**Supplementary Tables**

**Supplementary Table S1. Effect of supplementing sow diets with *Bacillus altitudinis* WIT588 spores from day (D) 100 of gestation to weaning (D26 of lactation) on tissue mobilisation and reproductive performance of sows1.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Treatment | |  | *P*-value | | |
| Item | Days | CON2 | PRO3 | SEM | Treat-ment | Day | Treat-ment × Day | |
| N |  | 12 | 12 |  |  |  |  | |
| Body weight (kg) | D100 Gestation | 257.10 | 258.61 | 9.337 | 0.84 |  |  | |
|  | D114 Gestation | 283.47 | 278.77 | 2.769 | 0.23 |  |  | |
|  | D26 Lactation4 | 256.97 | 248.68 | 2.709 | **0.03** |  |  | |
|  | Overall |  |  | 1.991 | **0.02** | **<0.001** | 0.51 | |
|  |  |  |  |  |  |  |  | |
| Back fat (mm) | D100 Gestation | 17.29 | 18.61 | 0.784 | 0.24 |  |  | |
|  | D114 Gestation | 17.01 | 17.38 | 0.413 | 0.53 |  |  | |
|  | D26 Lactation | 14.80 | 14.35 | 0.405 | 0.43 |  |  | |
|  | Overall |  |  | 0.300 | 0.92 | **<0.001** | 0.31 | |
|  |  |  |  |  |  |  |  | |
| Feed intake (kg) | Gestation | 2.89 | 2.90 | 0.096 | 0.97 |  |  | |
|  | Lactation | 5.75 | 5.84 | 0.096 | 0.51 |  |  | |
|  | Overall |  |  | 0.068 | 0.62 | **<0.001** | 0.66 | |
| Body weight reduction (%)5 |  |  |  |  |  |  |  | |
|  | 9.89 | 11.48 | 1.292 | 0.24 |  |  | |
| Back fat reduction (%)5 |  | 6.38 | 8.21 | 3.923 | 0.62 |  |  | |
|  |  |  |  |  |  |  |  | |
| **Reproductive performance** | |  |  |  |  |  |  | |
| Gestation length (days) | | 114.76 | 114.59 | 0.331 | 0.689 |  |  | |
| Total born | | 14.62 | 15.49 | 1.253 | 0.560 |  |  | |
| Live born | | 13.50 | 13.97 | 1.170 | 0.735 |  |  | |
| Live born (%) | | 93.32 | 90.76 | 3.247 | 0.543 |  |  | |
| Stillborn | | 1.15 | 1.51 | 0.592 | 0.648 |  |  | |
| Piglets suckling at 48h *post-partum* | | 14.26 | 14.17 | 0.398 | 0.871 |  |  | |
| Mortality (%)6 | | 15.61 | 10.14 | 2.815 | 0.183 |  |  | |
| Weaned piglets | | 11.75 | 12.58 | 0.548 | 0.294 |  |  | |

1Least square means and pooled standard errors of the mean (SEM).

2CON: non-probiotic supplemented sows; 3PRO: probiotic-supplemented sows.

4Day 26 of lactation was the day that litters were weaned.

5Body weight reduction and back fat reduction were calculated for the entire lactation period.

6Mortality percentage was calculated for the entire pre-weaning period.

