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Split Suckling, Birth Order, and Birth Weight Affects Colostrum Intake and Pre-Weaning Weight Gain

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Abstract

Thirty sows (DNA Line 241, n = 10/treatment) and litters (sired by Line 600, pigs n = 412) were used to determine the effects of split suckling on immunocrit, colostrum intake, and growth of low birth weight pigs and pigs that farrow last in the birth order. Three treatments were used 1) control, all pigs suckled ad libitum; 2) weight based, the heaviest 6 pigs were removed for 1.5 h; or 3) birth order based, the first half of the litter was removed for 1.5 h. Over all litters, heavier pigs at birth had greater ($P < 0.01$) colostrum intake and pigs born in the last half of the litter had lower ($P < 0.01$) immunocrits (a measure of circulating immunoglobulins) than pigs born in the first half of the litter. Removing the heaviest 6 pigs for 1.5 h beginning 6 h after farrowing resulted in increased ($P < 0.05$) weight gain by d 7. A tendency ($P = 0.15$) for treatment × birth order interactions suggests that split suckling increased colostrum intake for the later born pigs.

Keywords

colostrum intake, low birth weight pigs, split suckling

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Summary

Thirty sows (DNA Line 241, n = 10/treatment) and litters (sired by Line 600, pigs n = 412) were used to determine the effects of split suckling on immunocrit, colostrum intake, and growth of low birth weight pigs and pigs that farrow last in the birth order. Three treatments were used 1) control, all pigs suckled ad libitum; 2) weight based, the heaviest 6 pigs were removed for 1.5 h; or 3) birth order based, the first half of the litter was removed for 1.5 h. Over all litters, heavier pigs at birth had greater ($P < 0.01$) colostrum intake and pigs born in the last half of the litter had lower ($P < 0.01$) immunocrits (a measure of circulating immunoglobulins) than pigs born in the first half of the litter. Removing the heaviest 6 pigs for 1.5 h beginning 6 h after farrowing resulted in increased ($P < 0.05$) weight gain by d 7. A tendency ($P = 0.15$) for treatment × birth order interactions suggests that split suckling increased colostrum intake for the later born pigs.

Introduction

Colostrum is an important source of nutrients and immunoglobulins for newborn pigs. As litter size increases, the access to colostrum may not be equally distributed, particularly to low birth weight (LBW, < 1.4 lb) pigs and pigs later in the birth order. Temporary removal of part of the litter (split suckling) is often employed to afford more equal access to colostrum; however, the practice is not standardized. The objective of the study was to determine the effects of split suckling on pig immunoglobins, colostrum intake, and growth of low birth weight pigs and pigs that are born later in the birth order.

Procedures

Thirty sows (DNA Line 241, n = 10/treatment) and litters (sired by DNA Line 600, n = 412 pigs) were used. Sows were observed when they neared farrowing, and the time the first pig was born was recorded. Each pig was dried with a towel and weighed after removal of its umbilical cord. Pigs were then tagged and returned to the farrowing crate behind the sow. Sows that had fewer than 9 pigs born alive, or farrowing was longer than 7.5 h were not included. Six hours after the birth of the first pig, the litter was randomly assigned to 1 of 3 split suckling treatments: 1) control, all pigs suckled ad libitum; 2) weight based, the heaviest 6 pigs were removed for 1.5 h; or 3) birth order based, the first half of the litter was removed for 1.5 h. During separation from the sow, pigs were in a plastic storage tote behind the crate and a heat lamp was provided. The pigs remaining with the sow were observed to confirm at least one suckle occurred during separation. After 1.5 h, all pigs were returned to the farrowing crate and allowed to nurse ad libitum.

