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Dietary diformates and monolaurate - support for a healthy gut in sows during lactation - a short review

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Introduction

It is generally agreed that good gut health is effective against intestinal pathogens, a strategy that has only been made possible through the removal of antibiotic growth promoters in feed. Creating and maintaining a healthy intestinal environment has become essential to productivity and food safety programmes alike. Maintaining a healthy gut requires up to 25% of the daily protein and 20% of the dietary energy supplied with the feed. This strategy should be carefully planned into the dietary programme, in order to not waste resources (Hittel and Lückstädt, 2017).

The application of organic acids and their salts to diets for pigs has been studied extensively for more than 50 years. They have proved especially effective in maintaining growth performance since the ban on antibiotic growth promoters came into effect in Europe. Numerous trials have demonstrated their mode and magnitude of action and established effective doses for piglets, fattening pigs and sows. The use of formic acid and its double potassium salt in particular has been the subject of intense investigation, with the result that we now understand its dose-dependent effect on growth performance and feed conversion in pigs under a range of different environmental conditions and feed formulations (Lückstädt and Mellor, 2011). The main mode of action is its antimicrobial effect, which makes it comparable with antibiotic growth promoters; but organic acids also reduce pH in the stomach, which optimises conditions for pepsin activity; and increases the digestibility of nitrogen, phosphorus and a number of minerals. This is not only beneficial in sparing nutrients, but it also prevents losses that might otherwise contribute to environmental pollution. A similar impact in swine production was noted recently with sodium diformate (double salt of sodium formate and formic acid), which is produced similarly to potassium diformate with a patented production technology (Lückstädt and Petrovic, 2019).

However, while the antimicrobial impact of organic acids and their salts, including potassium or sodium diformate, is mainly directed against Gram-negative bacteria, medium chain fatty acids (C-6 to C-12) have also been shown to have an antibacterial impact against various Gram-positive bacteria (Preuss et

al., 2005). This is especially true for lauric acid (C-12) and its monoglyceride ester, monolaurate. Lauric acid has the greatest antibacterial activity of all medium chain fatty acids. This effect is magnified if monolaurate is used (Batovska et al., 2009), making it a promising candidate as an additive or as an alternative to antibiotics for treatment of different diseases (Rouse et al., 2005).

Despite the well documented impacts of both additives, data on the combined impact of these additives on gut health in sows under commercial conditions are scarce. The current study reviews the impact of a combination of dietary diformates and monolaurate on its decontamination impact on Gram-negative and Gram-positive bacteria in sow faeces.

Material and Methods

Multiparous sows on commercial farms in Germany were fed either a commercial lactation diet as control - or a test diet, which contained additionally 1% of a diformate-monolaurate mixture (traded as Formi GML, ADDCON). On the 21st day of lactation, freshly excreted faecal matter was collected from all sows and analysed for *E. coli*, Enterococci, Streptococci and the total aerobic bacteria count. Data were analysed using the t-test and a significance level of 0.05 was used in all tests.

Results

Results of the microbial analysis revealed a strong significant impact of the product on the bacterial population in the faecal matter of sows. This holds true for *E.coli* and Streptococci / Enterococci counts, as well as the total aerobic bacteria count (Table 1).

Table 1: Bacterial count reduction rates (%) in sow faeces after feeding with 1.0% diformate-monolaurate (Formi GML) in the lactation diet

The significant reduction rates in the *E. coli* counts in the faeces were well above 90% and varied in the trials between 90% and 98%. Furthermore, the reduction in the Streptococci/Enterococci counts within the various trial periods were significant and varied from 75% to 99%. Finally, the count of total aerobic bacteria, among them the group of spoilage indicating bacteria, tended to be reduced (-94%).

Discussion and Conclusion

The addition of this combination of sodium diformate and monolaurate caused a significant improvement of the health status of sows. The impact against the Gram-positive Streptococci is especially noteworthy. This is particularly important since the EU-funded Focus Group is calling for actions to reduce the use

Table 1:

Trial	Bacteria	Reduction rate (%)	P-level
I	<i>E.coli</i>	-90.3	0.06
	Total Streptococci + Enterococci	-97.2	<0.01
II	<i>E.coli</i>	-98.3	<0.01
	Enterococci	-98.9	<0.05
	Streptococci	-75.1	<0.05
III	Total aerobic bacteria	-94.1	0.09

of antibiotic treatments on swine farms (eip-agri, 2014). In these three separate trials (Hittel and Lückstädt, 2017; Lückstädt and Hutter, 2018), the combined inclusion of diformate and monolaurate may therefore not only provide a healthy gut in sows, but might furthermore support a pork production chain with reduced zoonotic pathogen pressure. This will additionally help the EU-antibiotic reduction initiatives.

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