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Performance and microbial activity in the gastrointestinal tract of piglets fed fermented liquid feed at weaning

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ASBSTRACT

Feeding fermented liquid feed (FLF), containing high numbers of lactobacilli and yeast, and high concentrations of lactic acid, to piglets at weaning did not improve growth performance compared with piglets fed non-fermented liquid feed (NLF). No significant changes in the microbial activity (ATP concentration) in the GI tract of piglets fed the FLF were observed. However, pH in the stomach was significantly reduced, and a different microbial fermentation pattern in the colon was observed. Furthermore, the density of yeast was significantly increased, whereas the density of coliform bacteria was significantly decreased throughout the GI tract in piglets fed the FLF. The results suggest, that feeding FLF to piglets at weaning may assist in the prevention of coliform scours.

KEY WORDS: microbial activity, gastrointestinal tract, performance, piglets

INTRODUCTION

Post-weaning diarrhoea is associated with poor health and performance of the newly weaned pig. This is commonly prevented by administration of antibiotics. However, serious concerns regarding bacteria developing resistance to antibiotics, and fears that this could reduce the possibilities to treat diseased humans, may cause future legislation banning the use of antibiotics. This has called for alternative concepts that improve the health and performance of newly weaned pigs. The present study aims to investigate the effect of FLF on growth performance and on the gut microbiota of weaned piglets.

MATERIAL AND METHODS

FLF was prepared at 20°C in a 60 l cylindrical tank with continuous stirring, temperature and pH monitoring. A standard Danish piglet diet (wheat, 33%; barley, 33%; soyabean, 11%; and fish meal, 11%) was mixed with water in a 1:2.75 ratio. Fermentation time was 8 h and a residue of 50% remained in the tank between each fermentation. NLF was prepared immediately before feeding. SCFA plus lactic acid concentrations and bacteriological enumeration were determined in samples of both NLF and FLF. A total of 20 piglets (from five litters) were weaned at 4 weeks and transferred to individual cages. Four piglets from each litter, two of each sex, were equally divided into a group fed NLF and a group fed FLF. After 4 weeks on the experimental diets, the piglets were killed 3 h after the morning feed. The gastrointestinal tract was immediately removed and divided into 8 segments: the stomach, 3 equal parts of the small intestine, the caecum, and 3 equal parts of the colon. The contents of each segment were collected and the pH and the concentrations of ATP and SCFA were measured. In addition, the intestinal contents were serially diluted and plated onto appropriate media for bacteriological enumeration.

RESULTS

Characteristics of the experimental diets and performance of the piglets are given in Tables 1 and 2, respectively. The pH in the stomach of piglets fed FLF was significantly lower (3.67 ± 0.57) than in piglets fed NLF (4.19 ± 0.23), whereas a tendency towards a higher pH was found in the small intestine of FLF fed piglets (results not shown). The microbial activity (ATP concentration) in the gut was not significantly affected by the FLF diet, although the concentrations seemed to decrease in the small intestine, caecum and proximal colon of piglets fed the FLF (results not shown). Fee-

TABLE 1

Characteristics of the experimental diets

Indices	NLF	FLF
pH	6.12 ± 0.01	4.37 ± 0.15
Lactic acid[1]	nd	142 ± 12
Acetic acid[1]	nd	14 ± 3
Lactic acid bacteria[2]	2.83 ± 0.95	9.56 ± 0.12
Lactobacilli[2]	2.71 ± 1.01	9.56 ± 0.16
Coliform bacteria[2]	2.25 ± 0.50	4.12 ± 0.86
Yeast[2]	4.28 ± 0.51	5.95 ± 1.00

