FAILURE TO PROVE THE EFFECT OF FEEDING ON EXPERIMENTAL SALMONELLA TYPHIMURIUM INFECTION IN PIGS

D.L. BAGGESEN1*, H. MARIBO2, R. BØDKER1

1 Danish Veterinary Institute, 27 Bülowsvej, DK-1790 Copenhagen V, Denmark. * Phone: +45 35 30 07, Fax: +45 35 30 01 20, E-mail: dlb@vetinst.dk. 2 The National Committee for Pig Production, Copenhagen, Denmark

Keywords: Feeding strategy, organic production, experimental infection

Summary: The hypothesis of the present investigations was that organic feeding with a high level of protein might increase the risk of development of infection with S. Typhimurium compared to conventional feed. Also feeding with pelleted feed might increase the risk compared to feeding with meal feed. An experimental infection study with S. Typhimurium including a total of 60 pigs in 4 feeding groups: organic pelleted feed, organic meal, conventional pelleted feed and conventional meal, was performed. Pigs were followed by microbiological examination of faecal samples and serological analysis of blood in 8 weeks. In the experimental model applied, it was not possible to show any significant difference in the establishment and course of infection with S. Typhimurium in relation to the feeding strategy. The variation of the infection among the individual pigs included in the study was very high which may cover a possible effect of the different feedings. This high degree of variation may be taken into account when future experimental investigations have to be planned.

Materials and Methods: An experimental study including a total of 60 salmonella negative pigs was performed (3 groups of 5 pigs of each of 4 feeding groups). The pigs in each of the feeding groups were fed with 1) organic pelleted feed, 2) organic meal, 3) conventional pelleted feed and 4) conventional meal. Organic feed had a higher crude fiber content compared to the conventional feed (8% vs. 3.7%) and a more wide panel of protein sources (soya beans, rape, peas and lupin vs. soya and synthetic aminoacids).

From the start and throughout each of the experiments, pigs were given the different types of feed and water ad libitum. After 14 days all pigs were infected orally by use of a stomach tube with approximately 10^9 c.f.u. of a rifampicin resistant strain of S. Typhimurium DT12 (Nielsen et al., 1995). Throughout the study faecal material and blood samples were collected once a week in 8 weeks. Before challenge faecal samples was analysed qualitatively for Salmonella whereas after challenge, excretion of the challenge strain was quantified by serial 10-fold dilution of the unincubated preenrichment buffers and subsequently analysis of each of the dilutions as described previously (Baggesen et al., 1999). Agglutination of the O5-factor and identification of resistance against rifampicin verified isolated strains as the challenge strains. The excretion of S. Typhimurium was stated as log10 c.f.u per gram faeces. In addition, the faecal samples were examined by conventional bacteriological methods determining the level of Enterobactericeae (NMKL 144, 1992), Enterococci (NMKL 68, 1992) and Lactobacillus (NMKL 140, 1991). Blood samples were examined for the occurrence of salmonella antibodies by mix-ELISA covering O-antigens 4,5,6,7 and 12 (Nielsen et al., 1995) stated as OCD%. 95% confidense intervals for the mean salmonella count and the mean antibody OCD% was estimated as ± 2 (s.d. of the log10(c.f.u) / \sqrt{n} ) and ±2 (s.d. of the OCD% / \sqrt{n} ) respectively, by treatment group and by sampling day. With n=15 this equals the standard CI 95% for each treatment group average. Under the assumption of no treatment effect, the difference between the average of the four treatments and each treatment group average will have a CI 95% with a length of \sqrt{3} /2 times this quantity. Where samples were lost and sample sizes therefore less than 15 per treatment, CI 95% were adjusted accordingly.
Results: The salmonella infection was established in all pigs resulting in mean excreting of $10^2$ to $10^4$ c.f.u. $S$. Typhimurium per gram faeces 2 days after challenge followed by a decline in the excretion in the following weeks until the end of the experiments. Each of the infected pigs reacted at the infection by production of specific antibodies against Salmonella. The confidence limits were wide reflecting a large variation in the salmonella excretion (fig 1a) as well as in the antibody level (fig 1b) between individuals within each treatment group. No significant difference in the level of salmonella excretion (fig. 1a) or antibody titer (fig. 1b) between the four treatment groups could be detected. Neither in relation to the other bacteria investigated any differences between treatment groups could be detected.

