Effect of fermented feed on *Enterobacteriaceae* and lactobacilli population of the gastrointestinal tract of pigs.

René L. van Winsen¹*, Bert A.P. Urlings³, Len J.A. Lipman¹, Jos M.A. Snijders¹, David Keuzenkamp¹, Jos H.M. Verheijden², Frans van Knapen¹.

1: Department of the Science of Food of Animal Origin, Faculty of Veterinary Medicine, University of Utrecht, P.O. Box 80175, 3508 TD Utrecht, The Netherlands. Phone: +31 30 2535367. Fax: +31 30 2532365. Email: R.L.vanWinsen@vwd.vet.uu.nl. 2: Department of Farm Animal Health, Fac. of Vet. Med., Univ. of Utrecht, The Netherlands. 3: Department of Food Science³, ID-Lelystad, Lelystad, The Netherlands.

Abstract: Fermented feed contains high amounts of lactic acid and high numbers of lactobacilli. In a pig experiment the influence on the microbial population lactobacilli and *Enterobacteriaceae* in the gastrointestinal tract of the pig, by fermented feed was investigated. The numbers of *Enterobacteriaceae* in the contents of the stomach, ileum, caecum, colon, and rectum of pigs fed with fermented feed were significantly lower compared with the contents of the stomach, ileum, caecum, colon and rectum of pigs fed with dry feed. The numbers of total lactobacilli were significantly higher in the stomach contents of pigs fed fermented feed and in the ileum contents of one pig group fed fermented feed compared with the contents of pigs fed with dry feed. However, the influence of lactobacilli on *Enterobacteriaceae* could not be demonstrated. It was concluded that feeding fermented feed influences the bacterial ecology of the gastrointestinal tract and reduces the levels of *Enterobacteriaceae* in the different parts of the gastrointestinal tract.

Keywords: Fermented feed, gastrointestinal tract, *Enterobacteriaceae*, pigs.

Introduction: Fermented pig feed contains high concentrations of lactic acid, several volatile fatty acids (VFA; acetic acid, butyric acid, propionic acid), high numbers of lactobacilli, and has a low pH. These four parameters can have, alone or combined an effect on bacterial ecology of the gastric intestinal tract (GIT) of the pig. Lactic acid and VFA are also produced by the indigenous microflora in the GIT (Argenzio et al., 1974). Lactic acid and VFA are believed to play a role in the reduction of *Enterobacteriaceae*, including *Salmonella* (Prohaszka et al., 1990; Van Schie, 1987). Another hypothesis for *Salmonella* reduction is that lactobacilli ingested with fermented feed compete with (potential) pathogenic
bacteria in the GIT by strengthening the colonization resistance (2). To study the different mechanisms discussed above, an experiment was carried out where pigs were fed with *Lactobacillus plantarum* fermented feed and were challenged with *Salmonella*.

**Materials and Methods:** Two groups (12 pigs/group) were fed dry pig feed and two groups (12 pigs/group) were fed fermented pig feed. Two pigs of each group (seeder pigs) were orally challenged with one of the *Salmonella* isolates. The groups were: Group 1: Dry feed: *Salmonella enterica* serovar Goldcoast (serovar Goldcoast). Group 2: Fermented feed: serovar Goldcoast. Group 3: Dry feed: *Salmonella enterica* serovar Typhimurium DT12 (serovar Typhimurium) Group 4: Fermented feed: serovar Typhimurium DT12.

Bacterial counts: *Enterobacteriaceae* and Lactobacilli counts were counted on respectively VRBG agar and ROKOSA agar. *L. Plantarum* were counted on Lactobacillus Lactitol Vancomycin plates.

**Results:**

![Graph A](image1.png)

Graph A presents the total lactobacilli and *L. plantarum* numbers in contents of different sites of the gastrointestinal tract of pigs of the pigs fed with dry feed or fermented feed in the presence of *S. Goldcoast* (A) or in the presence of *S. Typhimurium* (B). Symbols: Total lactobacilli numbers in contents of the gastrointestinal tract of pig fed with dry feed (○) or fermented feed (●). *L. plantarum* numbers in contents of the gastrointestinal tract of pigs fed with fermented feed (▲) *L. plantarum* numbers in contents of the gastrointestinal tract of pigs fed with dry feed are under detection level of 4 log CFU (gram content)^{-1}. Results are presented as means of 10 pigs ± standard deviations.
FIG. 2. Numbers of *Enterobacteriaceae* (log-value of colony forming units (CFU)(gram content)^{-1}) measured in gastrointestinal contents of pigs fed dry feed and fermented feed. Symbols: dry feed group (group 1)(.), fermented feed group (group 2)(=), dry feed group (group 3)(||), fermented feed group (group 4)(//). Results are presented as means of 10 pigs ± standard deviations.

**Conclusion:** Fermented feed reduces the *Enterobacteriaceae* population in the gastrointestinal tract of the pigs. The numbers of *Enterobacteriaceae* found in the different feed groups are running equally i.e. the data points between the dry feed groups and fermented feed groups are at an almost similar distance. It seems that the reduction of *Enterobacteriaceae* initiates in the stomach. This reduction determines the *Enterobacteriaceae* numbers in the feces.

**References.**