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The impact of dietary swine plasma immunoglobulins on intestinal microbiota and general health in weaner piglets

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Background

Post-weaning diarrhoea (PWD) is a common condition in intensive swine production, resulting in reduced welfare of weaners, high consumption of antibiotics and zinc oxide, and economic losses for the farmer as a result of pig disease and death, and associated treatment costs. Antibiotics are standard treatment against PWD.

Presently, dietary immunoglobulin G, purified porcine plasma (ppIgG), has been shown to reduce diarrhoea symptoms and shedding of diarrhoeagenic pathogens in a challenge model of PWD (see talk on "Swine plasma immunoglobulins for prevention and treatment of post-weaning Diarrhoea" in Session 4), where the diarrhoeagenic haemolytic bacteria were cleared faster than in weaner piglets not receiving ppIgG.

Aim

To investigate if ppIgG modulates healthy weaner piglet intestinal microbiota and general health

Conclusions

- **No adverse side effects were observed by using ppIgG as a feed supplement.**
- **ppIgG does not change intestinal microbiota in healthy weaner piglets.**
- **These results suggest that ppIgG could be used for treatment of PWD and reduce antibiotic consumption.**

Figure 1: *In vivo* study design

A: Study 1

B: Study 2

Figure 1: Weaner piglets were grouped according to treatment (see below) and observed for 15 days before they were euthanized. Different intestinal sections were emptied of faecal contents, and then and inspected for pathological changes.

A: Group 1 received daily 4 grams of multimerised ppIgG, **Group 2** received 4 grams of ppIgG daily, **Group 3** received daily 4 grams of denatured ppIgG, and **Group 4** received daily 25 ml of PBS. Shortly into the study, two piglets (one in each group 1 and 4) became so ill they had to be euthanized. All piglets were euthanized at day 15.

B: Twenty-four four week old weaner piglets were placed in four groups: **Group 1** received daily 4 grams of ppIgG, **Group 2** received daily 1 gram of ppIgG, **Group 3** received daily 4 grams of denatured ppIgG, and **Group 4** received daily 20 ml of PBS. Shortly into the study (day 3) one piglet died in Group 3. All piglets were euthanized at day 15.

Pathology

Study 1:

Number of incidences of:	Multimerised IgG	4 gr IgG	Denat. IgG	PBS
Exocytosis[a]	1	0	0	1
Avg. Ileum Villi/crypt ratio[b]	1.4	1.4	1.3	1.8
Avg. colon crypt depth (µm)[b]	483	552	501	634

[a]Exudation of neutrophils to crypt lumen only happened in those piglets who were euthanized
[b]Only includes piglets that were alive at the end of study

Study 2:

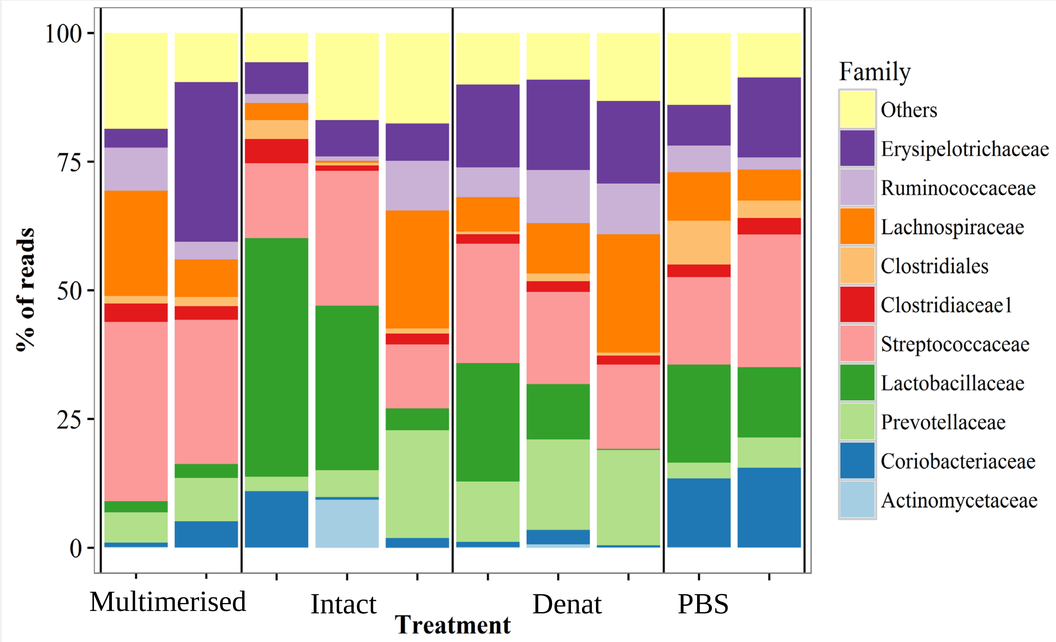
Number of incidences of:	4 gr IgG	1 gr IgG	Denat. IgG	PBS
Villi atrophy, ileum	1	0	1	0
Villi atrophy, jejunum	1	0	1	0
Dilatation of crypts, caecum[a]	0	0	1[b]	0

