



Dietary energy manipulations and
reproductive performance in primiparous sows

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Abstract

In primiparous sows, feed intake is generally insufficient to meet lactation demands. Inadequate nutrient supply increases mobilisation of body reserves and, as a consequence, affects subsequent reproduction. Excessive loss of body reserves during lactation is not only associated with delayed post-weaning oestrus and the size of the subsequent litter, but also increases culling rate and reduces sow longevity and the productivity of the breeding herd. The aim of the thesis was to develop a clear understanding of the impact of a negative energy balance during lactation on the reproductive performance of modern primiparous sows in Australia, and evaluate feeding strategies involving energy manipulations during crucial periods intended to improve subsequent litter size.

In the first study, the associations of sow body weight changes during lactation and the body weight at weaning with subsequent reproductive performance were studied to investigate breeding herd performance in South Australia. By minimising body weight loss and maintain adequate body reserves at weaning through the supply of sufficient energy when rearing equal to or less than ten piglets during lactation, the post-weaning reproductive performance and fertility had no influence in modern primiparous sows.

In the second study, the carry-over effects of energy intake during the early antral phase and subsequent follicular phase on follicle recruitment and ovulation rate were assessed using a gilt model. Follicle size at the end of the luteal phase was greater for gilts that were previously fed at a high feed level. During the follicular phase, high feeding increased follicle size at Day 5 and plasma oestradiol concentration.

Nevertheless, a low feed level during the luteal phase reduced ovulation rate and the number of embryos, and this was not counteracted by feed level during the follicular phase. