USPCE & NPB – Swine Research & Education Experience (SREE)
FINAL REPORT TEMPLATE

Project Title: The effects of iron supplementation prior to weaning on post-weaning piglet performance

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Scientific Abstract: Piglets weaned in a state of iron deficiency is high despite administration of iron early in life and are at increased risk of poor performance in the early post-weaning period. A study was conducted to assess piglet performance following an additional iron dose in the days just prior to weaning. From 24 litters, 72 piglet pairs, consisting of two piglets of the same sex and a weight difference of ≤ 1 kg, were selected at 4 days prior to weaning. One piglet received 200 mg iron injection and the other was administered an equivalent volume of saline. The 72 pairs were divided among 24 pens with 12 'iron' pig pens and 12 'control' pig pens. Pig body weight was collected once a week for four weeks. Blood samples were collected d-4 prior to the injections and at weaning to assess hematological status. At weaning, 'iron' piglets had increased white blood cell count ($P \leq .05$) and tended to have increased γ-Hydroxybutyric acid and packed cell volume ($P \leq .10$) when compared to d-4 blood sample values. Body weight at d-4 and weaning were similar between treatment groups, however, average daily gain was greater ($P = 0.01$) for control pigs. Iron-supplemented pigs had greater ($P = 0.03$) average daily gain from d 0-7 and a tendency ($P = 0.096$) for greater average daily feed intake. There were no differences in performance between groups beyond d7 post-weaning. The improved gain and feed intake of the supplemented pigs in the first week after weaning suggests that an additional dose of iron prior to weaning can contribute to a stronger start after weaning for young piglets.

Introduction: The weaning period is a very stressful portion of a piglet's life with many environmental and physiological changes occurring. It is critical for efficient pork production that these animals do not fall behind in the post-weaning phase. Within the first few weeks after weaning, it is common to see low feed intake (i.e. <200 g/d) which can negatively influence daily gain in the immediate post-wean phase and even further into the grow-finish phase, resulting in more resources to achieve the same level of growth. This situation is not desirable, and research was conducted to test a practical strategy producers could do to defend against this issue of lower production. Pigs are born with iron reserves sufficient to meet daily demand for 3 – 4 days thus depending on sow milk to meet iron need; however, sow milk is low in iron providing only about 10% of total daily iron need (NRC, 2012). As a result, it is common practice to administer 100 – 200 mg iron within 2 days of birth to all piglets with little adjustment for piglet birth weight. Perri et al (2018) report that in 19 of 20

commercial farms tested, 35% or more of piglets were deemed deficient in iron at weaning. Piglets who enter the post-weaning phase with poor hematological status often encounter low growth rates (Bhattarai and Nielson, 2015). In order to counteract this problem, an additional dose of iron was deemed a potential solution to boosting a piglet's hematological status to allow for optimal growth. This project focused on the effects of iron supplementation prior to weaning on piglet's post-weaning performance.

Objective: The objective of this experiment was to evaluate if an additional dose of iron four days prior to weaning would benefit piglets and reduce the effects of stress caused by weaning and improve performance in the post-wean phase.

Materials & Methods:
Piglet selection began 4 days prior to weaning (d-4) within a farrowing group of 24 sows at the SDSU Swine Research and Education Facility. Within each litter, piglets were paired based on weight and sex. A pair consisted of two piglets of the same sex and a weight difference of less than or equal to 1 kilogram. One piglet received the additional dose of iron through intramuscular injection and the other received an equivalent volume of saline again through intramuscular injection to act as the control group. The piglets were then given pair numbers with a colored ear tag. A red ear tag signified that the piglet received the additional dose of iron and a white ear tag signified that the piglet received the injection of saline. A total of 144 piglets (72 pairs) were selected to take part in the project.

