Ingestion of iron in sow's faeces by piglets reared in farrowing crates with slotted floors

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(*Received 23 June 1981 – Accepted 17 September 1981*)

1. Two sows were housed in farrowing crates with slotted floors and fed daily with approximately 200 μCi ^{198}Au from 3 d before farrowing until their piglets were 21 d old.

2. The sows' faeces became radioactive but their milk remained free of radioactivity. The piglets' mean ($\pm$SE) whole-body radioactivity was equivalent to $8 \cdot 5 \pm 0 \cdot 9$ g (range 3·8–15·5 g) of faeces. This is probably a measure of their daily intake of faeces.

3. The possibility of using this natural coprophagia to prevent piglet anaemia has been demonstrated on two commercial piggeries by feeding the sows a diet containing 2000 mg Fe/kg.

In a previous paper (Sansom & Gleed, 1981) it was shown that piglets born to sows housed in solid-floored farrowing pens ingested on average 20 g of faeces and bedding daily. Although there were wide variations in the amounts ingested by individual piglets (range 5–85 g/d) it was suggested that this natural coprophagia could provide a simple means of supplying sufficient iron to prevent them from becoming anaemic. By providing 2000 mg Fe/kg dry matter (DM) in the diet of the sow the Fe content of her faeces would be increased to approximately 2 mg Fe/g fresh material and every piglet would ingest at least 10 mg Fe/d. The estimated requirement of a piglet from birth to weaning at 3–5 weeks is 7–10 mg Fe/d (Venn *et al.* 1947).

However, in most farrowing houses the sows are housed in pens or crates in which the floors are either partially or wholly formed of slats or are made from pressed-steel sheets perforated with slots. Both forms of floor are designed to improve the cleanliness of the farrowing pens by allowing faeces and urine to drop through to collecting tanks beneath. In this system the piglets would have less access to the sow's faeces and supplementing the sow's diet with Fe would be less effective in preventing piglet anaemia.

These experiments were designed (1) to measure the quantity of faeces ingested by piglets reared in a farrowing crate with a slotted steel floor and (2) to assess the efficacy for preventing piglet anaemia of supplementing the diet of lactating sows with 2000 mg Fe/kg DM as $FeSO_4 . 7H_20$, the sows being kept in commercial piggeries using farrowing pens or crates with slatted floors.

MATERIALS AND METHODS

Expt 1

Two Large White × Landrace sows and their litters were used. At 3d before they were expected to farrow the sows were moved into the farrowing crate (PIC, Camborough Farrowing System) and thereafter were dosed daily with approximately 200 μCi ^{198}Au (Code GCS-IP; The Radiochemical Centre, Amersham, Bucks.) as described previously until the piglets were 21 d old. No bedding material was supplied except for some wood shavings in the solid-floored creep area. The piglets' whole-body radioactivity and the radioactivity of the sows' daily output of faeces were measured daily as before in a whole-body counter (Sansom *et al.* 1971). When the piglets were 21 d old they were slaughtered, washed

Table 1. *Mean whole-body radioactivity (counts/s) in the piglets of two sows given 200 μCi ^{198}Au daily, mean radioactivity (counts/s) in fresh faeces and the calculated mean quantity of faeces present in the piglets (g)*

(Mean values with their standard errors)

Sow no.	Piglet no.	Whole-body radioactivity (CPS) Mean	SE	Mean radioactivity in faeces (CPS/g) Mean	SE	Mean wt of faeces in piglets (g)
1	1	724	80	55	6	13·2
	2	398	44			7·2
	3	851	150			15·5
	4	357	52			6·5
	5	419	75			7·6
	6	232	35			4·2
	7	844	101			15·3
	8	596	73			10·8
						Mean 10·0 ± 1·5
2	1	240	24	31·5	3	7·6
	2	119	15			3·8
	3	138	18			4·4
	4	214	26			6·8
	5	260	30			8·3
	6	153	22			4·9
	7	211	28			6·7
	8	415	46			13·2
	9	280	28			8·9
						Mean 7·2 ± 1·0
						Over-all mean 8·5 ± 0·9

thoroughly and counted in the whole-body counter. The gastrointestinal tract was then removed and the empty carcase recounted.

