IRON SUPPLEMENTATION IN PIGLET ANAEMIA

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SUMMARY

A total of 111 Large White/Berkshire cross piglets in 14 litters was used for iron supplementation studies. Of 87 piglets supplemented with iron, 30 received *Ferri et Ammonii Citrate* orally, and 57 iron-dextran intramuscularly. Twenty-four untreated piglets were kept as controls.

The blood haemoglobin levels fell within four days after birth by 30 per cent. or more, and reached the lowest level usually by the second or third week.

Symptoms of anaemia were diarrhoea, paleness, listlessness and respiratory distress.

Oral therapy with *Ferri et Ammonii Citrate* was not as effective as parenteral administration of iron-dextran in restoring the haemoglobin levels.

The ease of administration, rapidity of response and the need for only one treatment favour the use of iron-dextran in the prevention and treatment of piglet anaemia.

Because sow's milk is a poor source of nutritional iron, it is important that piglets should be introduced at the earliest age possible to iron-supplemented creep feeding.

I. INTRODUCTION

Since the first description of piglet anaemia by McGowan and Crichton (1923), considerable attention has been given to this condition. The present knowledge of the aetiology, clinical symptoms, pathological manifestations, haematological changes and treatment has been reviewed by Seamer (1956).

Briefly, the disease has been described as microcytic hypochromic anaemia which affects mainly rapidly growing piglets during the first few weeks of life. Clinical signs of the disease are abnormal pallor, oedema of the eyelids, listlessness, reluctance to move, respiratory embarrassment at the slightest exertion, and diarrhoea. Death may occur suddenly from anaemia when the haemoglobin levels fall below the critical value, or from intercurrent respiratory infection.

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The pathological changes are principally a swollen enlarged liver with centrilobular fatty degeneration and necrosis, enlargement and dilatation of the heart (Shanks 1953), hydropericardium, pericarditis and haemopericardium (McGowan and Crichton 1923, 1924; McGowan 1924; and Doyle, Mathews, and Whiting 1928).

Most workers agree that piglet anaemia is essentially a nutritional iron deficiency, mainly because of the beneficial results obtained with various iron preparations in its treatment and prophylaxis. On the other hand, Howie, Biggar, Thomson, and Cook (1949) encountered anaemia in piglets given ample doses of iron during studies on pig housing, especially in those farrowed in cold, damp and draughty indoor pens with cold uninsulated floors. Brooksbank (1954) suggested copper deficiency as one of the causes. This is to some extent supported by the work of Gubler, Lahey, Chase, Cartwright, and Wintrobe (1952), who found that copper deficiency causes abnormalities in the iron metabolism of swine. Köhler (1956 *a,* 1956 *b,* 1957), on the basis of a definite shift in the serum albumin and gamma globulin ratio and the presence of sufficient iron in anaemic piglets, regarded deficiency of essential amino-acids as a more important factor than iron deficiency in the genesis of this disease.

In the treatment of piglet anaemia, various iron preparations, usually administered by the oral route, have been advocated. In his review, Seamer (1956) listed a number of preparations which have been used, viz. ferric oxide (to the sow), dialysed iron, ferric chloride, ferric citrate, ferric sulphate, iron pyrophosphate, reduced iron and an iron-dextran complex. Of these preparations, iron-dextran is the most recent to come into use, following initial experiments by Barber, Braude, and Mitchell (1955 *a*), Brownlie (1955), and later by other workers (McDonald, Dunlop, and Bates 1955; Birk-Sorenson and Christensen 1956; Christensen 1956; Behrens 1957; Dale and MacKay 1958; and Gwatkin and L'Ecuyer 1959). It is administered parenterally and has the advantage that the iron is readily absorbed and utilized.

At the time when treatment of our experimental piglets became imperative, iron-dextran was not available. *Ferri et Ammonii Citrate* was used in the belief that it was more readily absorbed than the other forms available. Subsequently, iron-dextran* was tested in several litters.

