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Prevention of post weaning diarrhoea by a *Saccharomyces cerevisiae*-derived product based on whole yeast

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ABSTRACT

The aim of this study was to examine whether yeast derivate (YD) based on whole brewery yeast added to the creep feed of suckling and newly weaned piglets or to the creep feed of the piglets and the sow's diet prevented post weaning diarrhoea (PWD) or affected performance. Thirty sows and their litters were randomly allocated to three treatment groups: PSP (1.5 g/kg of YD to the sows' feed from 1 wk before expected farrowing to weaning; 3 g/kg or 2 g/kg of YD added to the piglets' creep feed from 2 wk of age until 2 wk post weaning (PW) and from wk 2 to 5 PW, respectively); PP (YD added to the piglets' creep feed as in PSP); or C (control, no YD added). At weaning (4 wk of age) 2 individually housed piglets from all litters were subjected to either experimental *Escherichia coli* (*E. coli*) challenge or placebo treatment on d 1 to 3 PW, whereas performance was measured on 3 group-housed piglets from each litter. In individually housed piglets the faecal consistency score (FCS) was affected by an interaction between days PW, treatment group, and challenge group (P=0.005). In general, FCS was lower in placebo than in *E. coli*-challenged piglets and in PSP and PP piglets than in C piglets. The PSP and PP piglets had lower risk of PWD, defined as FCS > 3, on d 2 to 6 PW compared to C piglets (P=0.014 and P=0.001, respectively). This effect was evident in both placebo and *E. coli*-challenged PP piglets (P=0.010 and P=0.038, respectively), whereas PSP piglets only differed from C in *E. coli*-challenged piglets (P=0.030). In *E. coli*-challenged piglets faecal shedding of haemolytic *E. coli* was lower in PP than in C piglets (P=0.026). In placebo piglets the latency time to first observation of PWD was longer in PP than in PSP and C piglets (P=0.048 and P=0.017, respectively). The specific antibody titre in piglets or sows was not affected by YD. In group-housed piglets the medical treatment against PWD tended to occur in fewer PP than PSP and C pens within the first 3 wk PW (P=0.078). The average daily gain did not differ between treatments, but PSP piglets had an improved gain to feed ratio (G:F) in wk 0 to 5 PW (P<0.01). In conclusion, YD may prevent PWD at weaning at 4 wk of age if added to the creep feed 2 wk before weaning and PW. Adding YD to the sow as well may, however, antagonize the effect on PWD at a low pathogenic *E. coli* load, but may improve the G:F compared to no YD supplementation.

Abbreviations: ADFI, average daily feed intake; ADG, average daily gain; ADWI, average daily water intake; BA, blood agar plates; CFU, Colony Forming Units; *E. coli*, *Escherichia coli*; FCS, faecal consistency score; G:F, gain-to-feed ratio; MMA, Mastitis Metritis and Agalacti; PW, post weaning; PWD, post weaning diarrhoea; YD, yeast derivate based on *Saccharomyces cerevisiae*.

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1. Introduction

Post weaning diarrhoea (PWD), frequently associated with enterotoxigenic *Escherichia coli* (*E. coli*) infection (Frydendahl, 2002), is one of the major welfare and economic problems in pig production at weaning. Due to the ban of prophylactic use of antibiotics in the European Union, other actions that have the potential to reduce the risk of PWD have to be identified.

Yeast derivates based on *Saccharomyces cerevisia* (YD) added to the feed may be such an alternative. Mannans from YD may be immunomodulatory and prevent colonization of pathogenic *E. coli* as *E. coli* agglutinates to mannans (e.g. White et al., 2002; Davis et al., 2004b), whereas YD β-glucans may improve the specific immunity and prevent an exaggerated innate immune response to *E. coli* (e.g. Li et al., 2005, 2006; Wang et al., 2008a, 2008b; Gallois et al., 2009; Ganner et al., 2010; Juul-Madsen et al., 2010). In addition, YD based on whole yeast may contain nucleotides improving intestinal development and immunity (e.g. Sauer et al., 2011).