Expt 2

Two commercial piggeries, A and B, were used; their systems of management were as follows.

Piggery A. The farrowing house consisted of several rooms each containing eight concrete pens divided by a central corridor into two groups of four pens. Each sow was housed in a tubular steel crate behind which the floor was slatted. From 2–3 d before farrowing each group of four sows was given either a home-produced diet containing approximately 400 mg Fe/kg or the same diet supplemented with 10 kg $FeSO_4 . 7H_2O$/tonne – an additional 2000 mg Fe/kg. The piglets born to sows fed on the normal diet were injected intramuscularly with 200 mg Fe as Fe-dextran when 2–4 days of age, whereas the piglets born to sows given the Fe-enriched diet received no extra Fe. The piglets were weaned at between 16 and 21 d of age (mean 17 d).

Piggery B. The farrowing houses each contained approximately forty metal farrowing crates with slotted floors similar to those used in Expt 1. It was not possible to feed different diets to the sows in one farrowing house and the two treatments were therefore compared between farrowing houses. From 2–3 d before farrowing sows in one house were given their usual commercial diet containing approximately 400 mg Fe/kg while the sows in another house were given the same diet enriched with 2000 mg Fe/kg as $FeSO_4 . 7H_2O$. The piglets born to the sows on the different diets were either injected or not injected with 200 mg Fe as at piggery A. The piglets were weaned at 5 weeks of age.

Table 2. *The numbers of litters and piglets on each treatment at two commercial piggeries, A and B, and the mean weights, RBC, MCV, PCV, Hb and WBC of the piglets at weaning*

(Mean values with their standard errors)

		Normal diet + 200 mg Fe dextran			2000 mg Fe/kg diet, no added Fe dextran		
Piggery		Mean	SEM	*n*	Mean	SEM	*n*
A	Litters	—	—	23	—	—	24
	Pigs	—	—	208	—	—	191
	Pigs/litter	—	—	9·0	—	—	8·0
	Weight (g)	4079	72	208	4078	76	191
	RBC 10^6/mm^3)	548	5·1	193	557	4·8	179
	MCV (μm^3)	71·4	0·5	192	71·3	0·5	179
	PCV (%)	39·9	0·4	192	40·4	0·3	179
	Hb (g/100 ml)	12·2	0·12	193	12·5	0·08	179
	WBC (10^3/MM^3)	11·6	0·3	193	11·7	0·3	179
B	Litters	—	—	14	—	—	16
	Pigs	—	—	127	—	—	163
	Pigs/litter	—	—	9·1	—	—	10·2
	Weight (g)	7829	156	127	7972	152	163
	RBC (10^6/mm^3)	666	6·0	119	641	6·0	154
	MCV (μm^3)	63	0·3	119	57	0·4	154
	PCV (%)	42·6	0·4	119	36·1	0·5	154
	Hb (g/100 ml)	13·2	0·1	119	11·6	0·1	154
	WBC (10^3/mm^3)	18·0	0·4	119	17·9	0·4	154

At weaning the piglets in both piggeries were weighed and a blood sample was taken from the anterior vena cava, using EDTA as anticoagulent. The blood samples were analysed for erythrocytes (RBC), mean corpuscular volume (MCV), packed cell volume (PCV) and leucocytes (WBC) using a Coulter counter. Haemoglobin (Hb) was measured by the cyanmethaemoglobin method.

RESULTS

Expt 1

As in the previous experiment (Sansom & Gleed, 1981) the piglets' whole-body radioactivity increased quickly but tended to fluctuate about a mean rather than to increase steadily with time. Table 1 shows the mean whole-body radioactivity of each piglet and the mean radioactivity of the faeces of the two sows. The quotient of these quantities gives the mean quantity of faeces present in each piglet during the 21 d of the experiment.