This paper briefly discusses and compares the value of the two iron compounds in the treatment and prevention of piglet anaemia, and also includes a brief note on treatment with copper sulphate.

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* An iron-dextran compound released by Benger Laboratories Ltd., Cheshire, under the name "Imferon" and containing 50 mg iron per ml as ferric hydroxide, was made available by the courtesy of Fisons Chemicals Ltd., Sydney.

II. PROCEDURE

A total of 111 Large White/Berkshire cross piglets in 14 litters, reared with their dams at this Institute, was used for this study. The piglets were housed in concrete pens 15 ft x 9 ft with no access to soil up to the weaning age of 6–8 weeks. The sows were fed a dry mixture, comprising crushed sorghum, wheat and maize, meatmeal, livermeal, lucerne chaff, dried buttermilk and bran, with added ground limestone, salt and a vitamin A supplement. The mixture contained 0·056–0·084 per cent. iron. The piglets had unrestricted access to the dam's feed and generally started to nibble some dry feed between the third and fourth weeks of age.

They were weighed at birth and in most cases weekly thereafter until weaning. Haemoglobin determinations were made in a Lumitron colorimeter on blood drawn from the anterior vena cava according to the technique of Carle and Dewhirst (1942). The haemoglobin level was taken as an indication of the iron status.

In 65 piglets, the first haemoglobin levels were determined on blood samples obtained at or within 12 hours of birth. In the remaining 46 piglets, it was done at the age of seven days. In a number of piglets the haemoglobin levels were followed at weekly intervals up to weaning, but in others the levels were recorded at irregular intervals, generally at least two or three weeks after iron supplementation.

Eighty-seven piglets were supplemented with iron. Twenty-five received one oral dose of 0·5 g *Ferri et Ammonii Citrate* (FAC) dissolved in 3 ml of water at two or three weeks of age. Five were given a prophylactic treatment of 0·3 g at the age of three days, followed by a second dose of 0·5 g two weeks later. Fifty-seven piglets were treated with a single injection of 2 ml iron-dextran intramuscularly, from the 8th to the 27th day. Included in this group were five which had received iron-dextran (ID) after an initial dosing with FAC (Litter No. 192). Two litters (Nos. 365 and 371) received iron-dextran prophylactically at the age of four days. The remaining piglets received treatment on the basis of their haemoglobin status.

In most cases treatment was delayed as long as possible to enable the pattern of the haemoglobin levels at various ages to be studied.

Twenty-four piglets were not treated. These comprised one litter of 10 (litter No. 38) and 2–4 untreated piglets from each of four further litters (Nos. 37–B, 190, 365 and 371).

Six piglets received an oral dose of 0·3 g copper sulphate in 2 ml of water a week before being treated with iron.

During the trial the piglets were observed for clinical evidence of anaemia.

III. RESULTS

The range and mean of body-weights and haemoglobin levels of individual litters are set out in Table 1.

