Passive Mucosal Immunisation with Novel Simplified IgA Antibodies Produced in Seeds prevents Enterotoxigenic Escherichia Coli (ETEC) Infection in Weaned Piglets

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ETEC related post-weaning diarrhea causes recurrent economic losses to the porcine rearing industry. The embargo on antibiotic prophylaxis has led to a pressing need for a suitable alternative. To evaluate feed based oral prophylactic passive immunization against ETEC, we produced antibodies in seeds of Arabidopsis thaliana. Antibodies were designed by grafting 4 variable domains of lama heavy chain 11 antibodies (VHH) against ETEC on the Fc part of porcine IgG and IgA. Transformants producing the 4 VHH-IgG and 4 VHH-IgA antibodies from 0.2% up to 3% of seed weight were obtained. Cotransformation of the VHH-IgA constructs with porcine joining chain and secretory component led to production of assembled dimeric and secretory IgA like antibodies in seeds. In vitro analysis of the antibody producing seed extracts were all effective in aggregating ETEC and inhibiting bacterial binding to porcine gut villous enterocytes. In a piglet feed-challenge experiment, the feed containing a milled cocktail of all the VHH-IgA based antibodies (dose 20mg/ pig/ day) protected the piglets against the challenge infection; while feed with the 4 VHH-IgG producing seeds (dose 80mg/ pig/ day) failed to offer similar protection. Piglets receiving the VHH-IgA antibodies had a swift decline in shedding of ETEC, the seroconversion was significantly lower and they had a higher weight gain. Thus these results show a feasibility proof for oral passive immunization against ETEC.