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Use of Water by Piglets in the First Days after Birth

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KEYWORDS

piglet, water, drinking, agalactia, dehydration, body weight

ABSTRACT

Use of drinking water was determined for 51 litters of piglets by weighing and refilling a water dispenser each day for the first 4 d after farrowing. Measures of spillage, evaporation, and piglet drinking behavior indicated that most disappearance of water represented actual drinking by the piglets. Water use varied greatly among litters with an average of 46 g d^{-1} per piglet over the 4 d, and a range of negligible use to about 200 g d^{-1}. Water use, especially on day 2, was correlated negatively with the average weight gain of the litter during the first 2 d ($r = -0.45$, $P < 0.001$). Litters that lost weight or gained very little on days 1 and 2 showed a pronounced peak of water use on day 2 (averaging about 100 g d^{-1} per piglet), with declining use on days 3 and 4. In contrast, litters with high initial weight gains drank little water on days 1 and 2 but showed a steady increase in water use to day 4. The results suggest that piglets will drink appreciable amounts of water on the first days after birth especially if their milk intake is limited. We speculate that under these circumstances water intake may help to prevent dehydration and promote survival of piglets with low early milk intake.

Water, often called the "forgotten nutrient" of livestock, is ignored with particular thoroughness in the case of suckling pigs. Many textbooks on pig production say nothing at all about provision of water for unweaned piglets, while a few acknowledge that older piglets may use supplementary feed more effectively if water is available. Despite a few research reports which suggest otherwise (Aumaitre 1965: Svendsen and Andréasson 1981; Ehlert et al. 1981), the usual assumption appears to be that a piglet on an all-milk diet has no need for additional fluid.

This assumption may well be true of rapidly-growing piglets receiving abundant milk from the sow, but not all piglets are so fortunate. Many sows develop a degree of mastitis or hypogalactia within the first 3 d after farrowing and provide milk in reduced or highly variable amounts during this period (Bäckström et al. 1984). Even without recognizable illness of the sow, some litters lose weight or gain very little in their first 1 or 2 d, presumably because of low initial milk production by the dam (Thompson and Fraser 1988). In otherwise healthy litters, individual piglets, often those born weak or with low body weight, may lose weight and die in the first days after farrowing. It is not known whether dehydration, resulting from inadequate milk intake, is a significant problem in piglets that fail to thrive, and whether very young piglets have the developmental maturity to correct dehydration by drinking supplementary water.

In the following study, we took advantage of a detailed data collection on early piglet weight gains to record the use of supplementary water by piglets in the first days after birth and to determine whether water intake was increased in litters showing signs of low early milk consumption.

MATERIALS AND METHODS

This was part of a larger study which included a comparison of four different farrowing crate designs. The entire study consisted of 78 farrowings by Yorkshire sows from the Animal Research Centre's specific-pathogen-free herd. Measurements of piglet water intake were made on the 51 litters reported here.

The farrowing crates, described in detail by Fraser et al. (1988), were installed in farrowing pens of 3.5 - 3.9 m^2 with plastic-coated, expanded metal flooring raised 0.3 m above the floor of the room. Each pen was equipped with one 250-W heat lamp suspended 0.6 m above the pen floor. Water was accessible to the piglets from the time of farrowing from a plastic drinking bowl with an inverted, 4-L reservoir (Creep Waterer No. 79, Nelson Products Co., Sioux Rapids, Iowa). A two-hole piglet supplementary feeder was provided from 10 d of age.

Sows were moved into the crates 5 d before farrowing was due. They received 2 kg of pelleted feed per day before farrowing. After farrowing, feed was offered ad libitum, with the feed trough refilled daily. Sows had continuous access to water from a nipple-drinker installed 0.6 m above the floor. Routine management of the piglets included ear-notching for identification and clipping the needle teeth on the first day after birth; iron injection on days 3 and 10, and castration of males on day 10. Sows and litters remained in the crates until the piglets were 14 d old. Ambient temperature in the room was generally kept at 20-24°C by use of supplementary heating and cooling equipment, but extremes of 17 and 29°C were recorded over the 20-mo duration of the study.

Piglets were weighed to the nearest 5 g on the first morning after farrowing was complete, on each of the next four mornings, and on days 7, 10 and 14 after birth. All weighing was done between 10:00 and 12:00 h so that daily weight gains would cover a period close to 24 h. However, this meant that some litters were nearly 24 h old when weighed for the first time. In order to determine if there were any differences arising from age at first weighing, we noted whether a litter farrowed before or after 16:00 h each day, this being the last time during the day that sows were routinely checked. This divided the litters into two age classes (0-18 h vs. 18-24 h) at the time of first weighing.