**Supplementary Table S2. Effect of supplementing sow diets with *Bacillus altitudinis* WIT588 spores from day (D) 100 of gestation to weaning (D26 of lactation) on haematological parameters of sows1.**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | Treatment | | |  | | *P*-value | | | |
| Blood parameter | Day | CON2 | | PRO3 | SEM | | Treat-ment | | Day | Treat-ment ×  Day |
| N |  | 12 | | 12 |  | |  | |  |  |
| White blood cells  (×103 cells/μl) | G100 | 9.08 | | 9.77 | 0.754 | | 0.53 | |  |  |
| G114 | 8.37 | | 8.90 | 0.659 | | 0.56 | |  |  |
|  | W26 | 11.00 | | 9.93 | 0.571 | | 0.18 | |  |  |
|  | Mean | 9.68 | | 9.42 | 0.454 | | 0.66 | | **<0.01** | 0.19 |
|  |  |  | |  |  | |  | |  |  |
| Lymphocytes (×103  cells/µL) | G100 | 4.32 | | 4.15 | 0.386 | | 0.76 | |  |  |
| G114 | 3.31 | | 3.88 | 0.255 | | 0.11 | |  |  |
|  | W26 | 3.86 | | 3.51 | 0.229 | | 0.26 | |  |  |
|  | Mean | 3.58 | | 3.69 | 0.182 | | 0.64 | | 0.70 | *0.05* |
|  |  |  | |  |  | |  | |  |  |
| Lymphocytes (%)4 | G100 | 45.83 | | 46.74 | 2.370 | | 0.79 | |  |  |
|  | G114 | 39.02 | | 43.08 | 2.586 | | 0.28 | |  |  |
|  | W26 | 36.27 | | 36.37 | 2.319 | | 0.98 | |  |  |
|  | Mean | 37.65 | | 39.73 | 1.739 | | 0.41 | | *0.06* | 0.43 |
|  |  |  | |  |  | |  | |  |  |
| Monocytes (×103  cells/µL) | G100 | 0.66 | | 0.80 | 0.087 | | 0.20 | |  |  |
| G114 | 0.69 | | 0.65 | 0.058 | | 0.55 | |  |  |
|  | W26 | 0.67 | | 0.71 | 0.051 | | 0.62 | |  |  |
|  | Mean | 0.68 | | 0.68 | 0.042 | | 0.89 | | 0.70 | 0.43 |
|  |  |  | |  |  | |  | |  |  |
| Monocytes (%)4 | G100 | 8.04 | | 8.63 | 0.516 | | 0.43 | |  |  |
|  | G114 | 8.22 | | 7.57 | 0.563 | | 0.40 | |  |  |
|  | W26 | 6.40 | | 7.36 | 0.506 | | 0.17 | |  |  |
|  | Mean | 7.31 | | 7.46 | 0.405 | | 0.77 | | *0.05* | 0.12 |
|  |  |  | |  |  | |  | |  |  |
| Neutrophils (×103  cells/µL) | G100 | 3.45 | | 3.32 | 0.355 | | 0.79 | |  |  |
| G114 | 3.99 | | 3.67 | 0.571 | | 0.70 | |  |  |
|  | W26 | 5.67 | | 4.64 | 0.505 | | 0.17 | |  |  |
|  | Mean | 4.83 | | 4.16 | 0.384 | | 0.23 | | **0.02** | 0.52 |
|  |  |  | |  |  | |  | |  |  |
| Neutrophils (%)4 | G100 | 37.28 | | 37.05 | 2.602 | | 0.95 | |  |  |
|  | G114 | 47.04 | | 40.74 | 2.990 | | 0.15 | |  |  |
|  | W26 | 51.00 | | 49.05 | 2.646 | | 0.61 | |  |  |
|  | Mean | 49.02 | | 44.90 | 2.001 | | 0.16 | | **0.04** | 0.45 |
|  |  |  | |  |  | |  | |  |  |
| Eosinophils (×103  cells/µL) | G100 | 0.44 | | 0.50 | 0.045 | | 0.32 | |  |  |
| G114 | 0.35 | | 0.37 | 0.073 | | 0.82 | |  |  |
| W26 | 0.47 | | 0.40 | 0.066 | | 0.45 | |  |  |
|  | Mean | 0.41 | | 0.39 | 0.052 | | 0.74 | | 0.26 | 0.50 |
|  |  |  | |  |  | |  | |  |  |
| Eosinophils (%)4 | G100 | 4.59 | | 5.58 | 0.439 | | 0.13 | |  |  |
|  | G114 | 4.08 | | 4.11 | 0.639 | | 0.97 | |  |  |
|  | W26 | 4.29 | | 3.90 | 0.571 | | 0.63 | |  |  |
|  | Mean | 4.19 | | 4.01 | 0.429 | | 0.77 | | 1.00 | 0.73 |
|  |  |  | |  |  | |  | |  |  |
| Basophils (×103  cells/µL) | G100 | 0.10 | | 0.11 | 0.013 | | 0.54 | |  |  |
| G114 | 0.11 | | 0.17 | 0.024 | | **0.04** | |  |  |
|  | W26 | 0.17 | | 0.22 | 0.022 | | *0.07* | |  |  |
|  | Mean | 0.14 | | 0.20 | 0.018 | | **<0.01** | | **<0.01** | 0.72 |
|  |  |  | |  |  | |  | |  |  |
| Basophils (%)4 | G100 | 1.11 | | 1.36 | 0.127 | | 0.19 | |  |  |
|  | G114 | 1.24 | | 1.81 | 0.207 | | **0.05** | |  |  |
|  | W26 | 1.58 | | 2.32 | 0.188 | | **<0.01** | |  |  |
|  | Mean | 1.41 | | 2.06 | 0.155 | | **0.001** | | **0.02** | 0.61 |
|  |  |  | |  |  | |  | |  |  |
| Red blood cells  (×106 cells/µL) | G100 | 7.36 | | 6.99 | 0.534 | | 0.64 | |  |  |
| G114 | 5.88 | | 5.87 | 0.128 | | 0.94 | |  |  |
|  | W26 | 5.56 | | 5.83 | 0.115 | | *0.10* | |  |  |
|  | Mean | 5.72 | | 5.85 | 0.089 | | 0.29 | | 0.15 | 0.24 |
|  |  |  | |  |  | |  | |  |  |
| Haemoglobin (g/dL) | G100 | 14.55 | | 13.61 | 1.081 | | 0.56 | |  |  |
|  | G114 | 12.00 | | 11.67 | 0.244 | | 0.32 | |  |  |
|  | W26 | 11.27 | | 11.37 | 0.219 | | 0.73 | |  |  |
|  | Mean | 11.64 | | 11.52 | 0.175 | | 0.61 | | **0.03** | 0.32 |
|  |  |  | |  |  | |  | |  |  |
| Haematocrit (L/L) | G100 | 0.47 | | 0.44 | 0.032 | | 0.51 | |  |  |
|  | G114 | 0.39 | | 0.37 | 0.008 | | 0.14 | |  |  |
|  | W26 | 0.36 | | 0.37 | 0.007 | | 0.67 | |  |  |
|  | Mean | 0.38 | | 0.37 | 0.005 | | 0.40 | | *0.05* | 0.16 |
|  |  |  | |  |  | |  | |  |  |
| Mean corpuscular  volume (fL) | G100 | 63.52 | | 62.77 | 0.601 | | 0.25 | |  |  |
| G114 | 66.18 | | 63.88 | 0.474 | | **0.001** | |  |  |
|  | W26 | 65.01 | | 63.23 | 0.431 | | **<0.01** | |  |  |
|  | Mean | 65.60 | | 63.55 | 0.357 | | **<0.001** | | **0.03** | 0.51 |
|  |  |  | |  |  | |  | |  |  |
| Mean corpuscular  haemoglobin (pg/cell) | G100 | 19.90 | | 19.57 | 0.197 | | 0.13 | |  |  |
| G114 | 20.47 | | 19.93 | 0.154 | | **0.01** | |  |  |
|  | W26 | 20.20 | | 19.54 | 0.139 | | **0.001** | |  |  |
|  | Mean | 20.34 | | 19.74 | 0.113 | | **0.001** | | **0.02** | 0.65 |
|  |  |  | |  |  | |  | |  |  |
| Mean corpuscular haemoglobin  concentration (g/dL) | G100 | 31.33 | | 31.14 | 0.220 | | 0.56 | |  |  |
| G114 | 30.89 | | 31.23 | 0.122 | | **0.04** | |  |  |
| W26 | 31.02 | | 31.00 | 0.111 | | 0.91 | |  |  |
| Mean | 30.96 | | 31.12 | 0.093 | | 0.14 | | 0.62 | *0.09* |
|  |  |  | |  |  | |  | |  |  |
| Platelets (×103 cells/μL) | G100 | 120.80 | | 161.51 | 27.197 | | 0.31 | |  |  |
| G114 | 152.77 | | 164.59 | 18.432 | | 0.64 | |  |  |
|  | W26 | 240.59 | | 239.14 | 16.473 | | 0.95 | |  |  |
|  | Mean | 196.68 | | 201.87 | 13.474 | | 0.76 | | **<0.001** | 0.68 |