Table 1

RANGE AND MEAN OF BODY-WEIGHTS (LB) AND HAEMOGLOBIN LEVELS (g%) OF PIGLETS

No. of Litter	Piglets in Group	Age (days) and Treatment	At Birth		Days after Birth					
					4		7		14	
			Bwt.	Hb.	Bwt.	Hb.	Bwt.	Hb.	Bwt.	Hb.
37–A	7	21–FAC	3·2 2·7–3·6				5·9 4·4–6·9			
37–B	4	22–FAC	3·4 3·0–3·8	11·0 10·8–11·7			7·5 7·0–8·5	6·5 6·1–7·6	10·8 9·8–11·5	4·8 4·6–5·1
	4	nil	3·0 2·3–3·6	11·2 10·8–12·0			7·5 6·8–8·0	6·0 5·2–8·4	11·4 10·3–12·5	4·8 4·1–5·1
37–C	9	14–ID	2·7 2·3–3·5				5·2 4·0–6·5		6·4 4·4–8·5	5·6 4·6–6·8
38	10	nil	3·0 2·5–3·5	10·9 9·2–12·4			5·0 4·4–5·7	7·2 5·5–9·3	7·7 4·8–9·5	5·2 3·5–6·9
192	5	16–FAC 37–ID	2·7 2·5–2·9	10·8 9·9–11·2			6·5 6·3–6·6	7·1 6·6–8·4	10·2 10·0–10·8	5·1 3·4–6·4
	5	3–FAC 16–FAC	2·8 2·5–3·0	10·4 9·2–11·2			6·4 6·2–7·0	8·6 6·8–9·2	10·1 9·5–11·0	6·9 6·7–7·7
190	6	15–ID	3·1 2·4–3·6	11·1 9·1–12·4			6·3 5·0–7·3	6·6 5·5–7·7	9·7 7·7–11·2	4·6 4·1–5·4
	4	nil	3·3 3·1–3·8	10·9 9·5–11·7			6·4 6·2–6·8	6·8 6·7–8·3	10·1 9·8–10·7	5·4 5·2–5·7
149	6	16–ID	3·1 2·5–3·6				4·5 3·5–5·6	7·9 6·9–9·2	5·3 4·0–6·0	7·3 6·0–9·4
188	6	15–Cu 22–ID	3·1 2·8–3·6	10·6 9·0–11·5			5·7 4·0–6·5	7·8 7·1–9·0	8·3 5·5–10·5	6·6 4·9–7·1
	4	15–ID	2·4 2·5–3·5	10·8 9·7–12·4			5·7 4·3–6·8	7·6 7·0–8·5	8·4 5·8–10·7	6·5 5·2–7·4
151	2	8–ID	3·1 2·8–3·4	11·6 11·4–11·8			5·9 5·3–6·5	7·2 6·7–7·8	9·8 9·5–10·0	9·8 9·4–10·2
	2	15–ID	2·7 2·1–3·2	11·2 10·4–11·4			5·3 4·5–6·0	9·1 8·3–9·9	9·0 8·3–9·8	6·6 6·6–6·6
154	9	17–ID	3·4 3·0–3·9				6·9 6·1–8·5		11·2 9·5–12·0	5·0 4·3–6·0
199	1	15–ID	2·5				5·3		9·0	3·2
	5	15–FAC	2·7 2·5–3·2				5·5 4·7–5·8		9·5 9·0–10·5	4·8 4·2–5·7
198	9	15–FAC	3·0 2·3–3·6						11·1 7·0–12·5	5·4 3·3–6·7
365	2	4–ID	3·0 2·5–3·6	12·2 11·4–13·1	3·8 3·0–4·6	8·6 8·3–8·9	5·6 4·6–6·6	9·2 8·9–9·6	9·2 8·0–10·5	10·6 10·5–10·7
	2	nil	3·0 2·5–3·5	12·1 11·8–12·4	4·0 3·4–4·6	9·4 9·1–9·8	6·5 6·0–7·1	7·4 7·1–7·7	9·6 8·2–11·0	5·1 4·9–5·3
371	5	4–ID	3·0 2·8–3·1	12·5 11·5–13·3	3·6 3·2–4·0	8·8 7·3–10·1	5·1 4·6–5·8	9·3 8·6–10·2	8·1 7·0–9·5	10·9 10·2–11·5
	4	nil	3·0 2·5–3·6	12·8 12·1–13·5	3·8 3·1–4·5	8·6 6·9–10·2	5·5 4·3–6·6	7·4 6·0–8·5	7·8 6·5–8·5	6·1 5·3–7·4

ID—Iron-dextran intramuscularly Cu—Copper sulphate orally

(a) Blood Haemoglobin

The haemoglobin levels at birth ranged from 9·0 to 13·5 g/100 ml. Sixteen piglets had levels over 12·0 g/100 ml. In 40 piglets the levels were between 10·0 and 11·9 g/100 ml and in nine from 9·0 to 9·9 g/100 ml.