After weaning the piglets were transferred to the SDSU Animal Science Complex to be housed for 4 weeks during the duration of the trial. The 72 pairs were divided among 24 pens and each held 6 piglets given the same treatment with alternating pens. Pairs were separated into 2 pens, example being pig pairs 1 through 6 would be housed in pens 1 and 2 with pen 1 containing the control pigs and pen 2 containing the supplemented pigs. Pig body weight was collected once a week for the four weeks. Blood samples were collected d-4 prior to the injections of iron or saline and at weaning. These blood samples were gathered to confirm the iron injection was adequately administered and metabolized. Phase changes were based on time rather than budget where all piglets received the same diet throughout the trial. Pigs were allowed ad libitum access to feed according to a 3-phase feeding program. Phases 1 and 2 were 7 days in length while phase 3 was 14 days in length. When piglet weights were recorded feeder weights were recorded as well to be able to calculate total feed intake of the piglets in the pen. Leftover feed remained in feeders with the next week's feed added on top.

Results and Discussion:
Results are reported by diet phase. At weaning the piglets that were treated with iron had increased white blood cell count ($P \leq .05$) and tended to have increased γ-Hydroxybutyric acid (HGB) and packed cell volume (PCV) ($P \leq .10$) when compared to d-4 blood sample values. In the control group there was no statistical difference in white blood cell count, HGB, and PCV between d -4 and weaning. Both groups had no significant difference in red blood cell count between d-4 and d 0.

Body weight at d-4 and weaning were similar between treatment groups, however, there was a difference ($P = 0.01$) in average daily gain with the control pigs having greater daily gain during the pre-weaning phase than the supplemented pigs. Despite a slower daily rate of gain in the pre-weaning phase, the supplemented group had higher ($P = 0.03$) average daily gain in the period from d 0-7 when compared to the control group. The treated group also exhibited a tendency ($P = 0.096$) for higher

average daily feed intake with no statistical difference (P = 0.167) between groups in their feed to gain ratio. In the period d 7-28, no statistical differences between the piglet groups (P > 0.39) were determined. Over the entire study, there was no statistical differences documented.

This information is important because it demonstrates that the additional dose of iron was beneficial to the piglets in the early post-weaning phase as evidenced by the improved feed intake and weight gain. While these positive differences were not retained over the entire 4-week trial and weight of pigs in the two treatments were similar at the end of the project, the first week post-weaning is deemed a critical tipping point for weaned pigs. The improved gain of the supplemented pigs in the first week after weaning suggests that an additional dose of iron injected intramuscularly d-4 can provide positive outcomes in alleviating post-wean growth lag allowing piglets to have a stronger start after weaning.

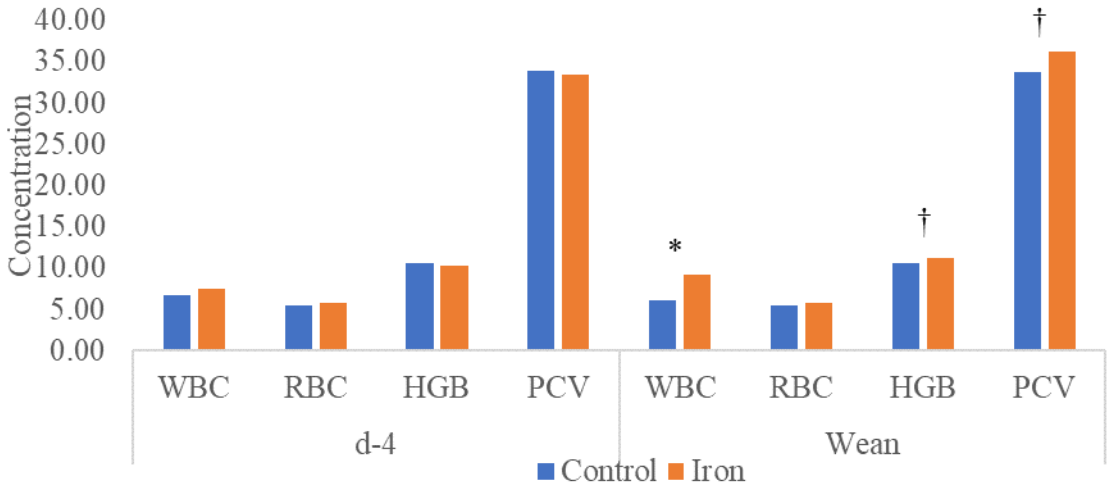

Figure 1. Blood profile of piglets before and 4 days after iron supplementation.