1Least square means and pooled standard errors of the mean (SEM).

2CON: non-probiotic supplemented sows; 3PRO: probiotic-supplemented sows.

4Percentages are based on the differential count of white blood cells.

**Supplementary Table S3. Pre-weaning growth performance of piglets born to sows fed a control or a probiotic-supplemented diet1.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Treatment | |  | *P*-value | | |
| Item | Day (D) | CON2 | PRO3 | SEM | Treatment | Day | Treatment  × Day |
| N |  | 153 | 154 |  |  |  |  |
| Mortality4 |  | 24 | 15 |  |  |  |  |
| Off trial5 |  | 6 | 3 |  |  |  |  |
|  |  |  |  |  |  |  |  |
| Body weight (kg) | Birth (D0) | 1.48 | 1.47 | 0.029 | 0.90 |  |  |
|  | D14 | 3.89 | 3.91 | 0.167 | 0.90 |  |  |
|  | Weaning (D26) | 7.24 | 7.30 | 0.168 | 0.69 |  |  |
|  | Overall |  |  | 0.150 | 0.71 | **<0.001** | 0.84 |
|  |  |  |  |  |  |  |  |
| Average daily gain (g) | D0-14 | 181.97 | 183.52 | 10.785 | 0.86 |  |  |
|  | D15-26 | 293.68 | 305.09 | 10.863 | 0.21 |  |  |
|  | Overall |  |  | 9.854 | 0.31 | **<0.001** | 0.44 |
|  | D0-26 | 233.27 | 236.13 | 11.207 | 0.70 |  |  |

1Least square means and pooled standard errors of the mean (SEM).

