Pork Industry Handbook: Baby Pig Anemia
Michigan State University
Cooperative Extension Service

Authors:
Elwyn R. Miller, Michigan State University
Duane E. Ullrey, Michigan State University
Reviewers:
Gene White, University of Nebraska
John Ficken, Ionia, Missouri

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pork industry handbook

COOPERATIVE EXTENSION SERVICE • MICHIGAN STATE UNIVERSITY

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Introduction

Baby pig anemia has been a potential problem since swine producers first farrowed litters in confinement, denying the nursing pig access to iron in the soil. Iron is a vital component in forming hemoglobin, a protein comprising about one-third the weight of the red blood cell. Hemoglobin within the red blood cell has the unique function of carrying oxygen from the lungs to the tissues of the body in support of cellular metabolism and transporting carbon dioxide resulting from cellular metabolism back to the lungs.

When there is a deficiency of iron, the baby pig cannot synthesize an adequate amount of hemoglobin. A blood sample taken from the iron-deficient, anemic pig will have fewer red blood cells than normal, and these red blood cells will be smaller and lighter in color than normal because of low hemoglobin content (Table 1). Thus, baby pig anemia is a condition of the blood in which the oxygen-carrying capacity is greatly reduced, and this condition is generally due to iron deficiency.

Causes of Iron Deficiency Anemia

Iron deficiency develops rapidly in nursing pigs reared in confinement because of (1) low body storage of iron in the newborn pig, (2) low iron content of sow's colostrum and milk, (3) elimination of contact with iron from soil, and (4) the rapid growth rate of the nursing pig. Let's consider the impact of each of these causes of iron deficiency.

Table 1. The typical blood picture of normal and anemic baby pigs.

Measure	Normal	Anemic
Hemoglobin, grams/100 milliliters	12	5
Hematocrit, % RBC (red blood cell) in blood	35	17
RBC count, millions/cubic millimeter	5	3
RBC size, cubic microns	70	55
RBC hemoglobin concentration, %	35	30

Low body storage of iron in the newborn pig. The baby pig is born with a total of about 40 mg. of iron in his body, most of which is present in the form of hemoglobin in blood and storage forms in the liver. With an iron requirement of about 7 mg. daily to maintain blood hemoglobin level in the normally growing baby pig, it is apparent that without supplemental iron, body stores will not last very long. Attempts to increase body iron stores in the fetal pig by administering large amounts of iron to the sow in late gestation, either in her feed or by injection, have not been successful. The data in Table 2 demonstrate the low initial body iron storage and high iron requirement of the pig compared to other domestic animals and man.

Low iron content of sow's colostrum and milk. Sow's colostrum and milk is a good source of all nutrients the baby pig is known to require, with the exception of iron. The concentration of iron in colostrum is seldom greater than 2 ppm, and in milk is lower, averaging about 1 ppm. Because of the low concentration of iron in sow's milk, the baby pig cannot obtain more than about 1 mg. of iron daily from this source. This falls far short of his requirement for 7 mg. daily.

Table 2. Body tissue iron of different species.

Species	PPM of iron in fat-free body tissue	
	Newborn	Adult
Pig	29	90
Cat	55	60
Rabbit	135	60
Human	94	74

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Attempts to increase significantly the iron concentration in sow's milk by feeding high levels of various forms of iron in the sow's late gestation and lactation diet or by injecting the sow with a large amount of iron-dextran late in gestation or during lactation have not been successful.

Elimination of contact with iron from soil. The baby pig is equipped with a snout with which he is able to root almost as soon as he is born. Thus, under natural conditions he could obtain his iron from the soil. When the pig is placed on concrete or reared in confinement in a central farrowing facility, he is denied this opportunity.

Rapid growth rate of the nursing pig. Compared to other domestic mammals, the baby pig has a tremendous ability to grow. This is demonstrated in Figure 1, in which the capabilities of the pig, lamb, calf, colt and child to increase their birth weight during the first 6 weeks of life are compared. This rapid growth of the nursing pig with the resulting increase in plasma volume demands a high intake of iron to maintain adequate hemoglobin. The data in Table 3 demonstrate the greater susceptibility of the baby pig to anemia than the nursing lamb or calf reared in confinement.