In order to minimize the effects of litter size, all litters were adjusted to 10-12 piglets. Piglets were removed at the time of the first weighing if they had physical abnormalities or weighed < 800 g. Large litters were then reduced to 12 by removal of randomly-chosen piglets. Small litters were increased to 10 by adding foster litter-mates which were of similar age and within the weight range of the recipient litter. Of the 53 piglets added by fostering, all but 10 were added by the time of the first weighing.

Records were kept on the litter's total daily water use for the first 4 d after farrowing. The piglet water dispenser was filled and weighed each day at 10:00 - 12:00 h (while the piglets were being weighed) and then reweighed the next day. To give a correction for evaporation, the same procedure was followed several times in a pen that did not contain pigs. For 28 of the litters, we attempted to measure spillage of water by installing a funnel with an opening of 18 × 12 cm and a collection bottle beneath the water dispenser. The bottle was weighed and emptied each day at the time of refilling the water dispenser.

With 10 litters, chosen for convenience, the piglets' drinking activity was monitored by time-lapse video recording. The piglet water dispenser was filmed at a rate of 1 frame per 2.5 s for 48 h beginning when the litter was first weighed. A litter's drinking activity was defined as the number of piglets with their mouths over the water surface in each frame, summed over all frames in the 48 h.

Because water intake was measured for litters (rather than for individual piglets), analyses of body weights and weight gains were also based on litter values. To adjust for the small differences in the number of piglets per litter, both daily water use and daily weight gain were expressed as a mean per piglet based on the number of piglets alive in the litter during the relevant 24-h period. This also adjusted for any change in litter size caused by piglet deaths, but these were small as only 19 of the 543 piglets died during the experiment.

Analyses of variance were applied to the means, using a model including farrowing crate type, litter age class at first weighing (0-18 h vs. 18-24 h) and the interaction. Correlations were calculated between the litters' water intake and average weight gains, after adjusting for the average initial weight of piglets in the litter. Two non-parametric tests, Wilcoxon's Rank Sum Test and Spearman's Rank Correlation (Hollander and Wolfe 1973), were applied in making comparisons where the assumption of a normal distribution was inappropriate.

RESULTS

Evaporation from the water bowl amounted to only about 2 g d^{-1} per piglet, and was ignored in calculating water use. Data on spillage from the drinkers, collected for 28 litters, were considered unreliable because urine was almost always found in the spillage bottle, presumably from piglets urinating immediately beside the drinker. The contents of the spillage bottle accounted on average for 20% of water use, with a range of 4-48% for different litters. The five litters with highest percentage spillage (> 30%) had relatively low total water use. Analyses were tried with and without adjustment for apparent spillage, and results were very similar. Because of the problems with the spillage measure, the analyses based on unadjusted data are presented.

Preliminary analyses of variance showed no substantial differences between litters that did or did not include fostered piglets. Analyses of variance also showed no evidence of differences in water use owing to farrowing crate type, litter age at first weighing (0-18 h vs. 18-24 h), nor to the interaction of crate type and age. These factors were ignored in subsequent analyses.

The piglets used considerable amounts of water during the first 4 d after farrowing, with an average of 469 d^{-1} per piglet. There was great variation from litter to litter as shown in Table 1: three litters used less than 10 g d^{-1} per piglet, 11 litters averaged over 75 g d^{-1}, and one litter exceeded 200 g d^{-1} per piglet. Average weight gain also varied greatly among litters (Table 1). Some litters gained 200 g or more per piglet each day after farrowing while others lost weight on the first 1 or 2 d and began to gain appreciable amounts only on day 3 or 4. The early weight gain patterns are described in detail by Thompson and Fraser (1988).

There was a small positive correlation between the litters' average initial weight (i.e. at time of first weighing) and water use on day 1 (r = 0.27, P < 0.05) and day 2 (r = 0.29, P < 0.05). Hence, the data were adjusted for initial weight when correlations involving water use were calculated. Water use tended to correlate negatively with weight gain during the first 3 d (Table 2). Water intake on day 2 showed the strongest correlations. The relationships involved considerable variation as illustrated in Fig. 1. However, the nine litters with the lowest gains on days 1 and 2 all used > 50 g d^{-1} of water per piglet on day 2, and the three litters that lost weight on days 1 and 2 all used) 100 g d^{-1} on day 2. Litter 76 had the lowest gains and the highest water intake in the experiment (Fig. 1); because of the extreme values, this litter was omitted from the calculation of correlation coefficients. By day 4, the situation had changed considerably, and water use tended to show low positive correlations with weight gain. Adjustment for farrowing crate type made almost no difference to the correlation coefficients.

