production and improvement of animal welfare

by Stefan Hirtenlehner,
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In the swine industry, the status of the pig's gut health not only affects the well-being and performance of the animal, but has consequences for all of us in terms of resource-efficient living. By using wood-based feed supplements made from renewable sources, swine farmers may provide a major contribution to sustainable meat production and improvement of animal welfare.

KEY FOR SUSTAINABILITY AND EFFICIENCY

Sustainable pig production implies a prudent use of resources. To nourish the world's population in the future, it will be of the utmost relevance to care for the planet and preserve the environment by aiming for: less greenhouse gas emissions, less nutrient waste, enhance (or at least stabilise) biodiversity and avoid deforestation.

Consequently, the aim is to use as few feedstuffs as possible to produce meat and thus improve the efficiency of converting feed mass into pig body mass. Moreover, enhanced feed efficiency is crucial for profitability since feed costs represent roughly two-thirds of the total operation cost of a conventional swine farm.

Today we face a time shaped by a geopolitical crisis, which demonstrates the fragility of the food and feed supply: although high producing animals need high quality feed, effort is needed to minimise feed-to-food competition, which means that plant material, which could be used by humans should not be considered primarily for use as a feedstuff.

In turn, this means that we need to pay even more attention to the health and functionality of the gastrointestinal tract to improve feed efficiency, especially when using sub-optimal quality feed. Improving feed efficiency means improving the metabolic utilisation of dietary nutrients, and an improved nutrient absorption, for which an intact and healthy gut is a prerequisite.

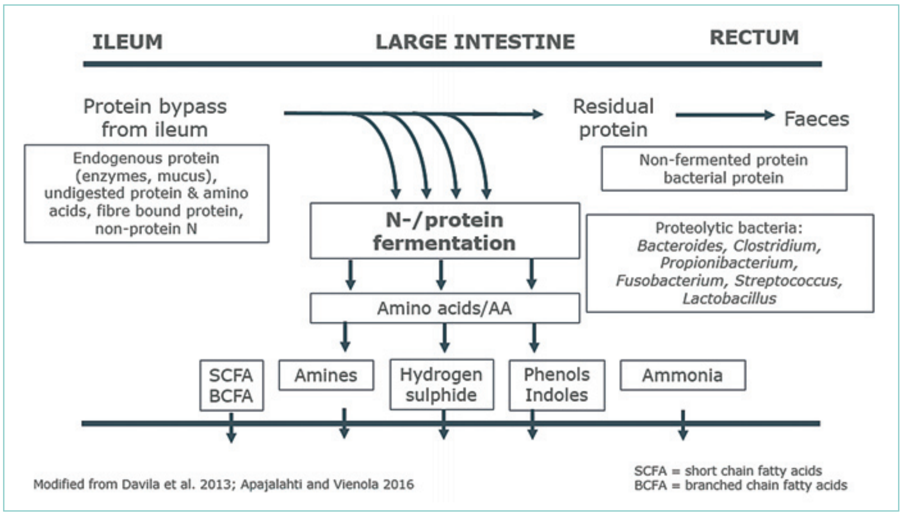

Fig. 1. Overview of the proteolytic fermentation process in the pig's intestinal tract.

REDUCING MEDICAL COSTS

Since the epithelial cells of the gastrointestinal tract are the first contact sites for pathogens, the gastrointestinal tract must not be seen in the context of nutrient absorption only, but needs to be considered as an important part of the animals' immune defence.

Thus, an intact and healthy gut tissue lowers the risk of an invasion of pathogens from the lumen to the bloodstream and hence, indirectly counteracts the outbreak of local and/or systemic infections, whilst maintaining a high resorptive capacity for nutritive molecules.

Every infectious disease avoided, is saving money, since costs for medication, treatment and performance losses are avoided. Also important for a healthy and well-functioning gut is its role as the host of a complex micro-ecosystem of a variety of micro-organisms, referred to as microbiota.