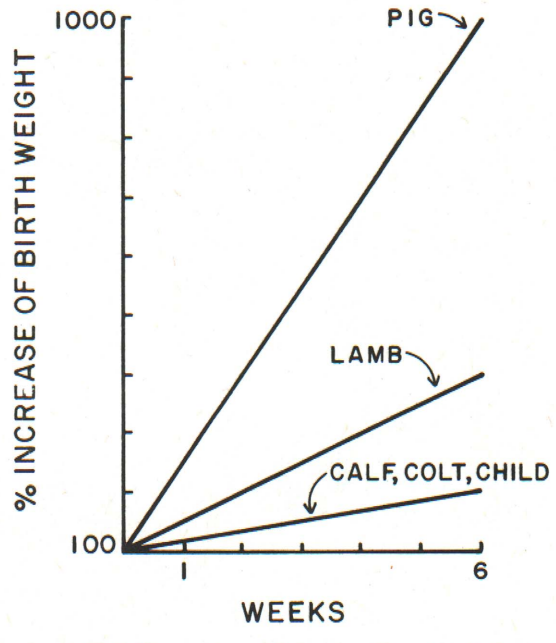

Figure 1. Relative preweaning growth rate of pig, lamb, calf, colt and child.

Table 3. Hemoglobin values at 3 weeks of age of nursing pigs, lambs and calves that received either no supplemental iron or an injection of iron-dextran early in life.

Species	Untreated	Iron injected*
Pig	4.0	10.7
Lamb	6.2	10.8
Calf	9.0	9.8

*Intramuscular iron-dextran injection supplied the following milligrams of iron: pig, 100; lamb, 375; calf, 500.

Signs of Iron Deficiency Anemia

Iron deficiency may vary from a borderline chronic anemia to acute anemia. Signs of chronic anemia are poor growth, listlessness, rough hair coat, wrinkled skin and a paleness of the mucous membranes. A characteristic sign of a more acute anemia is labored breathing or a spasmodic movement of the diaphragm muscles following exercise, and this is referred to as "thumps." In the most acute state, fast growing pigs may die suddenly from a shortage of oxygen. Anemia also lowers the resistance of the pig to disease and respiratory problems, and enteritis may appear more frequently in chronically anemic pigs.

Necropsy findings in anemic pigs include enlargement of the heart and spleen, fluid in the chest and abdomen, and thin watery blood. Paleness of the mucous membranes may also be seen.

In addition to these signs, white pigs which are 2 or 3 weeks old and anemic do not have their characteristically pink ears and snout. This may be seen before any other signs are evident. If this is observed, anemia may be verified by determining hemoglobin level in a blood sample taken from an ear vein. If the hemoglobin value is below 9 g./100 ml., the pig is borderline anemic and needs supplemental iron.

Prevention of Iron Deficiency Anemia

There are numerous ways in which supplemental iron may be administered to baby pigs either (1) orally (by mouth) or (2) parenterally (by injection) to meet their needs for iron (Figure 2). Much of the oral iron is not absorbed and is excreted in the feces. That which is absorbed appears first as plasma iron (transferrin) which is transported to the bone marrow for the production of red blood cell hemoglobin, to muscle for myoglobin which aids in muscle metabolism, to liver and spleen for iron storage as ferritin and hemosiderin, and to all tissues of the body for iron enzymes which are necessary for cellular metabolism. Intramuscularly injected iron-dextran is picked up from the muscle by nearby lymph nodes and released into plasma intact as iron-dextran and either used for hemoglobin or myoglobin formation or stored as ferritin or hemosiderin.

Oral iron. Supplemental iron may be administered orally through (a) placing soil in the farrowing pen, (b) swabbing the sow's udder with an iron solution, (c) dosing the pig with iron pills, paste or liquids, (d) placing liquid, moss, meal, pellet or block preparations in the creep area, or (e) feeding high levels of iron in the sow's diet and allowing pigs access to sow's feed and feces.

Soil. This is an effective method of providing iron if the soil is replaced frequently and is free of swine parasite eggs. If the creep floor is partially slotted, place the soil on the solid concrete portion of the pen. If the creep floor is totally slotted, place the soil in a shallow tray. The disadvantages of this method are the labor involved and the difficulty in obtaining soil when the ground is frozen.

Udder application. If an iron solution is swabbed on the sow's udder daily throughout lactation, this will effectively prevent anemia. However, the labor required is too much for most of the modern swine producers.

Dosing. Weekly administration of iron pills, paste or liquid preparations will prevent anemia. Disadvantages of this method are the labor involved in the repeated dosing and lack of assurance that the pig has consumed the dose.

Placing iron preparations in the creep. A number of iron preparations on the market are designed to be placed in the creep area of the farrowing pen. These consist of iron solutions with special dispensers, iron salts mixed with sphagnum or peat moss, iron salts mixed with sweetened energy sources in meal or pellet form, and iron blocks designed to be fastened to the dividing wall between adjacent farrowing pens. Most of these commercial iron

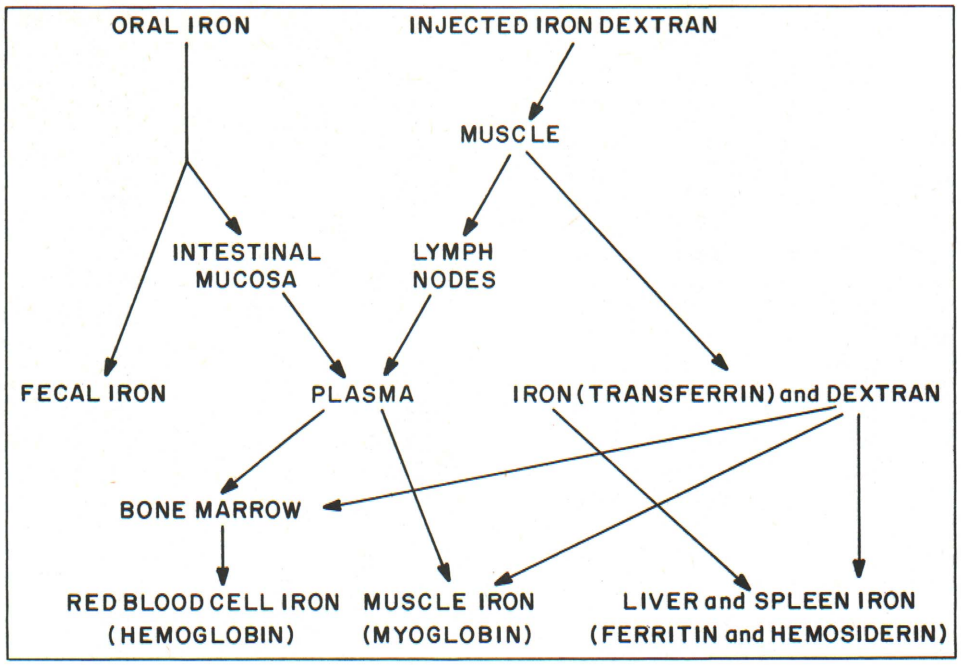

Figure 2. Utilization of oral and injected iron.

preparations are quite effective in preventing anemia if they are properly placed in the creep area where pigs will consume them. The effectiveness of the iron blocks is questionable since some of the pigs may not consume enough of the blocks to obtain the required amount of iron.

The swine producer himself can make a very effective iron source by mixing the following:

Sow's lactation ration	88%
Ferrous sulfate	10
Corn oil	2
	100%

If this is placed in a shallow tray in the creep, pigs will readily consume it and will maintain adequate hemoglobin levels. Data are presented in Table 4 on the growth and hemoglobin levels of pigs receiving this preparation or commercial iron preparations placed in the creep area.

The chemical form of the iron used in an oral iron source is very important, as shown in Table 5. Ferric oxide and ferrous carbonate have frequently been used in commerclal trace mineral mixes for young pigs, but they are very poorly available forms of iron. Ferrous sulfate is the

Table 4. Growth and hematology of pigs receiving iron sources placed in the creep area of the farrowing pen.

Iron source	Hemoglobin, g./100 ml.		Bodyweight, lb.	
	3 days	3 weeks	3 days	3 weeks
Iron pellet	8.2	11.1	3.6	11.8
Iron meal	8.2	8.5	3.7	13.0
Iron-peat moss	7.9	9.9	4.2	12.8
Iron-lactation ration	8.2	11.0	4.4	13.6
Iron solution	7.7	10.8	3.8	14.1
Iron-dextran*	8.3	10.7	3.7	13.6

*150 mg. of iron from intramuscular injection of iron-dextran at 3 days of age. Included for comparison. Not given orally.

Table 5. Availability of iron from different chemical forms.

Available	Poorly available	Unavailable
Ferrous sulfate (mono-di- or hepta-hydrated)	Ferrous carbonate	Ferric oxide
Ferrous ammonia sulfate	Ferric orthophosphate	
Ferrous chloride	Ferric pyrophosphate	
Ferrous fumarate		
Ferrous gluconate		
Ferric ammonium citrate		
Ferric choline citrate		
Ferric glycerophosphate		
Ferric chloride		
Ferric sulfate		

most frequently used form because it is quite available and economical. The monohydrate form of ferrous sulfate ($FeSO_4 \cdot H_2O$) has physical properties which make it suitable for mixing with other dietary ingredients, and the iron is equally as available to the pig for hemoglobin formation as that from the heptahydrate form ($FeSO_4 \cdot 7H_2O$). Cost of iron from either commercial source is similar.

Indirectly from feed and feces of sows fed high levels of iron. As stated earlier, there is little increase in transfer of iron to the fetus or sow's milk by feeding high levels of iron in the sow's diet. However, pigs may obtain an adequate amount of iron from the sow's feed and feces when this is done. Organic or chelated forms of iron have no particular advantage over ferrous sulfate in this regard. Disadvantages include the inefficient use of iron and dependence on uncertain and unsanitary means of providing the iron.

Parenteral iron. Supplemental iron to prevent anemia may also be administered by injection. For iron injections to be effective, one must use (a) the proper form of iron, (b) the proper amount of iron, and (c) the proper method of iron administration. Sanitary procedures should be used to avoid production of abscesses.

Form of iron. The form of iron must be one that (1) is effectively utilized for hemoglobin formation by the pig throughout the nursing period from a single injection, (2) is compatible with fluids and tissues of the body and in no way toxic at necessary levels of administration, (3) does not cause pain at the site of injection, and (4) can be administered in a minimal volume of fluid which is of the proper viscosity to allow the use of a small needle and yet not result in excessive "run back." Iron-dextran and iron-dextrin complexes, when properly produced, meet all these criteria and are the best forms on the market.

Amount of iron. The proper amount of iron to inject depends on the age at which the pigs will be weaned. If pigs are to be weaned by 3 weeks of age, 100 mg. of iron is an adequate amount to inject. If pigs are to be weaned beyond 3 weeks of age, 150-200 mg. of iron should be injected.

Method of iron injection. Although it has been demonstrated that iron injections may be given intramuscularly, intraperitoneally or subcutaneously, the preferred method is intramuscularly. Injection may be made in the ham or neck muscle. The site of injection should be precleaned with 70% ethyl alcohol. The injectable iron is drawn into and dispensed from a clean plastic 10-20 ml. syringe with a 20-gauge disposable needle, 1/2 to 1 in. long. To help prevent run back of iron from the injection, the skin may be forced slightly to one side with the thumb just before making the injection. Proper method of injection is demonstrated in Figure 3. Iron injections may be made any time within the first 3 to 4 days of life. Although a single injection is usually adequate, in instances of especially heavy milking sows with rapidly growing pigs that do not consume creep feed, a second iron injection may be necessary before weaning.

Another method of preventing iron-deficiency anemia should be mentioned. It is the oral dosing of newborn pigs with iron-dextran. When the newborn pig receives an oral dose of 100-200 mg. of iron from iron-dextran, the iron is effectively absorbed. Recent research indicates that this single dose is nearly as effective as an iron injection if dosage occurs within the first 6 hours of life. However, this method has the disadvantages of a limited dosage period and the likelihood of greater waste of iron-dextran by oral dosing as compared to injection.

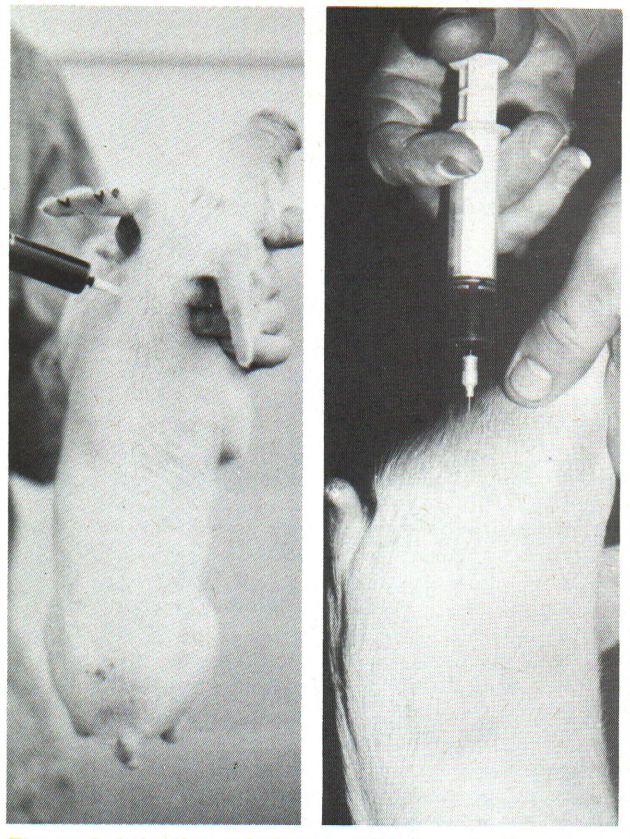

Figure 3. Injecting a baby pig with iron-dextran.

Iron Toxicity

Although iron is an essential nutrient for the pig and is critical in preventing anemia, excessive amounts of iron can be toxic. Oral iron in general is quite safe because of the protection provided by the intestinal barrier. However, a single oral dose of ferrous sulfate supplying 600 mg. of iron/kg. of bodyweight produced signs of iron toxicity within 3 hours. These signs included incoordination, shivering, heavy breathing and convulsions. In some pigs there was profuse diarrhea; and necropsy findings included damage to the gastric and intestinal mucosa. High level feeding of iron (5,000 ppm in diet) results in rickets in young weaned pigs consuming a diet that is marginal in phosphorus.

Injection of some forms of iron, which may be quite safe orally, can cause iron toxicity and death. This is why it is important to use an injectable iron form such as iron-dextran which has been shown to have a high margin of safety. There have been instances of death following typical iron-dextran injections. However, in most cases these have been due to selenium-vitamin E deficiency or improper administration of the iron.

Other Causes of Anemia

Baby pig anemia has been experimentally produced by nutritional deficiencies other than iron, including copper and pyridoxine (vitamin B_6). However, sow's milk is quite adequate in these nutrients, and the likelihood of nursing pigs being deficient in one of these nutrients is very remote. Pigs from sows consuming moldy feed or deficient in vitamin K may lose an excessive amount of blood from the umbilical cord at birth and quickly become anemic. Addition of 2-4 g. of vitamin K (menadione) per ton of sow's diet will help prevent this. Also, internal parasites may cause intestinal damage and loss of blood. None of these causes of anemia would be likely to occur in well-managed herds reared in confinement. Thus, iron is the one nutrient of constant concern in the prevention of baby pig anemia.