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# Hemoglobin levels in organic piglets

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## Farm description

- Organic production
- Approx 450 sows
- Weaning age
- *M. Hyopneumoniae* +?
- Sells 95%



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## Background

Strong robust piglets are a prerequisite for good production results

Iron situation differs from conventional farming

Necessary<sup>1,2</sup> or not<sup>3,4</sup>

- Piglets require 7mg of iron/day, NOT covered by milk intake
- Iron plays a role in erythropoiesis and oxygen transport
- Critical component of hemoglobin and myoglobin<sup>5</sup>
- Iron plays a role in electron transfer, DNA synthesis and many other intracellular processes<sup>6</sup>
- Enhances gut health<sup>7</sup>

1: Szabo P., Bilkei G. 2002, Iron deficiency in outdoor pig production: Short communication, Journal of veterinary medicine series A, Vol 49, issue 7

2: Heidbüchel, K., Raabe, J., Baldinger, L., Hagmüller, Bussemas, R., 2019: One iron injection is not enough – iron status and growth of suckling piglets on an organic farm, Animals, 9(9):651

3: Walker, E. A., Taylor J. H. 1965: The effect of parenterally administered iron upon outdoor-reared piglets, Animal Science, Vol 7, issue 1, pp. 1-6

4: Kleinbeck, S. N., McGlone, J. J. 1999, Intensive indoor versus outdoor swine production systems: genotype and supplemental iron effects on blood hemoglobin and selected immune measures in young pigs, Journal of animal Science, Vol 77, issue 9, pp. 2384-2390

5: Zimmerman, J. J., Karriker, A. R., Schwartz, K. J., Stevenson, G. W., Zhang J., 2019, Diseases of Swine, 11. ed.

6: Morris, C. J., Earl, J. R., Trenam C. W., Blake, D. R., 1995, Reactive oxygen species and iron – a dangerous partnership in inflammation, Int. J. Biochem., 27, pp. 109-122

7: Yutian, P., Shuhui L., Haitao, X., Xiaofeng, Z., Yizhen, W., Huahua, D., 2018, Iron promotes intestinal development in neonatal pigs, Nutrients 10(6), 726.

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## Background<sup>5</sup>

Anemia: Decrease of the number of red blood cells or the concentration of hemoglobin in them

Anemia classification

- Defective erythropoiesis
  - Anemia of chronic disease
  - Nutritional deficiencies (iron, copper, vitamin B12)
  - Viral infections (PRRSV, PCV2)
- Hemolytic
  - Autoimmune: neonatal isoerythrolysis
  - Erythrocyte parasitism: *Mycoplasma suis*
  - Erythrocyte fragmentation
    - DIC, vasculitis
- Hemorrhagic
  - Hemorrhagic enteropathies, dysentery, Lawsonia
  - Gastric ulceration
  - Hemorrhagic bowel syndrome, volvulus
  - Parasitisms
    - External (lice)
    - Internal (*Trichuris* and *Strongyloides*)
  - Clotting deficiency (vitamin K deficiency)
  - Thrombocytopenia

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<sup>5</sup>: Zimmerman, J. J., Karriker, A. R., Schwartz, K. J., Stevenson, G. W., Zhang J., 2019, Diseases of Swine, 11. etd.

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## Diagnostics

- Hemoglobin measurement with Haemocue
  - 3 stages of iron deficiency anemia
    - 1: total body iron is diminished, but erythropoiesis and synthesis of Hb is not affected
    - 2: iron supply to the erythropoietic bone marrow is inadequate, but Hb synthesis is not affected
    - 3: Iron supply is insufficient to maintain normal blood Hb synthesis <sup>8</sup>
- Age
  - Feasible sampling time vs normal sampling time
  - Development of hemoglobin during the first weeks
- Anemia cut-off
  - 8g/dl (80g/l)<sup>9</sup>

8: Hastka, J., Lasserre J. J., Schwarzbeck, A., Hehlmann, R., 1994, Central role of zink protoporphyrin in staging iron deficiency, Clin. Chem., 40 (5), pp. 768-773

9: Chen, X., Zhang, X., Zhao, J., Tang, X., Wang, F., Du, H., 2019, Split iron supplementation is beneficial for newborn piglets, Biomedicine & Pharmacotherapy, 120.