Studies on the effect of YD on post weaning (PW) performance show conflicting results, but YD may improve the resistance to *E. coli* infection in piglets pre-treated with YD for 1–4 wk PW (White et al., 2002; Maiorano et al., 2007; Stuyven et al., 2009). Studies on the effect of YD on PWD at the usual time of PWD outbreak (d 3–4 PW; Madec et al., 1998) combined with pre-treatment through supplementary creep feed to suckling piglets have not been reported. Furthermore, it has not been investigated whether adding YD to the sow during late pregnancy and lactation may enhance a potential preventive effect of YD on PWD. The aim of the present experiment was to study the effect of adding YD based on whole yeast to the creep feed for suckling piglets weaned at 4 wk of age on diarrhoea within 1 to 3 wk after weaning, specific antibody titre, and performance as well as whether the concurrent addition of the YD to the sow improved the effect.

2. Materials and methods

All procedures involving animals were approved by the Danish Animal Experiments Inspectorate in accordance with the Danish legislation.

2.1. Animals

The experiment included 30 sows and their litters (Landrace-Yorkshire or Landrace-(Yorkshire-Duroc) cross-bred litters), originating from the sow production unit at Aarhus University, Foulum. The herd had a high health status according to the Danish specific-pathogen-free scheme, and was declared free from toxigenic *Pasteurella multocida, Sarcoptes scabei var. suis, Haematopinus suis, Brachyspira hyodysenteria*, and *Actinobacillus pleuropneumoniae* serotypes 1,2,3,4,5,7,8,9,10. The sows were multiparous (parity 2–7). Before entering the experiment, the sows had been DNA-tested (Jørgensen et al., 2004) and found to be homozygote carriers of the gene encoding for intestinal F4 fimbria receptors for *E. coli*: F4 adhesion. All their offspring therefore would also have intestinal F4 receptors.

The piglets were housed from birth until weaning in undisrupted litters in farrowing crates with the dimension 1 m × 2.5 m for the sow plus an additional 1 m × 2.5 m get-away-area for the piglets equipped with a heating lamp. The experimental buildings were insulated and thermostatically controlled to approximately 20 °C. Straw was used for bedding. The piglets were weaned at 4 wk of age. At weaning 2 piglets from each litter were assigned to an *E. coli* challenge trial and 3 piglets from each litter continued in a performance trial, whereas the sow and the remaining piglets were returned to the production unit.

The piglets in the *E. coli* challenge trial were individually housed in 0.72 m × 1.55 m pens, whereas the piglets in the performance trail were group-housed in 1.28 m × 1.63 m pens. Sawdust was used for bedding. At weaning the room temperature was 28 °C and thereafter it was decreased by 1 °C per week. During the whole experiment the pig house was exposed to natural daylight (56°29′ N, 9°34′ E) from windows, combined with artificial lighting from 07:30 to 15:30 h.

2.2. Experimental design

The experiment included 10 repetitions of 3 sows and their litters randomly allocated to one of three treatment groups: (1) YD added to the feed of sow and piglets during lactation and post weaning (PSP); (2) YD added to the feed of only the piglets during lactation and post weaning (PP); and (3) a control group that did not get YD in the feed (C).

The YD used was Progut™ (Suomen Rehu Oy, Helsinki, Finland), which, according to the manufacturer, is whole brewery yeast hydrolysed after a patented process, consisting of heat treatment (70 °C) of the yeast for inactivation, storage below 10 °C in a storage tank, evaporation of water with an evaporator rising the dry matter content of the yeast up to 300–400 g/kg, processing with acid-alkaline treatment, spray drying of the processed product, cooling, sieving, and bagging. The dietary composition and nutrient profile of the feed and YD are shown in Table 1. In treatment group PSP, 1.5 g/kg of YD was added to the sows' feed from 1 wk before expected farrowing and during lactation. The piglets were offered a solid weaner diet from 2 wk of age until 2 wk after weaning and a starter diet from 2 wk after weaning until 5 wk after weaning. In the treatment groups PSP and PP the weaner diet were added 3 g/kg of YD and the starter diet were added 2 g/kg of YD. The sows were fed twice daily with a daily ration per 10 piglets of 2.6 kg, 4.5 kg, 6.0 kg, 7.0 kg, and 7.5 kg at d 2, 7, 14, 21, and 28 after farrowing, respectively. The piglets were fed *ad libitum*.