VETERINARY RESEARCH

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Feeding of the probiotic bacterium *Enterococcus faecium* NCIMB 10415 differentially affects shedding of enteric viruses in pigs

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Abstract

Effects of probiotic bacteria on viral infections have been described previously. Here, two groups of sows and their piglets were fed with or without feed supplementation of the probiotic bacterium *Enterococcus faecium* NCIMB 10415. Shedding of enteric viruses naturally occurring in these pigs was analyzed by quantitative real-time RT-PCR. No differences between the groups were recorded for hepatitis E virus, encephalomyocarditis virus and norovirus. In contrast, astrovirus was exclusively detected in the non-supplemented control group. Rotavirus was shedded later and with lower amounts in the probiotic piglet group ($p < 0.05$); rotavirus-shedding piglets gained less weight than non-infected animals ($p < 0.05$). Serum titres of anti-rotavirus IgA and IgG antibodies were higher in piglets from the control group, whereas no difference was detected between sow groups. Phenotype analysis of immune cell antigens revealed significant differences of the CD4 and CD8β ($p < 0.05$) as well as CD8α and CD25 ($p < 0.1$) T cell populations of the probiotic supplemented group compared to the non-supplemented control group. In addition, differences were evident for CD21/MHCII-positive ($p < 0.05$) and IgM-positive ($p < 0.1$) B cell populations. The results indicate that probiotic bacteria could have effects on virus shedding in naturally infected pigs, which depend on the virus type. These effects seem to be caused by immunological changes; however, the distinct mechanism of action remains to be elucidated.

Introduction

Bacteria- and virus-induced gastrointestinal disorders are a common problem in piglets. Infections are often associated with insufficient maternal immune protection, poor hygiene conditions, environmental changes, weaning stress, and dietary changes after weaning. To decrease the risk of infectious diseases, in-feed antibiotics have been used for decades. Their ban in Europe in 2006 has increased attempts to identify alternatives such as prebiotics, probiotics, organic acids, trace elements and other feed additives. In pigs, probiotics such as *Enterococcus faecium* are commonly used. Some studies show positive effects of probiotics against microbial infections in pigs [1-4].

No effective therapy exists against intestinal virus infections of pigs. Therefore, vaccination is the most promising method to actively control disease and viral shedding. However, vaccines are only available for a few viruses, whereas a wide range of viruses could be detected in porcine feces. Some of them are closely related to human viruses and are therefore supposed to have a zoonotic potential. This includes astrovirus (AstV), encephalomyocarditis virus (EMCV), hepatitis E virus (HEV), norovirus genogroup II (NoV GGII) and group A rotavirus (rotavirus A). The infections can be associated with diarrhoea. For example rotavirus A causes acute diarrhoea in weaning and post-weaning piglets as well as in children [5]. Natural infection with hepatitis E virus is subclinical in pigs but may cause disease in humans [6,7] whereas infection with EMCV is associated with myocarditis and reproductive failure in pigs [8,9]. The clinical significance of norovirus and astrovirus infection in pigs is unclear. Some studies

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