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Speaker's Abstract

The pancreatic duct ligated pig – a model to study human exocrine pancreatic insufficiency

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The pancreatic duct ligated pig – a model to study human exocrine pancreatic insufficiency

Exocrine pancreatic insufficiency (EPI) is a disease common in human as well as veterinary medicine. The underlying diseases in humans are chronic pancreatitis, pancreas cancer but also Cystic Fibrosis. EPI is characterised by severe maldigestion and malabsorption of diverse nutrients – resulting in poor nutritional status and deficiency of fat soluble vitamins. The pancreatic duct ligated (PL) pig was developed decades ago and is an established animal model to study EPI. Pancreatic duct ligation results in a complete EPI in pigs, while endocrine function is not impaired.

The combination of pancreatic duct ligation and implantation of an ileo-caecal fistula allows quantifying the digestibility of nutrients within the small intestine. While for fat this would not be necessary (as fat is not digested in relevant amounts in the hindgut) this is crucial for protein and starch. In monogastric farm animal (pigs and poultry) nutrition it is worldwide standard to formulate requirements for protein or amino acids on the basis of praecaecal digested amino acids – taking into account that only praecaecally absorbed amino acids can be integrated into the amino acid pool of the host.

Due to the enormous compensatory fermentative capacity of the hindgut, starch is not excreted via faeces in EPI-patients even in the absence of pancreatic enzyme replacement therapy – resulting in the assumption that starch digestibility is not relevantly affected in the event of EPI. The studies performed in PL-pigs reveal a marked reduction in praecaecal digestibility of starch to a varying extent depending on the botanical source and thermal treatment of the starch used. Although fermentation of starch in the hindgut results in volatile fatty acids that are used as energy source from the host the intestinal gas production that is associated with carbohydrate fermentation is unintended and might cause painful gastrointestinal disturbances. By using the animal model data regarding the effects of EPI on endogenous N-

losses were generated – the markedly increased endogenous N-losses combined with reduced praecaecal digestibility of crude protein impressively demonstrating the need for a higher protein supply for EPI-patients compared to healthy individuals.

To sum up the general focus on impaired fat digestion in the context of EPI (resulting in enzyme therapy recommendations based on lipolytic activity of enzymes) does not take into account the reduced praecaecal digestibility of starch and protein. By using the animal model of ileo-caecal fistulated PL-pigs a much more precise characterisation of effects of EPI is possible – allowing to optimise therapy and dietetic measures based on exact data.

The investigations on effects of EPI on the growth of juvenile pigs did show a significant increase in mass of the gastrointestinal tract (GIT). This is rooted in the higher digesta mass within the GIT due to maldigestion and malabsorption, but also results from an elongation of the small intestine (which had not been described before in literature in the context of EPI). This observation concerning a higher mass of GIT is of great clinical relevance as the exclusive use of body weight results in an overestimation of the nutritional status of EPI-patients.

Although steatorrhea is the most relevant clinical symptom of EPI, it must be emphasised that the effects of EPI are much more diverse and complex (e.g. endocrinological effects) – therefore recommendations for therapy and dietetic measures should not be limited to lipase substitution and fat content of the diet.

As several effects of EPI on digestive processes cannot be detected by analysing faecal samples the use of suitable animal models enabling the characterisation of the praecaecal digestibility is crucial to optimise therapy and dietetic measures in EPI patients. The combination of an animal model and ex-vivo or in-vitro methods opens up many possibilities to test and optimise dietetic and therapeutic measures in a sophisticated manner.

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