Medium chain fatty acids help sows to reach their genetic potential

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Year after year the genetic potential of sows rises. Litters of 20 piglets are no longer an exception. The continuous selection focus on high litter sizes puts an enormous pressure on the sows. To reap the benefits of the genetic potential, issues like milk production, pre-weaning mortality and weaning weight of piglets deserve the highest attention. Ensuring a high health status of sows is thus indispensable to tackle these issues.

Several non-antibiotic, plant-derived antimicrobial substances have been proposed as promising feed additives to ensure a high health status, but lots of them lack scientific proof. Medium chain fatty acids (MCFAs) are saturated fatty acids consisting of aliphatic tails of 6-12 carbon atoms and a polar head.

The use of free (not coated, micro-encapsulated or esterified as mono-, di-, or triglycerides) MCFAs as a functional feed ingredient is an effective way to overcome the stressors faced by the current sow industry.

This is because they exert lots of beneficial effects along the gastrointestinal tract (GIT) of sows, both on a pathogen level as well as on a host level.

A healthy intestinal tract is the most important factor to ensure a high feed intake and a good milk production.

Furthermore, MCFAs can increase the energy available for newborn piglets, by increasing the glycogen reserves in piglets. MCFAs can also exert a bioactive effect on mammary glands and thus increase the colostrum production of sows.

Balancing microbiota

MCFAs have a relative high acid dissociation constant (pKa) which means that they will mainly stay in their un-dissociated form in acid environments like the stomach.

Undissociated MCFAs are capable of penetrating the phospholipid bilayer of bacterial cells, thereby destabilising the cell membrane. This results in leaking of bacterial cell content on the one hand and entering of MCFA in the bacterial cells on the other.

Once inside the cell the MCFAs dissociate, which results in the accumulation of protons and dissociated MCFA molecules. The protons cause intracellular acidification and eventually killing of the bacteria. Dissociated MCFAs will intercalate with the bacterial DNA, thereby inhibiting DNA replication and thus bacterial growth.

Free MCFAs provide an early pathogen barrier in the stomach of the animal. This is an advantage over MCFA esterified mono, di- and triglycerides, which are only active in the intestinal tract after endogenous lipase releases the free MCFA molecules.

Next to a specific antibacterial action, MCFAs will have a suppressing effect on the virulence of pathogens at small intestinal level. In this way, MCFAs are able to

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Fig. 1. Effect of medium chain fatty acids (MCFAs) on piglet mortality and weaning weight.

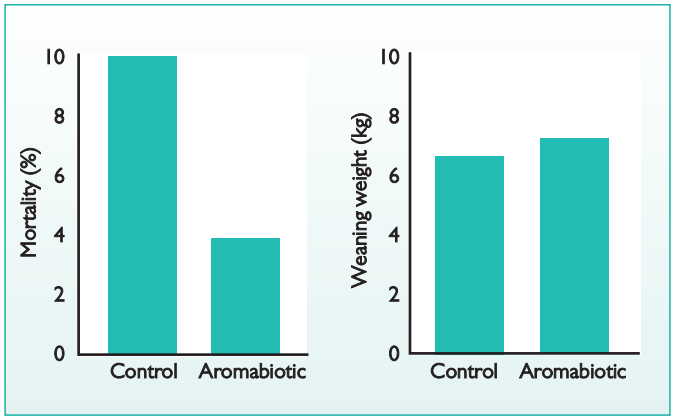
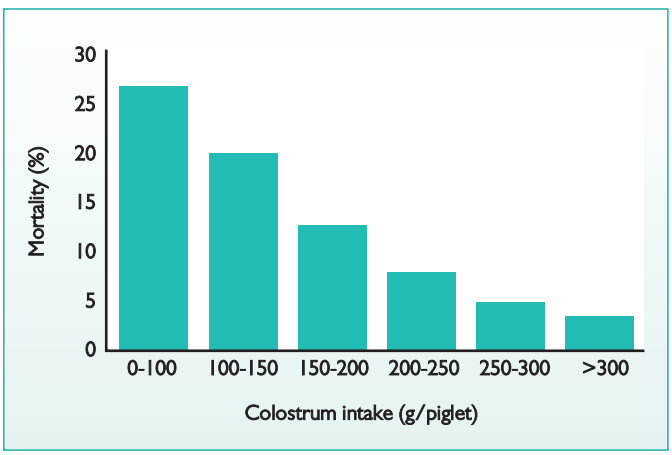


Fig. 2. The effect of colostrum intake on piglet survival.



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decrease the risk for pathogenic virulence. Remarkably, lactobacillus is much more resistant to MCFAs thanks to its very specific membrane. This means that the beneficial microbial system of the gut will be largely unaffected. A healthy microbiota is important to maintain the sow's gut health, thereby improving the feed intake, digestion, uptake of nutrients and milk production after farrowing. Research also showed that sows with a healthy microbiota are more likely to produce larger litters.

Before birth, the intestine of piglets is sterile, but shortly after birth becomes colonised by bacteria acquired from the sow and the sow's faeces. Supplementation of the sow feed with MCFAs can reduce the excretion of pathogens by the sow, and therefore decrease the colonisation of the piglet's intestine with these pathogens.

In other words, a balanced microbiota results in healthier sows and in this way promotes litter size, feed intake and milk production on the side of the sow and birth weight, vitality and health on the piglet's side. This results in higher litter sizes, less piglet mortality, and higher weaning weight of the piglets (Fig. 1).

Boosting colostrum

The increased litter sizes have the unintended effect of decreasing the average piglet birth weight. Related to a lower birth weight, piglets will also be weaker and more susceptible to mortality. Furthermore, weaker piglets will also ingest lower amounts of colostrum. Moreover, colostrum production in highly prolific sows increased, but the amount of available colostrum per piglet decreased. Insufficient colostrum intake is one of the main reasons for neonatal piglet mortality (Fig. 2).

Colostrum is essential for piglet development to provide energy for thermoregulation, immune transfer from the sow, and intestinal development.

Studies showed that feeding MCFAs in late gestation has a stimulating effect on colostrum production of sows. Therefore it is possible to reduce piglet mortality the first days after birth.

Glycogen reserves

Glycogen, together with colostrum, is the sole energy source available for piglets immediately after birth. The glycogen reserves of piglets are built up during the last part of gestation, and rapidly converted to glucose after birth. Improving glycogen reserves in piglets is an important way to increase the energy and thus vitality of the piglets.

Feeding high levels of sugars and starch or fat to sows at the end of gestation is not effective in increasing glycogen reserves, because this increases the insulin resistance in sows and the risk for hyperinsulinism in piglets. Extreme insulin resistance in sows will decrease the glucose metabolism immediately after farrowing.

Consequently, higher glucose levels will appear in the blood, with a higher saturation feeling and a lower voluntary feed intake as a result. Hyperinsulinism, in its turn, can cause extreme glucose metabolism in newborn piglets, with quick depletion of the energy reserves around birth. This will increase the risk of stillborn piglets, less vital born piglets, as well as postnatal mortality.

On the other hand, dietary fats rich in MCFAs may have a glucose sparing effect in unborn piglets, stimulating in this way glycogen reserves without increasing the sow's insulin resistance. The risk for hyperinsulinism in newborn piglets will also be lower in this way.

Conclusion

Thanks to genetic selection, today's sows possess an enormous genetic potential. Unfortunately it is difficult for standard nutrition to keep up with this potential. This makes the use of functional feed ingredients indispensable in the pig industry.

MCFAs have been shown to exert a wide range of beneficial activities in sows, both on pathogen and on host level, helping pigs to reach their full genetic potential. ■