The unusual pattern of early water use by slow-gaining litters is particularly apparent when the 10 litters with the smallest weight gains on days 1 and 2 are compared with the 10 litters which had the largest gains during the same period (Fig. 2). Initially, the litters with low gains used much more water than the rapidly-gaining litters ($P < 0.02$ on day 2 by Wilcoxon's Rank Sum Test). However, the rapidly-gaining litters showed a steady daily increase in their water use, and by day 4 were using slightly more water, on average, than the litters with low initial gains.

For the 10 litters whose drinking activity was recorded on video tape, water use and drinking activity were highly correlated (Spearman's Rank Correlation $r = 0.95$, $P < 0.01$).

Table 1. Means and ranges of litter values for average daily water use and average daily weight gain during the first 4 d after farrowing

	Water use ($g\ d^{-1}$ per piglet)			Weight gain ($g\ d^{-1}$ per piglet)		
Day	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
1	31	3	157	84	–136	224
2	51	3	304	130	–41	210
3	50	5	289	150	4	236
4	53	4	157	174	51	290
1-4	46	6	204	135	–3	210

Table 2. Partial correlations† between litter weight gain and water use over various time periods

Weight gains (days)	Water use					
	Day 1	**Day 2**	**Day 3**	**Day 4**	**Days 1-2**	**Days 1-4**
1	–0.22	–0.43	–0.23	0.04	–0.37	–0.25
2	–0.08	–0.35	–0.24	0.25	–0.25	–0.12
3	–0.05	–0.36	–0.19	0.16	–0.25	–0.13
4	–0.26	–0.45	–0.26	–0.02	–0.41	–0.30
1-2	–0.19	–0.45	–0.27	0.13	–0.38	–0.23
1-4	–0.20	–0.49	–0.28	0.12	–0.40	–0.26
1-7	–0.26	–0.44	–0.28	0.14	–0.40	–0.24
1-14	–0.23	–0.29	–0.16	0.21	–0.29	–0.13

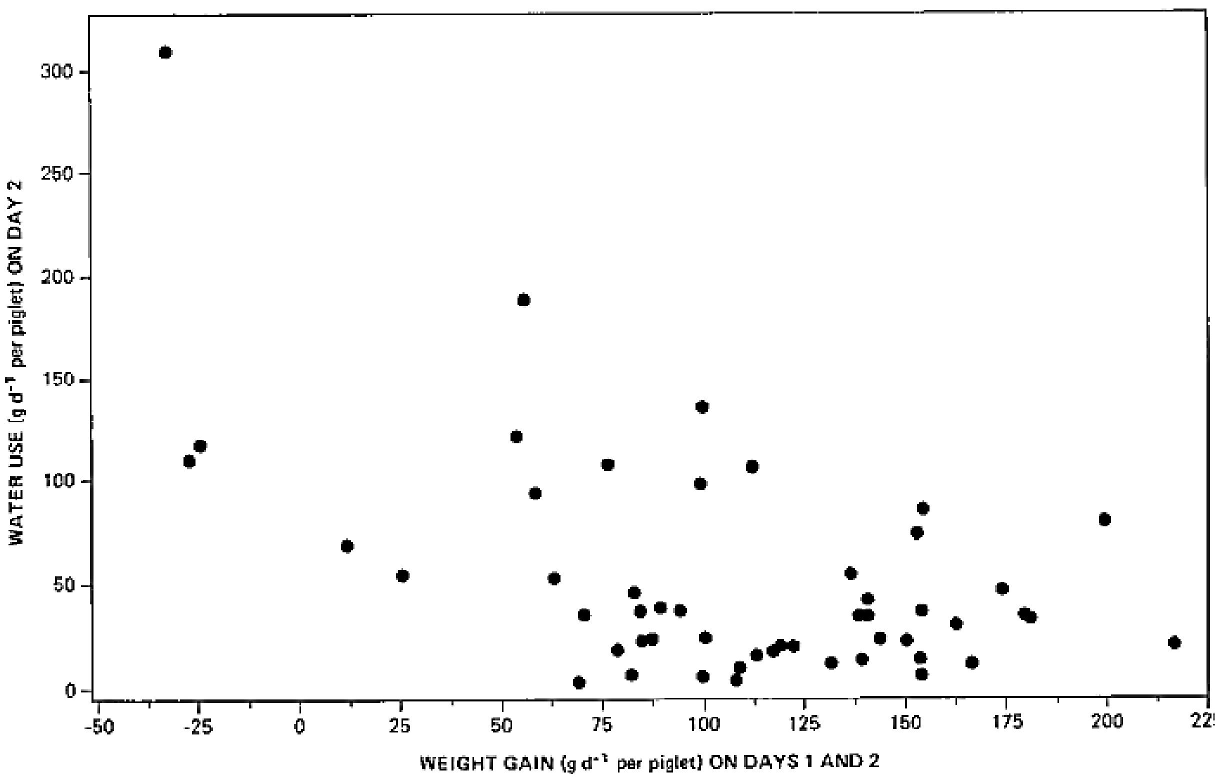
†Adjusted for average initial body weight of the litters and based on the data from 50 litters, with litter 76 having been omitted because of extremely high water use. Critical values, two-tailed, are $r = 0.273$ ($P < 0.05$), $r = 0.354$ ($P < 0.01$), and $r = 0.443$ ($P < 0.001$).

