

The Impact of Litter Size on Pig Growth Performance and Variability

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Prior to the widespread adoption of all-in-all-out production systems, variation in growth was largely a “hidden” cost. Pigs were selected from pens when they reached market weight, and the fact that some pigs required 4 to 6 weeks longer than others to reach market went largely unnoticed, or at least ignored. Furthermore, in continuous-flow systems, downtime due to variable growth rates affects pen usage, while in all-in-all-out (AIAO) systems, it affects room or barn usage. The economic impact is therefore much greater in AIAO systems.

Additionally, sow productivity is rapidly increasing in Canada: Average litter size has increased from 10.4 to 11.2 piglets in the last 5 years. Increased litter size results in reduced average birth weight. Typical, a 1 pig increase in litter size reduces mean birth weight by 50 to 150 grams, and doubles the proportion of pigs with a birth weight below 800 grams. Whether this reduced birth weight is accompanied by increased variation in growth is the current focus of research at the Prairie Swine Centre and Lacombe Research Centre.

Variation begins on the day piglets are born; a typical CV for birth weight is between 22% and 26%. When piglets from 52 sows were followed through eight consecutive parities, it was shown – not surprisingly - that the number of live-born piglets in a litter was negatively correlated with mean piglet birth weight and positively correlated with the CV of litter birth weight. The percent survival to weaning was highest in litters with fewer piglets born alive, high mean birth weight and a low birth weight CV.

After birth, additional factors contribute to variability. Heavier birth weight piglets consume about 30% more milk than their lighter littermates. In addition, heavier birth weight piglets, or at least those that win the most fights early in life, tend to suckle the anterior teats on the sow, which are known to deliver higher milk volumes. Lower milk intake is not only associated with slower growth, but whole-body protein synthesis is also reduced.

One of the most predictable contributors to variability in the post-weaning period is the variability in weaning weight. For example, the correlation (r) between weaning weight and nursery exit weight was found to be 0.73. Numerous researchers have related weaning weight to nursery exit weight by suggesting that for every 1 kg increase in weaning weight, nursery exit weights will increase by X kg. It is our experience that this relationship varies widely among farms; at PSC Elstow Research Farm, we have found that for every 1 kg increase in weaning weight, there is a concomitant 1.9 kg increase in nursery exit weight (~70 days of age) and a 4.2 kg increase in market weight.

While differences in birth weight are obvious, what is less clear is the relationship between birth weight and physiological “competency” at birth, or factors that may affect later growth rates. Low birth weight has been associated with a reduced number and height of intestinal villi, reduced lactase and lipase activity, reduced muscle respiratory enzyme activity, fewer muscle thyroid hormone receptors and lower IGF-1 levels in the blood. Additionally, increased litter size and associated smaller birth weights has been shown to lower the number of muscle fibres differentiating before birth. This could logically lead to changes in carcass composition and the eating quality of pork.

Because of the interest in this subject, an experiment is currently underway at the Prairie Swine Centre and Lacombe Research Centre whereby 98 litters were followed from farrowing through to market. Our objective is to study the impact of litter size and birth weight on growth performance, carcass composition and eating quality of pork. The experiment is still in progress, but the following information is now available.

Litters were arbitrarily assigned to “small” (3 to 10 born alive), “medium” (11 to 13 born alive) and “large” (14 to 19 born alive) litters. Normal cross-fostering was allowed. Although, larger litters had the expected reduced average birth weight, the SD was similar between larger litters and litters with fewer piglets. A similar tendency was observed as the pigs grew. In fact, by nursery exit, and at 1st pull, the slight increase in CV observed at birth in the larger litters (a result of a reduced average body weight) was no longer observed.

Work on this project continues at Lacombe Research Centre to study the muscle composition and pork eating quality of pigs selected from each of 4 birth-weight categories within each of 25 litters. These data should be available in the near future.

Given that litter size is growing rapidly, and there is growing controversy surrounding the drive to increased sow productivity, much more data is required to determine the true impact of litter size and birth weights on ultimate pig performance and ultimate pork quality. Based on these preliminary results, the impact may not be as large as some people suggest.

Effect of litter size on growth and the variation in growth.

	Small litters (n=38)	Medium litters (n=39)	Large litters (n=21)	All litters (n=98)
Total Born Alive				
n	318	472	324	1114
Mean	8.37	12.10	15.43	11.37
Total Born				
n	350	521	329	1200
Mean	9.21	13.36	15.67	12.24
Total Weaned				
n	277	402	274	949
Mean	7.29	10.31	12.86	9.68
Birth Weights				
n	271	396	268	935
Mean (kg)	1.59	1.41	1.35	1.44
StDev (kg)	0.32	0.30	0.32	0.33
Min (kg)	0.80	0.75	0.75	0.75
Max (kg)	2.50	2.50	2.35	2.50
CV (%)	20.13	21.27	23.76	22.61
Weaning weights (ave. 19 days of age)				
n	271	396	268	935
Mean (kg)	6.78	6.43	6.47	6.55
StDev (kg)	1.59	1.33	1.45	1.45
Min (kg)	1.55	2.00	2.05	1.55
Max (kg)	10.70	9.75	10.10	10.70
CV (%)	23.45	20.67	22.39	22.11
Body weights at nursery exit (ave. 68 days of age)				
n	271	396	268	935
Mean (kg)	32.57	31.67	32.88	32.28
StDev (kg)	5.00	4.28	4.63	4.62
Min (kg)	11.90	18.75	14.50	11.90
Max (kg)	44.40	43.85	44.90	44.90
CV (%)	15.36	13.50	14.10	14.33
Body weights at 1st pull				
n	255	330	221	806
Mean (kg)	96.88	96.29	98.11	96.98
StDev (kg)	11.06	10.74	11.13	10.96
Min (kg)	59.90	49.00	51.20	49.00
Max (kg)	108.00	118.40	122.20	122.40
CV (%)	11.41	11.16	11.35	10.44