Days after Birth											
21		28		35		42		49		56	
Bwt.	Hb.	Bwt.	Hb.	Bwt.	Hb.	Bwt.	Hb.	Bwt.	Hb.	Bwt.	Hb.
	6·7 / 4·6–9·8	15·8 / 7·5–19·5			10·3 / 9·6–11·7		10·9 / 10·8–11·7		10·0 / 8·3–11·0		
14·5 / 13·0–16·0 16·8 / 13·5–19·5	4·1 / 3·9–4·3 4·6 / 4·0–5·2	18·4 / 16·5–20·0 19·0 / 16·8–20·3	7·1 / 5·4–8·6 5·9 / 5·4–6·5	23·2 / 21·0–24·8 23·2 / 21·5–24·3	8·7 / 8·2–9·9 8·0 / 6·7–8·8	30·5 / 24·5–36·0 28·2 / 26·5–29·5	10·5 / 9·5–11·4 10·0 / 9·5–10·5				
		14·2 / 7·5–15·5	9·2 / 4·6–10·2							33·6 / 28·0–37·0	
11·1 / 7·5–13·5	4·2 / 2·8–5·9	13·5 / 8·5–16·5	3·5 / 2·2–4·9	15·6 / 11·8–18·0	4·6 / 2·1–6·9	20·7 / 15·8–25·5	6·1 / 3·7–9·0	26·2 / 21·5–31·8	6·7 / 4·5–10·6		
13·1 / 11·8–14·5 13·3 / 12·5–15·0	6·2 / 5·2–6·8 7·1 / 6·3–7·8	16·0 / 15·5–17·7 17·2 / 16·2–17·8	6·1 / 4·7–7·1 6·6 / 6·1–6·8	19·2 / 18·0–20·7 20·9 / 18·5–22·5	5·7 / 5·1–6·6 7·1 / 6·6–7·8	22·5 / 20·5–24·2 22·7 / 21·5–24·5	9·4 / 8·7–10·7 7·0 / 6·2–8·5	29·4 / 27·0–31·0 26·5 / 23·3–29·7	12·0 / 11·4–12·4 10·1 / 7·1–11·2		
11·8 / 10·0–12·5 12·5 / 12·0–13·0	8·7 / 8·2–10·7 5·9 / 5·5–6·6	13·9 / 11·0–15·5 14·6 / 12·6–16·8	10·0 / 9·0–11·7 7·4 / 6·9–8·4	18·4 / 15·7–20·3 19·0 / 16·5–22·5	10·1 / 8·4–11·5 7·8 / 6·7–10·5	22·5 / 19·5–25·3 23·2 / 20·0–29·5	11·5 / 10·5–12·4 9·0 / 6·0–12·0	28·5 / 25·5–32·0 29·0– / 25·0–37·0	12·2 / 11·4–13·8 10·1 / 5·6–13·5		
7·7 / 4·0–8·5		9·3 / 5·5–11·3	11·5 / 10·7–12·2					22·1 / 16·0–26·5			