[1] mmol kg liquid feed^{-1}

[2] log CFU g liquid feed^{-1}

nd: not detectable

TABLE 2

Performance of piglets fed either NLF or FLF

Indices	NLF	FLF
Weight at 4 weeks[1], kg	7.9 ± 1.1	8.1 ± 0.9
Weight at 6 weeks, kg	12.1 ± 1.1	12.1 ± 1.1
Weight at 8 weeks, kg	20.4 ± 1.4	19.9 ± 1.7
Average daily weight gain, g	468 ± 38	440 ± 52
FCR, kg feed kg weight gain^{-1}	1.11 ± 0.07	1.14 ± 0.06
Diarrhoea score[2]	0.4 ± 0.8	0.9 ± 1.5

[1] weight at weaning

[2] faeces were recorded daily according to the numbers 0 = normal, 1 = a little loose, 2 = thin, and 3 = aqueous

ding the FLF to piglets led to significantly higher concentrations of lactic acid in their stomach and small intestine compared to piglets fed the NLF, whereas in the colon, a significant decrease in the concentrations of butyric acid was observed (results not shown). With respect to the gut microbiota, the density of yeast was significantly increased, and conversely, a significant decrease in the density of coliform bacteria was found throughout the GI tract of piglets fed the FLF (Figure 1).

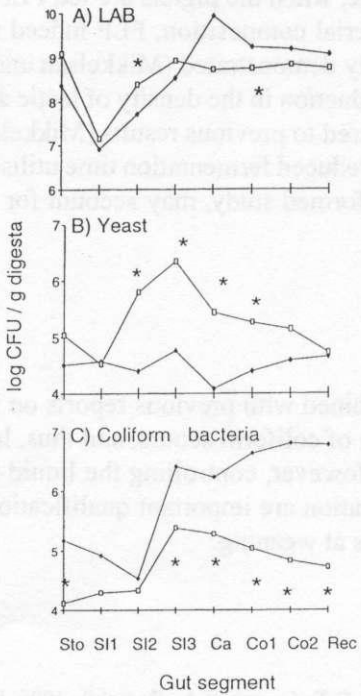

Figure 1. Density of selected populations of bacteria in various regions of the gastrointestinal tract on piglets fed either NLF (♦) or FLF (□), * P<0.05

DISCUSSION

Jensen and Mikkelsen (1998) reported that FLF of good quality can be prepared at 20°C with 8 h fermentation time and 50% residue. This concept was used in the present study. However, coliform bacteria proliferated in the FLF (Table 1). Other investigations have shown that coliform bacteria are suppressed in FLF (Geary et al., 1996; Russel et al., 1996; Mikkelsen and Jensen, 1997). The presence of coliform bacteria in the FLF may be an explanation for the relatively poorer growth performance of piglets fed the FLF in the present study (Table 2). Other investigations have shown that FLF improves feed intake and stimulates the growth of piglets (reviewed by Jensen and Mikkelsen, 1998). In a previous study, we found that FLF, prepared at 25°C and with a 24 h fermentation time, reduced the microbial activity (ATP concentration) in the small intestine, changed the microbial fermentation in the colon and also reduced the density of bacteria throughout the GI tract of piglets (Mikkelsen and Jensen, 1997). In the present study, no significant effect of FLF on the ATP concentration in the gut was found. However, the contribution of the predominant SCFAs present in the colon was affected. This indicates a change in fermentation patterns due to different nutrient supply or bacterial composition in the large intestine, when the piglets are fed FLF instead of NLF.

With respect to the bacterial composition, FLF indeed reduced the density of coliform bacteria as formerly demonstrated (Mikkelsen and Jensen, 1997; Jensen et al., 1998), whereas the reduction in the density of lactic acid bacteria (Figure 1) was less pronounced compared to previous results (Mikkelsen and Jensen, 1997). The lower temperature and reduced fermentation time utilised in the present study, compared to the earlier performed study, may account for the less marked effect presently observed.

CONCLUSIONS

The present results combined with previous reports on FLF suggest, that FLF may assist in the prevention of coliform scours, and thus, lower the need for antibiotics in pig production. However, controlling the liquid feed fermentation patterns and microbial proliferation are important qualifications in order to obtain a safe feed formula for piglets at weaning.

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