2CON: non-probiotic supplemented sows; 3PRO: probiotic-supplemented sows.

4Mortality: In CON group, mortality was due to overlay (N=12), starvation (N=11), and pot belly (N=1). In PRO group, mortality was due to overlay (N=5) and starvation (N=8).

5Off trial: Runt piglets (CON, N=6 and PRO, N=3) that were removed from the trial.

**Supplementary Table S4. Effect of *Bacillus altitudinis* WIT588 spore supplementation to sow and piglet diets on small intestinal morphology of piglets at day 8 post-weaning1.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Maternal | Control | Control | Probiotic | Probiotic |  |  | *P*-value |  |
| Post-weaning (pw) | Control | Probiotic | Control | Probiotic |  |  |  | Maternal |
|  | CON/CON2 | CON/PRO3 | PRO/CON4 | PRO/PRO5 | SEM | Maternal | pw | × pw |
| N | 10 | 10 | 10 | 10 |  |  |  |  |
| **Duodenum** |  |  |  |  |  |  |  |  |
| Goblet cells | 14.2 | 13.5 | 14.3 | 15.5 | 1.62 | 0.52 | 0.88 | 0.54 |
| Villous height (µm) | 340.9 | 362.7 | 400.7 | 384.7 | 12.18 | **<0.01** | 0.81 | 0.13 |
| Crypt depth(µm) | 175.2 | 178.9 | 192.7 | 188.3 | 6.27 | **0.04** | 0.96 | 0.52 |
| VH:CD ratio6 | 2.0 | 2.1 | 2.1 | 2.1 | 0.09 | 0.62 | 0.78 | 0.69 |
| Villous area (µm2) | 38819 | 42958 | 49822 | 48103 | 2565.7 | **<0.01** | 0.64 | 0.26 |
| Crypt area (µm2) | 6531 | 6946 | 7636 | 7335 | 380.9 | *0.06* | 0.88 | 0.35 |
|  |  |  |  |  |  |  |  |  |
| **Jejunum** |  |  |  |  |  |  |  |  |
| Goblet cells | 9.9 | 7.4 | 10.3 | 10.1 | 1.19 | 0.20 | 0.26 | 0.32 |
| Villous height (µm) | 346.5 | 346.1 | 345.7 | 379.9 | 11.41 | 0.16 | 0.15 | 0.14 |
| Crypt depth(µm) | 182.5 | 169.2 | 190.8 | 187.4 | 6.29 | **0.04** | 0.19 | 0.44 |
| VH:CD ratio6 | 2.0 | 2.1 | 1.9 | 2.0 | 0.08 | 0.37 | **0.03** | 0.69 |
| Villous area (µm2) | 38151 | 39743 | 38426 | 45784 | 2773.5 | 0.26 | 0.12 | 0.31 |
| Crypt area (µm2) | 6918 | 6544 | 7615 | 8535 | 486.1 | **<0.01** | 0.58 | 0.19 |
|  |  |  |  |  |  |  |  |  |
| **Ileum** |  |  |  |  |  |  |  |  |
| Goblet cells | 11.8 | 15.6 | 15.9 | 15.9 | 1.79 | 0.22 | 0.30 | 0.30 |
| Villous height (µm) | 317.9 | 333.6 | 334.4 | 357.2 | 10.46 | *0.06* | *0.08* | 0.74 |
| Crypt depth(µm) | 180.2 | 186.0 | 182.1 | 191.8 | 5.62 | 0.50 | 0.18 | 0.73 |
| VH:CD ratio6 | 1.8 | 1.9 | 1.9 | 1.9 | 0.07 | 0.41 | 0.48 | 0.85 |
| Villous area (µm2) | 36571 | 38533 | 37001 | 46354 | 2438.5 | *0.10* | **0.03** | 0.14 |
| Crypt area (µm2) | 7116 | 7307 | 7006 | 8312 | 411.0 | 0.28 | *0.08* | 0.18 |

1Least square means and pooled standard errors of the mean (SEM).

2CON/CON, non-probiotic supplemented sow/non-probiotic supplemented piglet; 3CON/PRO, non-probiotic supplemented sow/probiotic-supplemented piglet; 4PRO/CON, probiotic-supplemented sow/non-probiotic supplemented piglet; 5PRO/PRO, probiotic-supplemented sow/probiotic-supplemented piglet.

6VH:CD ratio, villous height:crypt depth ratio.