12·7 / 5·3–14·2 10·7 / 7·5–15·0	5·5 / 4·3–6·9 9·0 / 8·2–9·5	13·9 / 7·0–17·5 14·0 / 9·3–19·5	9·0 / 6·0–10·7 9·6 / 8·2–10·6	17·4 / 9·5–21·0 17·6 / 12·0–23·5	9·5 / 7·9–10·8 9·5 / 8·7–11·0	23·3 / 13·5–27·8 22·5 / 16·7–29·5	10·8 / 8·6–12·9 9·9 / 9·0–11·5	24·1 / 16·5–32·5 26·0 / 20·0–32·0	11·1 / 9·4–12·9 10·8 / 10·0–11·7		
15·0 / 14·5–15·5 12·8 / 12·5–13·0	9·6 / 9·4–9·9 9·3 / 9·2–9·4	19·3 / 18·5–20·0 17·0 / 17·0–17·0	8·3 / 8·0–8·6 9·3 / 9·1–9·4	24·6 / 23·5–25·8 21·2 / 21·0–21·3	7·8 / 7·1–8·6 9·3 / 9·1–9·4	29·5 / 28·0–31·0 26·0 / 25·5–26·5	7·9 / 7·3–8·6 9·0 / 7·8–10·3	35·5 / 32·5–38·5 31·8 / 30·0–32·5	8·8 / 7·8–9·7 10·0 / 8·4–11·7		
		17·5 / 15·6–18·8	9·1 / 7·9–10·3							32·4 / 25·0–35·0	
		16·0 19·5 / 18·5–20·5	9·6 6·4 / 4·0–7·1							29·0 34·4 / 30·5–36·5	
		16·0 / 13·5–19·0	5·1 / 3·4–7·0					31·2 / 24·5–36·0			
14·2 / 13·5–15·0 12·9 / 10·8–15·0	8·8 / 8·6–9·0 3·8 / 3·6–4·0	18·4 / 17·8–19·0 16·8 / 15·0–18·5	7·6 / 7·3–7·9 4·1 / 4·0–4·2	24·8 / 24·5–25·0 21·5 / 20·0–23·0	8·0 / 6·8–9·3 4·8 / 4·7–5·0	27·8 / 27·0–28·5 24·8 / 24·5–25·0	8·4 / 6·2–8·6 5·4 / 5·3–5·5	31·7 / 30·5–33·0 28·8 / 28·5–29·0	9·8 / 9·6–10·0 8·4 / 8·2–8·6	39·5 / 38·5–40·5 36·8 / 36·5–37·0	12·4 / 12·4–12·4 11·1 / 11·0–11·2
11·6 / 10·3–13·8 10·6 / 8·5–12·0	11·6 / 10·2–13·1 6·8 / 4·4–9·4	15·7 / 12·8–18·5 13·2 / 11·5–15·0	11·0 / 9·5–12·8 7·0 / 4·9–10·2	19·5 / 16·5–21·5 18·0 / 15·5–19·0	10·8 / 9·6–12·2 7·6 / 4·9–10·2	26·0 / 22·0–28·5 22·2 / 22·0–23·0	10·4 / 9·2–12·2 7·8 / 5·0–10·5	34·4 / 29·5–38·5 28·4 / 27·5–29·0	10·8 / 10·2–12·2 10·9 / 8·1–14·0	39·7 / 34·5–44·5 34·2 / 32·5–36·0	12·1 / 11·2–13·1 10·9 / 10·3–12·0

