
1 Introduction

In commercial swine production weaning is probably one of the most dramatic incidents in a piglet's life. To warrant a high operating efficiency in pig production, piglets have been weaned gradually earlier in the recent decades, so the common weaning age in Europe nowadays is between 21 and 28 days of life. During weaning transition piglets encounter tremendous changes in their environment, social structure and dietary regime and are bound to adapt to those alterations in a considerable short time. One important aspect in this matter is the immaturity of the gastrointestinal tract (GIT), which results in its impairment during weaning transition, particularly in response to low feed intake (McCracken, 1995; Spreeuwenberg, 2001). As a consequence higher incident of gastrointestinal (diarrhoea etc.) and respiratory (pneumonia etc.) diseases occur and are accompanied by stagnation or loss of body weight – a complex widely referred to as “post-weaning growth-check”. To overcome these problems, antimicrobial feed additives have been commonly used in starter diets in the past decades. There are at least four proposed mechanisms for the effects of these additives: inhibition of sub-clinical infectious diseases, especially of gastrointestinal ailments like diarrhoea; reduction of nutrient usage by commensal microflora; reduction of potentially growth-depressing microbial metabolites and enhanced nutrient uptake through thinner intestinal wall (Gaskins, 2002). The major outcome was the improvement of growth rates and feed efficiency, thus having a favourable impact on the financial aspects of farming.

However, such impacts of antibiotic additives on zootechnical and veterinary parameters failed to be consistently demonstrated in the past decade. Additionally and even more significant, research could evidence cross-resistances to antibiotics used for clinical application in both human and veterinary medicine (Wegener, 1998; Aarestrup, 1998; Aarestrup, 2000). The implication of this discovery is that therapeutic antibiotics might lose their potency and have to be withdrawn from therapeutic application. In its extreme a real emergency state could arise if - due to resistances – even last resort antibiotics are not effective anymore against life-threatening diseases. Therefore an EU-wide ban on antimicrobial feed additives in animal nutrition took effect, with the main purpose to phase out antibiotics at growth-promoting levels, in particular in the weaning phase of piglets. The importance of this strategy could be clearly demonstrated by Denmark, one of the first European countries implementing this ban in 1995. Danish researchers could evidence a marked decrease in antimicrobial resistances of food animals up to 2000, thus diminishing one of the main pools for cross-resistances (Aarestrup, 2001).

For that reason it became important to search for suitable alternative strategies to alleviate weaning in commercial pig production. However, to evaluate potential

alternatives and its properties, a profound knowledge of the porcine GIT and its potential alterations during weaning transition is crucial.

Considerable efforts have been made to investigate mechanisms of infectious diseases, the biology of the respective pathogens, host resistance and therapy in both human and veterinary medicine. This applies also to GIT disorders and ailments of young piglets before and after weaning. In contrast, at present fairly little knowledge is available or published on GIT disorders arising from alterations in diet or social structure as it is the case for the weaning process. In recent years, research has focussed on weaning and its effects, with special emphasis on immunological and histological alterations. However, to date even less information is available about digestive physiological changes, especially in respect to the microflora, its metabolites and the digestion of proteins in the small intestine of young pigs. Because of its importance for protein accretion and with this muscle growth, the fate of protein and amino acids is of considerable interest, especially in relation to the weaning process and applied starter diets. As the enzymatic digestion of proteins is considered to be completed by the end of the small intestine, the terminal ileum represents the most appropriate site to evaluate this component.

Therefore the main objective of our investigations was the qualitative and quantitative evaluation of ileal digesta in piglets before and after weaning, i.e. in time. Furthermore, in weaned piglets, we wanted to investigate the influence of different starter diets on these aspects.

I. Qualitative Evaluation of Ileal Digesta

For qualitative aspects we aimed to investigate a range of chemical and microbiological parameters, discriminating them by their potential impact on gut health. We focussed on the commensal microflora and its main metabolites – such as lactic acid, volatile fatty acids and ammonia - in the small intestine of weaning piglets. For the realisation we choose classical and molecular approaches in microbiological techniques such as selective agar plating and PCR-based genetic fingerprinting such as denaturing gradient gel electrophoresis (DGGE). (Furthermore we intended to apply a considerable novel technique – D-alanine method – for the assessment of bacterial nitrogen.) We took considerable interest to elucidate the role of dietary regime, especially the transition from liquid to solid feed (sow milk to starters) and the application of various solid starter diets. Here we wanted to investigate the effect of antibiotic-supplemented starter vs. non-

supplemented and the impact of 2 home-produced starters based on regional, home-grown products. Especially the latter diets were of particular interest regarding properties and with this their practical applicability by farmers of our region.

II. Quantitative Evaluation of Ileal Digesta

Another crucial aspect was the fate of protein in the piglet's GIT, as protein accretion has a direct impact on live weight gain and with this on swine production efficiency. Therefore the evaluation of nitrogen flow with special emphasis on endogenous nitrogen losses in the small intestine of piglets before and after weaning was of considerable interest to us. The aim of our studies was to assess total ileal nitrogen and the contribution of endogenous and microbial nitrogen in piglets pre- and postweaning. With this we would be able to estimate the real ileal digestibility of nitrogen of the applied dietary treatments: milk replacer in the preweaning balance study and 4 starter diets, already used for the qualitative part mentioned earlier, in a postweaning balance study. Thus, we conducted two experiments pre- and postweaning, using piglets fitted either with T-cannulas or ileorectal anastomosis and applying the ^{15}N -tracer technique and D-alanine method to estimate endogenous and microbial nitrogen and nitrogen digestibility.

Results obtained in our studies are part of the EU frame-work project "HealthyPigut" (contract-no. QLK5-CT-2000-00522). They contribute to the pool of information about piglets during weaning transition and the various alterations encountered in digestive physiology, microbiology and immunology. Besides experiments and thereby derived results to be presented in this thesis, collaborative work was undertaken with various institutional partners in the frame of the project. Thus, samples obtained from animals in the course of our own studies were provided for further analysis in immuno-histology (Medical School Hannover / Germany, group H-J Rothkoetter) and mucin analysis (INRA St.Gilles, group JP Lalles). Results from this work will be presented by the respective groups in an appropriate fashion.