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## Results

- Piglets approx 7 days old
- Randomly picked
- 22% are or are close to being anemic

Nr.	ID	Hæmoglobin g/l
1	So 285	54
2	-	100
3	-	108
4	-	100
5	-	82
6	-	117
7	-	109
8	-	124
9	So 439	128
10	-	84
11	-	98
12	-	133
13	-	84
14	-	114
15	-	100
16	-	108
17	-	128
18	-	98

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## Discussion

- Relevant causes of anemia
  - Defective erythropoiesis
    - Nutritional deficiencies of Iron or Copper
      - Copper promotes iron absorption and is essential for incorporation of iron in hemoglobin
    - Viral infections (PRRSV, PCV2)
  - Hemolytic
    - Erythrocyte parasitism: *Mycoplasma suis*
  - Hemorrhagic
    - Gastric ulceration
    - Hemorrhagic enteropathies: Dysentery, Lawsonia
    - Parasitisms
      - External: Lice
      - Internal: Trichuris, Strongyloides

## Discussion

- Organic production factors:
  - Age<sup>10</sup>
  - Sow-soil access can increase sow level and thereby the piglet level at birth<sup>11</sup>
    - Higher level than conventional piglets? Due to a higher starting point?
  - (seasonal variation)
- More sensitive measurement parameters
  - Underestimation?
  - RBC size heterogeneity (red blood cell distribution width, RDW)<sup>12,13</sup>
- Dose
  - Oral versus parenteral<sup>14</sup>
    - Low expression of duodenal iron transporters in the first days of life
  - How much should be given?
    - Excess of iron exceeds iron binding capacity of transferrin – free iron in serum – catalyses the formation of reactive oxygen species
  - Hepcidin-25<sup>15</sup>
    - Iron regulatory peptide hormone excreted by the liver
    - Can potentially act as a guide for optimal levels of intake

10: Ventrella, D., Dondi, F., Barone, F., Serafini, F., Elmi, A., Giunti, M., Romagnoli, N., Forni, M., Bacci, M. L., 2017, The biomedical piglet: establishing reference intervals for hematology and clinical chemistry parameters of two age groups with and without iron supplementation, BMC Veterinary Research, 13:23

11: Bhattarai, S., Framstad, T., Nielsen, J. P., 2019, Association between sow and piglet blood hemoglobin concentrations and stillbirth risk, Acta Veterinaria Scandinavica, 61:61

12: Bhattarai, S., Nielsen, J. P., 2015, Early indicators of iron deficiency in large piglets at weaning, Journal of Swine Health and Production

Bog

13: McClure, S., Custer, E., Bessman J. D., (1985), Improved detection of early iron deficiency in nonanemic subjects, JAMA, (253), pp. 1021-1023

14: Lipinski, P., Strynski, R. R., Canonne-Hergaux, F., Tudek, B., Olinski, R., Kowalczyk P., Dziaman, T., Thibaudeau, O., Gralak, M. A., Smuda, E., Wolinski, J., Uzinska, A., Zabielski, R., 2010, Benefits and risks of iron supplementation in anemic neonatal pigs, The American Journal of Pathology,

15: Starzynski, R. F., Laarakkers, C. M. M., Tjalsma, H., Swinkels, D. W., Pieszka, M., Stys, A., Mickiewicz, M., Lipinski, P., 2013, Iron supplementation in suckling pigs: how to correct iron deficiency anemia without affecting plasma hepcidin levels, PLoS One, 8(5)



## Recommendations

- Iron injection at castration
  - 1ml Solofer (200mg of ferrihydroxide dextran)
- Follow up test
- Further diagnostics if the levels had not increased
  - PCV2, PRRS
  - Mycoplasma suis
  - Stomach ulcer check
  - McMaster on manure from sows
  - Copper
- Retrospective changes I would have liked to make
  - Comparable piglet age
  - RDW
  - Plasma hencidin measurements

Nr.	ID	Hæmoglobin g/L
1	So 493	144
2		140
3		164
4		124
5		140
6		
7	So 579	139
8		132
9		123
10		125
11		128
12		119
13		
14	So 640	145
15		136
16		133
17		147
18		149
19		
20		

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## References

- 1: Szabo P., Bilkei G. 2002, Iron deficiency in outdoor pig production: Short communication, Journal of veterinary medicine series A, Vol 49, issue 7
- 2: Heidbüchel, K., Raabe, J., Baldinger, L., Hagmüller, Bussemas, R., 2019: One iron injection is not enough – iron status and growth of suckling piglets on an organic farm, *Animals*, 9(9):651
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- 13: McClure, S., Custer, E., Bessman J. D., (1985), Improved detection of early iron deficiency in nonanemic subjects, *JAMA*, (253), pp. 1021-1023
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- 15: Starzynski, R. F., Laarakkers, C. M. M., Tjalsma, H., Swinkels, D. W., Pieszka, M., Stys, A., Mickiewicz, M., Lipinski, P., 2013, Iron supplementation in suckling pigs: how to correct iron deficiency anemia without affecting plasma hepcidin levels, *PLoS One*, 8(5)