Pigs were weighed 24 h after birth of the first pig and at d 7 and 20 post farrowing. Also during the 24 h weighing, blood was collected from the cephalic or mammary vein (0.5 mL). Serum was separated by centrifugation and 50 µL of a 40% (wt/vol) of ammonium sulfate in distilled water was added to precipitate immunoglobulins. The precipitated sample was centrifuged (12,000 × g in a hematocrit centrifuge tube) for 10 min at room temperature. The immunocrit, a measure of colostral immunoglobulins (described by Vallet and co-workers[1]), was calculated as the ratio of the precipitate to the total length of the column. The colostrum intake was estimated according to the method of Amdi and co-workers[2] as:

$$\text{Colostrum}/24\text{ h} = 1.55 \times 0.944 \times \text{body weight gain } 24\text{ h} + (115).$$

Data Analysis
Data were analyzed using Proc GLIMMIX of SAS (Version 9.4, SAS Institute Inc., Cary, NC). Sow was the experimental unit with treatment nested within sow. The model included birth weight group: High > 1.45 kg (HBW); Middle > 1.11 and < 1.45 kg (MBW); Low < 1.11 kg; and birth order (1^{st} or second half of pigs born).

Results and Discussion
Birth weights were not ($P < 0.10$) different across treatments (Table 1) and weight gain to d 1 and d 20 were not ($P > 0.10$) affected by treatment. However, weight-based split suckling litters gained more ($P < 0.05$) than the controls to d 7. Pigs in the HBW category had greater ($P < 0.01$) weights on d 1, 7, and 20.

Colostrum intake (Table 2) was less ($P < 0.01$) for the MBW and LBW compared to HBW pigs, and for LBW compared to the MBW pigs. There were no ($P > 0.10$) differences in immunocrit ratios due to treatment or birth weight category. However, a tendency ($P = 0.15$) for a treatment × birth order effect may indicate a benefit for split nursing for later born pigs (Figures 1 and 2). Overall, pigs born in the second half of the litter had lower ($P < 0.01$) immunocrit values than pigs born in the first half of the litter. Immunocrit and colostrum intake were positively correlated ($r = 0.49$, $P < 0.01$).

Our data indicate that both birth weight and birth order affect pigs in the preweaning period and weight-based split suckling improved growth to day 7. Two methods for estimating colostrum intake are those based on weight gain during the first 24 h after birth and the circulating immunoglobulins. We found a tendency for birth-order-based split suckling to increase colostrum intake for the second half of the pigs born.

[1] Vallet, J.L., Miles, J.R., Rempel, L.A. A simple novel measure of passive transfer of maternal immunoglobulin is predictive of preweaning mortality in piglets. Vet. J. 2013. 195:91-97.
[2] Amdi, C., Krogh, U., Flummer, C., Oksbjerg, N., Hansen, C.F., Thei,l P.K. Intrauterine growth restricted piglets defined by their head shape ingest insufficient amounts of colostrum. J. Anim. Sci. 2013.91:5605-5613.

However, weight-based split suckling did not improve colostrum intake for light birth weight pigs. Neither treatment affected immunocrit values. Overall, our immunocrit measurements are higher than those reported previously. Perhaps this could be due to sow genetics or management practices.

Table 1. Pig body weight gain by treatment

Treatment	Birth weight, lb	D1 gain, lb	D7 gain, lb	Overall gain, lb
1 Control				
10 litters, 132 pigs	2.82	0.22	2.51[a]	9.46
2 Weight-based split suckling				
10 litters, 137 pigs	2.82	0.25	2.93[b]	10.14
3 Birth order based split suckling				
10 litters, 143 pigs	2.80	0.23	2.65[ab]	9.26
SEM	0.042	0.024	0.11	0.38

[ab] Means with different superscripts differ ($P < 0.05$).

Table 2. Colostrum intake and immunocrit values by birth weight category and treatment

Treatment	Birth weight category[a]	Colostrum intake, grams	Immunocrit
1 Control	High	299	0.150
10 litter, 132 pigs	Mid	249	0.151
	Low	194	0.133
2 Weight-based split suckling	High	327	0.147
10 litters, 137 pigs	Mid	285	0.159
	Low	210	0.149
3 Birth order based split suckling	High	310	0.145
10 litters, 143 pigs	Mid	265	0.145
	Low	227	0.155
SEM		21.61	0.009

[a] Overall, High pigs consumed more colostrum than Mid pigs and Low pigs, and Mid pigs consumed more colostrum than Low pigs ($P < 0.01$). There were no differences among treatment for immunocrit.