Since a balanced microbiota is important for the development of gut morphology, immune functions as well as digestive physiology, the diversity of those micro-organisms may directly influence growth performance, feed digestion or, when imbalanced, can cause malfunctions leading to, for example, diarrhoea or constipation.

The presence of specific micro-organisms is needed to make energy usable, which would be unused without their help: in particular fibre-rich feedstuffs contain a high share of molecules indigestible via the endogenous enzymes produced by pigs. Those molecules may be degraded by micro-organisms and energy will be released in the form of fermentation metabolites, which, in turn, can be absorbed by the colonocytes of the intestinal tract.

MANAGING FERMENTATION

Regarding gut health, the modulation and management of the microbiota is one of the most important ways to avoid intestinal malfunction, since not only indigestible fibre fractions may be fermented microbiologically, but also digestible substrate if not absorbed will be utilised by microbiota. Protein, amino acids or fibre-bound protein, that is not utilised because of an oversupply or because of a disease dependent impairment of the intestinal resorptive capacity, will reach the large intestine and be fermented by proteolytic bacteria.

Fermentation of protein may lead to the formation of toxic and pro-inflammatory

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metabolites, such as biogenic amines, ammonia, or indoles (Fig. 1). Moreover, the higher the share of substrate for proteolytic bacteria, the faster they proliferate and the microbial balance drifts towards a dysfunctional one causing an extraordinarily enhanced protein fermentation.

A balanced microbiota 'prefers' carbohydrates as a source of carbon since the utilisation of carbohydrates as an energy source is more efficient than the utilisation of proteins or amino acids.

Thus, in a healthy situation, a higher share of carbohydrates than protein reaches the hindgut, which favours the saccharolytic fermentation, resulting in the formation of short chain fatty acids as fermentation metabolites, beneficially influencing the intestinal tract.

This means, to manage the microbiome towards a healthy gut function, swine feed needs to be rich in insoluble fibre but fermentable fibre.

WOOD-DERIVED PRODUCTS FOR A HEALTHY GUT

In order to promote gut health throughout the post-AGP era, safe alternatives were developed within the last decade. Products from renewable sources, without affecting the feed-to-food competition, such as wood, gain high interest among swine farmers for reasons of sustainability, profitability, and animal welfare.

With agromed Protect, the Austrian company agromed succeeded in the development of a wood-derived feed additive by using selected tree species and different parts of trees rich in bio-active molecules, i.e. lignans and phenolic acids, strengthening the gut barrier and thus providing a lower risk for pathogens to invade the blood system.

Moreover, the sophisticated combination of lignans and phenolic acids support gut health by a remarkable antioxidative mode of action proven in vitro gut cell culture models as well as in vivo trials on piglets, as presented at the Zero Zinc Summit held in June 2022 in Copenhagen, Denmark.

Another, rather well-known wood-derived product is lignocellulose acting as a fibre concentrate. For efficient management of fermentation processes, the quality of the lignocellulose product is essential. Eubiotic lignocellulose (LC) is an insoluble, but nevertheless partly fermentable lignocellulose, so it beneficially influences the composition of microbiota in a way to reduce unfavourable proteolytic fermentation.

Table 1 demonstrates a reduced formation of biogenic amines analysed in digesta samples from two parts of the intestinal tract of weaning piglets, after feeding for eight weeks on a control diet supplemented with either soybean hulls or LC (OptiCell, agromed Austria GmbH) as an additional fibre source.

	Control	Soybean hulls	OptiCell
Inclusion level (%)	-	2.5	1.5
Ileum			
Cadaverine (mg/kg DM)	330[a]	377[a]	48[b]
Σ amines Ileum (mg/kg DM)	1.916	1.869	1.644
Colon			
Cadaverine (mg/kg DM)	488	581	305
Σ amines Ileum (mg/kg DM)	2.199	2.380	2.019

Table 1. Reduced formation of biogenic amines analysed in digesta samples.

CONCLUSION

Wood-based feed solutions offer new but well explained opportunities to support gut health management and act as a sustainable answer in terms of animal nutrition and animal welfare. ■