At slaughter the mean ($\pm$SE) percentage of the whole-body radioactivity present in the piglets' gastrointestinal tracts was $94·0 \pm 1·06$%.

Expt 2

Table 2 shows the numbers of litters and piglets on each treatment at each piggery, their weights (mean$\pm$SEM) at weaning and the mean ($\pm$SEM) values of RBC, MCV, PCV, Hb and WBC.

DISCUSSION

Expt 1

The farrowing crates were cleaned daily and it was observed that there were always faeces on the floor as well as beneath. In this experiment no bedding was supplied to the sow, and the piglets therefore always had access to radioactive faeces which were undiluted with bedding. The average radioactivity in the piglets was therefore directly equivalent to the presence of 8·5 g of faeces with a range among individual piglets of 3·8–15·5 g. As was pointed out in the previous paper (Sansom & Gleed, 1981) these quantities can be converted into the quantities of faeces ingested daily only by making an assumption about the average time taken for the material to pass through the gastrointestinal tract. By assuming a passage time of 24 h the average weight of faeces present can be equated to the average weights ingested daily and the results of these experiments can be compared with those from the experiments in solid-floored farrowing pens (Sansom & Gleed, 1981).

As expected the piglets of these two sows ingested less faeces (approximately 8·5 g/d) than those of sows housed in solid-floored pens (approximately 20 g/d). However, the range of quantities ingested (3·8–15·5 g/d) would still make it possible to supplement the piglets adequately with Fe provided that the sow's diet contained sufficient Fe.

Expt 2

At both piggeries the piglets born to sows given diets enriched with 2000 mg Fe/kg were well protected from clinically significant anaemia, whether that be defined as a haemoglobin concentration less than 6 g/100 ml (Matrone *et al.* 1960) or less than 8 g/100 ml (Agricultural Research Council, 1967). Indeed, at piggery A the piglets of sows fed on the Fe-enriched diet had as high levels of RBC, PCV and Hb as those which received direct intramuscular injections of 200 mg Fe as Fe-dextran. There were no differences in other haematological values or in the mean weight of the piglets at weaning. At piggery B, the RBC, PCV and Hb values of the piglets born to sows given the Fe-enriched diet were all significantly lower than in piglets injected with Fe-dextran. At this piggery the farrowing crates were cleaned thoroughly every day whereas at piggery A the crates were cleaned less frequently. As a result the sows at piggery B tended to be cleaner and faeces were less readily available to the piglets than at piggery A; this difference may account for the lower haematological values. However, there was no difference between the mean weights of the two groups of piglets at weaning.

The concentration of Fe in the faeces of sows given 2000 mg Fe/kg diet is approximately 2 mg Fe/g fresh faeces. In Expt 1 it was estimated that piglets reared in farrowing crates with slotted floors ingested between 3·8 and 15·5 g fresh faeces daily. This quantity should provide between 7 and 30 mg Fe, ample to prevent anaemia if the Fe is readily available. The effectiveness of the Fe-enriched sow diet in preventing piglet anaemia at these two commercial piggeries suggests that the piglets were ingesting substantial quantities of faeces daily and that the Fe was available for absorption.

The sows at both piggeries accepted the Fe-enriched diet readily. At piggery A, the diet was given as a powdered meal and there was no reduction in feed intake. At piggery B, the diet was given as a cubed pellet and a few gilts were reported to be reluctant to accept the change of diet on coming into the farrowing house. However, there were no significant effects on performance (Table 2).

These experiments show that piglets ingest some of the sow's faeces even when accommodated in pens with slatted floors, and that by feeding the sows an Fe-enriched diet this natural coprophagia can be used to prevent them from becoming anaemic.

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Printed in Great Britain