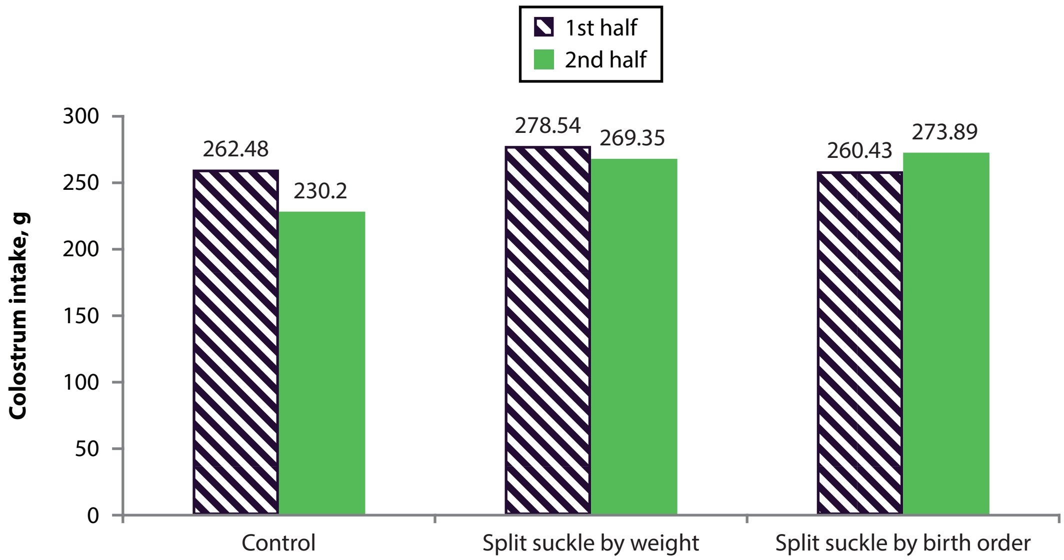

Figure 1. Colostrum intake as affected by birth order and treatment. There was a tendency ($P = 0.15$) for a birth order × treatment interaction. (SEM = 13.20).

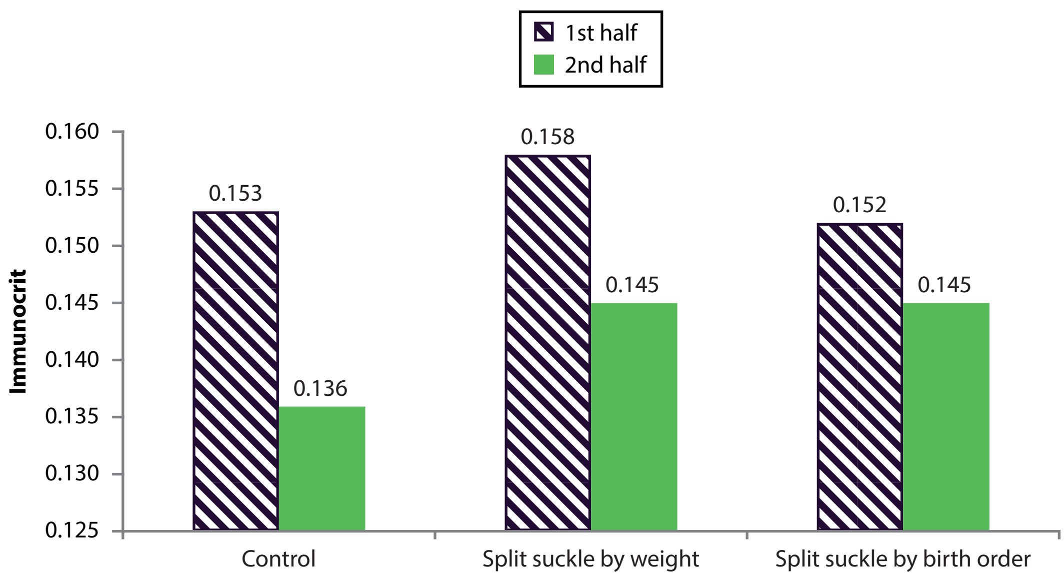

Figure 2. Immunocrit values as affected by birth order and treatment. (SEM = 0.04).