* Indicate significant differences at $P \leq 0.05$ using Tukey's means separation test. .

† Indicate tendencies ($0.05 < P \leq 0.10$) using Tukey's means separation test.

WBC= White blood cells (K/ul).

RBC= Red blood cells (M/ul).

HGB= γ-Hydroxybutyric acid (g/dl).

PCV= Packed cell volume (%).

Table 1. Iron Supplementation prior to weaning and post-weaning piglet performance.

Item	CONTROL	IRON[1]	SEM	P-value[2]
BW d-4, kg	4.84	4.82	0.055	0.840
BW d0, kg	6.30	6.18	0.071	0.221
ADG d-4 to d0, kg	0.17	0.15	0.003	0.012
Period, d0 - 7				
BW d7, kg	7.23	7.25	0.083	0.827
ADG, kg	0.13	0.15	0.007	0.030
ADFI, kg	0.16	0.17	0.005	0.096
F:G	1.24	1.13	0.056	0.167
G:F	0.83	0.89	0.031	0.139
Period, d7 - 14				
BW d14, kg	9.77	9.80	0.122	0.837
ADG, kg	0.36	0.36	0.010	0.938
ADFI, kg	0.38	0.38	0.009	0.927
F:G	1.04	1.04	0.020	0.954
G:F, kg/kg	0.96	0.96	0.017	0.973
Period, d14 - 21				
BW d21, kg	13.79	13.83	0.175	0.865
ADG, kg	0.57	0.58	0.015	0.951
ADFI, kg	0.73	0.74	0.011	0.443
F:G	1.27	1.28	0.019	0.606
G:F, kg/kg	0.79	0.78	0.013	0.559
Period, d21 - 28				
BW d21, kg	17.85	17.72	0.225	0.689
ADG, kg	0.58	0.55	0.020	0.396
ADFI, kg	0.87	0.86	0.013	0.429
F:G	1.52	1.56	0.042	0.485
G:F, kg/kg	0.67	0.65	0.021	0.521
Period, d0 - 28				
ADG, kg	0.41	0.41	0.007	0.992
ADFI, kg	0.53	0.54	0.006	0.638
F:G	1.30	1.31	0.015	0.646
G:F, kg/kg	0.77	0.77	0.010	0.634

[1]Additional Fe dose 4d prior to weaning.
[2]Significant differences at $P \leq 0.05$ using Tukey's means separation test.
Tendencies ($0.05 < P \leq 0.10$) using Tukey's means separation test.

References:

Bhattarai, S., and Nielsen, J.P. 2015. Early indicators of iron deficiency in large piglets at weaning. J. Swine Health Prod. 23:10-17.

NRC. 2012. Nutrient requirements of swine: 11th revised edition. The National Academies Press, Washington, DC.

Perri, A., Friendship, R.M., Harding, J.C.S., and O'Sullivan, T.L. 2016. An investigation of iron deficiency and anemia in piglets and the effect of iron status at weaning on post-weaning performance. J. Swine Health Prod. 24:10-20.

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Student Statement:
Research Experience & Education:

Growing up I never thought I would get involved with research, let alone swine research. I grew up on a beef cattle operation and was never really exposed to swine production until I came to SDSU. I have deep respect for research as it is essential for the world of agriculture to grow and continue producing food products for the growing world population. The ability to take part in this project expanded my horizons into the pork industry and allowed me to have hands on experience in a production-based setting. I never thought I could get so attached to pigs, but every day I miss the piglets on my project. I loved going in to feed, care, and watch them grow into the feeder piglets they were when this project ended. It gave me an immense sense of pride to know that my small project would be benefiting producers, which is something I want to be able to do in my future career. I want to see producers succeed in raising whatever livestock species they have. I am currently looking for a future career in feed or pharmaceutical sales in the livestock productions industries. Taking part in this project allowed me to have experience I can have in my toolbelt for the ideal future career. I would not trade this experience for anything!

Final Report is due to cvangenderen@usporkcenter.org by December 31, 2020.