DISCUSSION

Most of the disappearance of water from the piglet drinker can be attributed to water consumption by the piglets. A litter's water use was closely correlated with the behavioral measure of apparent drinking by the piglets based on the video recordings. Evaporation was minimal, and spillage accounted for no more than

20% of water use on average. We conclude, therefore, that the litters were consuming appreciable but highly variable amounts of water beginning on the first day after farrowing.

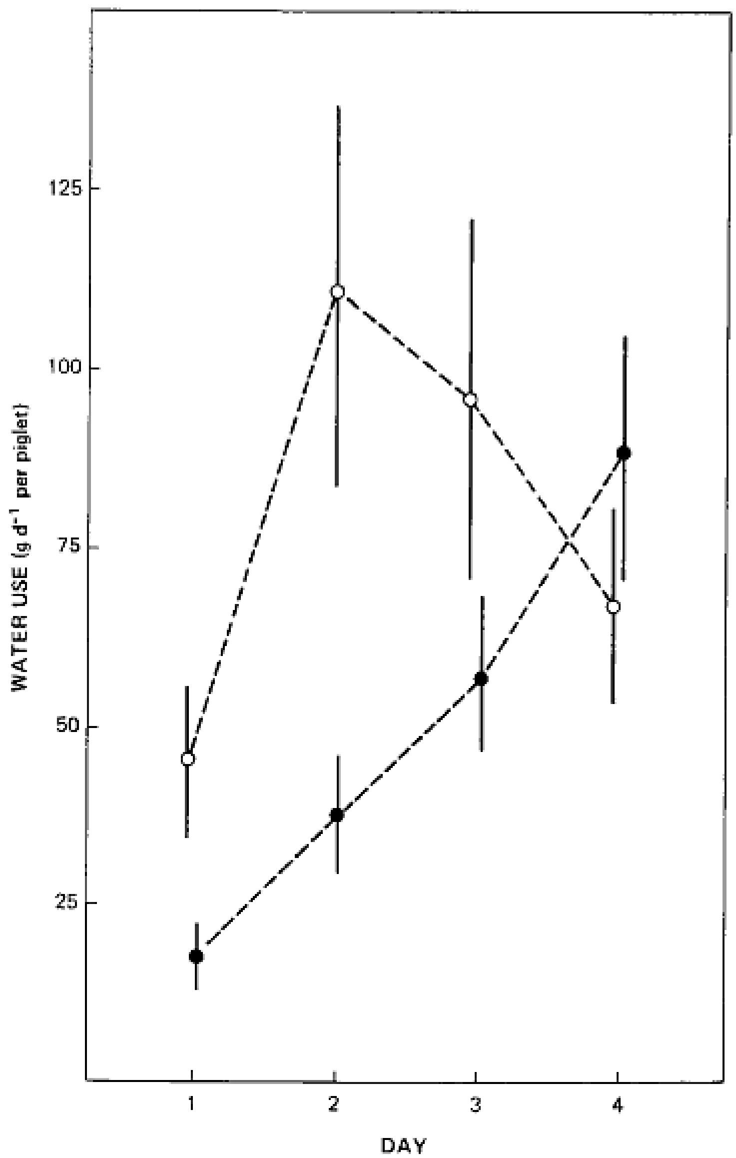
Fig. 1. Average water use on day 2 in relation to average body weight gain on days 1 and 2 for the 51 litters. Each point represents one litter. Average water use is negatively correlated with average weight gain (*r* = –0.41, or *r* = –0.45 after adjustment for average initial body weight). Litter 76 (the top, left-hand point) supports this trend but was omitted from the calculation because of unusually high water use.