FAC—*Ferri et Ammonii Citrate* orally

In the 24 untreated piglets there was a steady and marked decline of the blood haemoglobin in the first three weeks of life. In many the levels had dropped within a week after birth by 30 per cent. or more. Observations on two litters (Nos. 365 and 371) indicated that this decline occurs within a few days after birth. At the end of the second week the levels often were only half or even less of their birth levels. The decline usually continued up to the fourth week, occasionally reaching a figure of 3 g/100 ml or less. Thereafter, the haemoglobin levels generally showed a tendency to increase slowly. Though in occasional piglets there was a more sudden rise just before weaning, the levels usually remained low.

The lowest levels reached in the piglets were 1·5, 2·2 and 2·8 g/100 ml respectively in one untreated litter (No. 38). The level of 1·5 g/100 ml haemoglobin was recorded in a pig on the 39th day after birth. It died the following day. The remaining two figures were recorded in two piglets on the 28th day. They improved gradually, although their haemoglobin levels at seven weeks were still only 4·5 and 6·0 g/100 ml respectively.

In two litters, Nos. 37A and 37B, a single oral dose of 0·5 g FAC apparently gave satisfactory results as judged by the post-treatment rise of haemoglobin two weeks later. This rise was noticeable, especially in piglets which had the lowest pre-treatment readings. In the other treated litters the response was disappointing. Even when prophylactic treatment at three days was followed by a further treatment at two weeks, the birth levels of haemoglobin were not restored. However, they quickly responded to iron-dextran treatment (Table 1).

Of the 57 piglets treated with iron-dextran, 50 were medicated at the stage where the haemoglobin levels indicated an advanced state of anaemia.

With one exception (one piglet in litter 37C) iron-dextran had a marked effect on the post-treatment haemoglobin levels. In most cases the levels rose by 30–50 per cent. within a week. In many instances the pre-treatment level was doubled, especially when the levels at the time of treatment were less than 5 g/100 ml. Usually the rise continued at a somewhat slower rate thereafter until weaning. In a number of piglets, however, after an initial rise the levels became more or less stationary until a further rise occurred just before weaning. In one group (No. 151) of four, where the levels at the time of treatment were only moderately low, i.e. 6·6–7·8 g/100 ml, the haemoglobin after an initial rise in three of these began to decline slowly some two weeks after treatment, and rose again slightly before weaning.

Administration of iron-dextran at the fourth day of life quickly restored the haemoglobin to satisfactory levels with a peak about two weeks later. It is of interest that iron-dextran restored the birth level in only one of the seven treated piglets, while in the six others the levels remained somewhat lower. After the peak was reached, a mild secondary decline became evident, but recovery followed as soon as the piglets started to consume dry feed mixture in sufficient quantity. At the weaning age of eight weeks the haemoglobin levels were comparable with those at birth.

A single oral dose of copper sulphate failed to arrest the decline of haemoglobin in a group of six piglets in one litter (No. 188), but administration of iron-dextran one week later produced rapid improvement.

(b) Symptomatology and Pathology

The most common clinical evidence of iron deficiency was diarrhoea characterized by pasty to liquid, whitish, creamy to yellowish faeces in a variable number of piglets in each litter. With the exception of two litters (Nos. 38 and 192) no other symptoms were noticed clinically, although the haemoglobin levels in some piglets fell to 3·2 g/100 ml.

In the untreated litter No. 38, several piglets showed extreme pallor, listlessness and rapid respiration between the fourth and fifth weeks of age, and one piglet died. It had a haemoglobin level of 2·1 g/100 ml on the fourth day preceding death and 1·5 g/100 ml one day before death. It showed congestion of the liver and severe myocardial degeneration.

In litter 192, three piglets before iron supplementation showed a slightly laboured respiration. The haemoglobin levels of these piglets ranged from 4·7 to 6·5 g/100 ml.

In general, scouring in all litters coincided with low haemoglobin levels and lasted, if not medicated, for 5–7 days or longer. Iron supplementation shortened this time, so that with iron-dextran the faeces became normal again within 1–3 days. After treatment with FAC, faeces returned to normal in three days at the earliest, but in some piglets scouring persisted for six days.

In litter No. 37C, scouring which had persisted for nine days in several piglets despite oral medication of 0·5 g oxytetracyline* daily for three days disappeared within 24 hours after the use of iron-dextran.

* "Terramycin—Animal Formula Soluble Powder" by Chas. Pfizer & Co., Inc., Brooklyn, N.Y.

(c) Body-weights

Birth weight apparently had no influence on the incidence of anaemia. However, there was some indication that at the critical age of 2–3 weeks lower haemoglobin levels appeared to be more common in piglets that had made more rapid weight gains, though occasionally the reverse was true.