Discussion and conclusions: Several epidemiological investigations have shown the significance of feeding strategy on the risk of salmonella infection in finisher pigs. Feeding with non-heat treated and optional also coarse-grained feed has a protective effect on prevalence of salmonella. In addition, the level of protein in the feed has shown to have a relation to development of diarrhoea and as a consequence to the possibility of establishment of salmonella infection.

In the experimental model applied, it was not possible to show any significant difference in the establishment and course of infection with $S$. Typhimurium in relation to the feeding strategy. The failure to demonstrate any effects of the different feeding strategy may reflect that there in fact are no effects of the feed applied or that the effects are so limited that they are concealed by the wide variation of the infection among the individual pigs included.

As salmonella infection in pigs is multifactorial, it has been involved with difficulties to establish a stable experimental model, which result in high degree of variation in the infection output. This variation shall be taken into account when future experimental investigations are designed.

Figur 1 Faecal excretion of $S$. Typhimurium (challenge strain) (a) and development of antibodies in pigs of different feeding groups

Acknowledgement: The Danish Ministry of Food, Fisheries and Agriculture supported the study. We thank Anders Stockmarr for statistical advice.

References:
Dramatic reductions of in feed medication via immunization against enteric pathogens

J Kolb*, M Roof, D Walter

Boehringer Ingelheim Vetmedica, Inc., 2501 North Loop Drive, Ames, IA 50010 USA, Email: jkolb@bi-vetmedica.com, Phone +1-515-203-0092, Fax +1-515-268-1760

Summary: The use of in-feed antimicrobials is coming under increased pressure in food animal production. Five field studies examined the impact of vaccines to stimulate protective immunity against pathogens commonly controlled with in-feed antimicrobials (Lawsonia intracellularis, a common enteric pathogen causing ileitis). Grow-finish pigs were immunized and various levels of in-feed antimicrobials used to control or prevent Lawsonia were removed. Performance was compared between vaccinated and matched, continuously medicated barns. Performance was improved in vaccinated/reduced medication pigs while allowing for a 50% or greater reduction in in-feed antimicrobials targeting ileitis. More than six grams of tylosin and 20 grams of tetracycline per pig were removed from finishing feeds. Up to 50% of the time period in vaccinated finishing pigs occurred without any medications in feed. Large amounts of in-feed antimicrobials were successfully removed while improving growing and finishing pig performance.

Keywords: vaccination, antimicrobials, Lawsonia, Salmonella, grow-finish

Introduction: Use of in feed antimicrobials in pork production is a controversial activity. Historically, in feed antimicrobials have been used to treat and prevent disease, as well as promote growth in normal, healthy pigs. A large percentage of pigs have typically received some type of medication for either disease treatment or growth promotion at some point in the production phase (Dewey et al., 1999). However, the continuous feeding of in-feed antimicrobials may contribute to the development of resistance in swine pathogens, a potential risk for animal and human health (Mathew et al., 2002). Active immunization against enteric pathogens may offer producers the chance to reduce in feed antibacterials while maintaining or improving production.

Materials and Methods: A common enteric pathogen of swine, Lawsonia intracellularis, the causative agent of ileitis, recently has had a first of its kind oral vaccine approved. Common antibacterials such as tylosin, tetracyclines and lincosin are frequently used in in-feed, water and injectable formats to treat and prevent disease associated with Lawsonia. Five large scale field experiments using immunization to prevent disease were performed to evaluate both the impact of vaccination on biologic performance and assess the ability to reduce the reliance of producers on in-feed antimicrobials to control a common enteric disease.

Barns of pigs were vaccinated late in the nursery phase or at placement to the finishing phase with Enterisol® Ileitis (Boehringer Ingelheim Vetmedica, GmbH.), or remained as non-vaccinated, continuously medicated control groups. Enterisol Ileitis is first and only vaccine to protect pigs against ileitis which is administered orally. A total of 55 barns and approximately 46,900 pigs were immunized. There were a similar number of non-vaccinated control barns. A complete description of the study format has been described elsewhere (Kolb,2003).