The variation in water intake, although large, was far from random. As noted previously (Thompson and Fraser 1988), some litters gained little or no weight in the first 1-3 d after farrowing, presumably because of a temporary inadequacy of the sow's milk supply which tended to be rectified by the third or fourth day of lactation. Such litters were particularly likely to drink water, especially on day 2. On day 1, water intake was poorly correlated with gain, probably because the litters were just discovering the water source at this stage, and low milk intake may not have caused much significant dehydration within the first day. The high water intake on day 2 was probably in response to low fluid intake on both days 1 and 2 as reflected by the correlations. By days 3 and 4 litters with low early weight gain showed declining water intake (Fig. 2), presumably corresponding to improvements in the sow's milk supply as reflected by the weight gains (Table 1). Gain on days 3 and 4 was poorly correlated with water use on those days, but remained correlated with water use on day 2; this was presumably because a litter's gain on these later days is highly correlated with its gain on the first 2 d (Thompson and Fraser 1988).

The relationship between weight gain and water use involved a great deal of unexplained variation (Fig. 1). Some litters with below average gains (e.g., about 75 g d^{-1} on days 1 and 2) used very little water. Possibly these animals, although somewhat undernourished, still received enough milk to meet their fluid requirements. Alternatively, some piglets may have been too feeble or inactive to drink much, some may have lacked the developmental maturity to drink water in compensation for low fluit intake, and some may simply have failed to find the water dispenser. Variation in Fig. 1 was also due to some rapidly-gaining litters which used appreciable amounts of water. These pigs were probably consuming in the order of 400 g of milk each day (see Salmon-Legagneur 1965); it is not clear whether the 50-100 g d^{-1} of water per piglet used by some of these litters was of any real importance.

Fig. 2. Average water use on days 1-4 by the 10 litters with the lowest (open circles) and the 10 litters with the highest (closed circles) average body weight gain on days 1 and 2. Data were expressed as averages for each litter (g d^{-1} per piglet). Each point in the graph shows the mean ± SEM of 10 such litter averages.



Our findings on water intake by piglets are in sharp contrast with several earlier studies. With water provided for 9 h per day, Friend and Cunningham (1966) recorded an average intake of only 12 g d^{-1} per piglet in the first week after birth. Aumaitre (1965) recorded an average water intake of only 9 g d^{-1} per piglet in the first week; Bekaert and Daelemans (1970) recorded no water intake in the first week; and Wójcik et al. (1978) reported no water use before day 5 and only 12 g d^{-1} on average between days 5 and

10. In most of these studies, water was provided in open bowls, so the very young piglet's reluctance to use a nipple drinker (Bekaert and Daelemans 1970; Ehlert et al. 1981) was not a factor. Only the recent Swedish study by Svendsen and Andr6asson (1981) has reported water consumption similar to our values, with 30-50 g d^{-1} per piglet beginning on the first day after birth.

Why these discrepancies? The earlier studies, especially those done in the 1960s, may have involved lower environmental temperatures and/or less effective warming of piglets by supplementary heaters. Since the 1960s, increased emphasis has been placed on providing very warm conditions for new born piglets. Well-heated, modern facilities may help to prevent chilling and hypoglycemia in poorly-nourished piglets, but the greater warmth may cause increased water loss from the piglets and thus increase the risk of dehydration in poorly-nourished animals.

Factors other than hypogalactia may make additional water important for very young piglets. Ehlert et al. (1981) suggested that piglets with diarrhea may require extra water, and Svendsen and Andréasson (1981) concluded that provision of water from birth increased the survival of weak and underweight piglets which, presumably, would have difficulty competing for milk. If water is important mainly for sick or undernourished piglets, then our data may actually underestimate the importance of water. In our specific-pathogen-free herd, mastitis is virtually absent, and only 3 of the 51 litters lost weight on the first 2 d after farrowing. In more typical herds, mastitis is a common cause of piglet malnutrition on the first 3 d of lactation (Bäckström et al. 1984), and low initial weight gain coupled with high mortality is a common problem (de Passillé 1987).

These results lead us to question the common, although often unstated, assumption that supplementary water is of no consequence to piglets in the first few days after birth. We would speculate that under-nourished piglets, especially those housed in a warm environment, may be prone to dehydration in the first days after farrowing, and that at least some such piglets have the developmental maturity to compensate by drinking water. If this proves to be true, then provision of a water bowl accessible to the piglets from birth might help to reduce piglet deaths.

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