[a]Crypts also filled with acellular slime
[b]Observed at day 3 in the piglet that died during the experiment

Pathological observations were carried out on tissues collected by autopsy. In **Study 1** exocytosis (exudation of neutrophils) in colon and caecum were only observed in those two piglets that were euthanized due to severe illness within the first day of the study. Otherwise intestinal morphology of ileum and colon appeared normal in the remaining 10 piglets after 14 days of ppIgG supplement. In **Study 2** two piglets in Group 1 (4 grams of ppIgG) and one piglet in Group 3 (denatured ppIgG) had less/smaller villi than normal. One piglets died the night between day 3 and 4 and pathological examinations showed slime-filled crypts in the caecum. Remaining 20 piglets showed no intestinal abnormalities. The overall conclusion from the pathological evaluation of the intestines was that ppIgG does not result in adverse effects.

Figure 2: NGS of healthy weaner piglet intestinal microbiota after ppIgG feed supplement

A: Study 1; ileum



B: Study 2; Jejunum

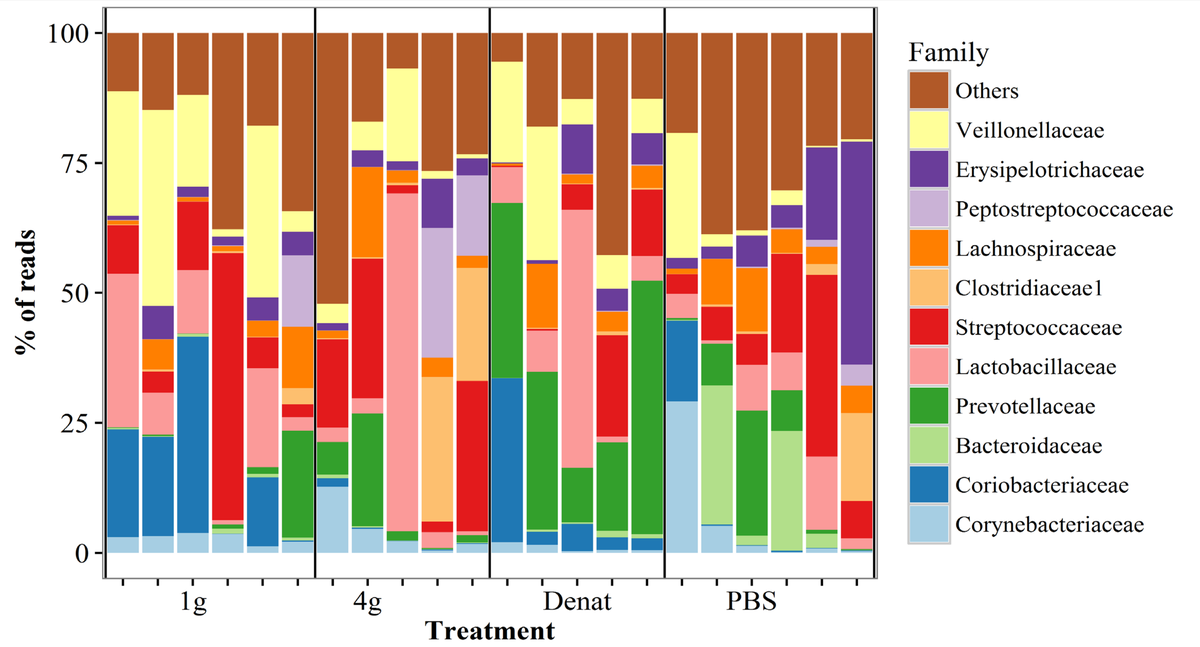


Figure 2: DNA was extracted from the content of either (**A**) ileum or (**B**) jejunum obtained at autopsy on day 15. The V1/V2 regions of the bacterial 16S rRNA gene was amplified by PCR using universal primers. The PCR-16S DNA-products were sequenced on the Illumina MiSeqTM 250PE platform, and the sequences were analysed using BION-meta software. Taxonomical classification at bacterial family level was done according to the Ribosomal Database Project II (RDP-II) SSU database.

Comparing the taxonomical classification data, the intestinal microbiota appears to differ equally within and between groups of weaner piglets, thus no significant differences were observed. Hence, ppIgG does not alter the normal commensal microbiota in healthy weaner piglets.