Although the experiment was not designed to determine the influence of iron therapy on weight gains, statistical analysis of the results supported the conclusion that iron-dextran and FAC both improved the rate of gain if they were administered early. Table 1 shows that with the exception of litter No. 190 the mean body-weights of piglets treated with iron-dextran were at weaning 2·7–5·5 lb more than the weights of untreated piglets in the same litters. In litter No. 190 the mean weight of the controls was half-a-pound more than that of the supplemented pigs but the figures were unduly influenced by one very heavy pig in this group. The mean growth rate of the supplemented group was faster than that of the controls (statistically significant at the 5 per cent. probability level). Treatment with iron-dextran at seven days was also superior to treatment at 14 days (significant at the 5 per cent. level).

IV. DISCUSSION

Anaemia is common in piglets submitted to this Institute for diagnostic purposes. This applies not only to piglets reared on impervious floors but also to those with access to soil. Haemoglobin levels of only 6–7 g/100 ml have been recorded in piglets even up to 12 weeks old.

Observations at the Institute have shown that the haemoglobin levels in piglets reared on concrete floors decline very rapidly within a few days after birth in spite of good nutrition and husbandry. The decline usually continues to the end of the second or third week. After this time the levels frequently have fallen to less than half of the values at birth, e.g. 5 g/100 ml or less. Diarrhoea is a common clinical sign at this stage, although it may occur also when the decline is less pronounced. Anaemia may also be evident. Disinclination to move and respiratory embarrassment appear when the levels reach 3 g/100 ml or less, though in one litter it became evident at haemoglobin levels around 5 g/100 ml. Several workers (Kernkamp 1935; McDonald, Dunlop, and Bates 1955) expect clinical signs of the disease as a result of anaemia to develop when the haemoglobin levels decrease by more than 30 per cent. of the birth values. According to Baskett and Lamont (1936), death is to be expected at levels between 3 and 4 g/100 ml, while Kernkamp (1935) regarded 2·5 g/100 ml as a critical level. In experience at the Institute, however, even at this level piglets did not always succumb but recovered gradually. Under poor husbandry conditions, these levels might have proved critical.

After reaching the lowpoint, the haemoglobin levels generally improved slowly from the third week of age onwards, coinciding with increasing intake of dry pig-feed. Generally, a sharper rise in haemoglobin levels in untreated piglets was evident at the age of seven weeks, when the piglets were consuming a considerable amount of dry feed mixture. The rise in haemoglobin levels at this stage was probably due to the iron contained in the feed. Sow's milk is a poor source of nutritional iron, and it is considered not to supply more than about 1 mg Fe per day per sucking pig of the daily requirement of 7 mg (Venn, McCance, and Widdowson 1947) to 15 mg (National Research Council 1950, cited by Barber *et al.* 1955) for the growing piglet in the first three weeks of life in order to maintain normal haemoglobin levels.

The observations strongly indicate that iron-supplemented creep feeding should be introduced early and preferably between two and three weeks of age.

Iron therapy in the form of oral dosing of individual piglets with a mixture of ferrous sulphate, copper sulphate and molasses, or the application of this mixture to the sow's udder, as recommended in this part of Queensland, leaves much to be desired. Experiments with FAC have shown that a single dose of 0·5 g (supplying about 100 mg Fe) of this compound also is of limited value only. Intramuscular injection of 2 ml iron-dextran, however, proved to be remarkably effective in raising the haemoglobin levels and is considered to be a highly effective method in the treatment and prevention of piglet anaemia.

In view of the results of Barber *et al.* (1958) and Dale and MacKay (1958), who showed that although repeated injection of iron-dextran gave an enhanced haemoglobin curve, no significant differences were obtained in body weights at weaning, the need for more than one treatment does not appear to be justifiable. It is essential that treatment should be given early, within 3 or 4 days after farrowing, in order to carry the piglets over the critical period and until such time as the creep feeding will supply the iron supplement.

Toxic hazards are most unlikely to be encountered in the course of iron-dextran medication. One report only of toxic effects has been published (Behrens 1957). None occurred in our trial.

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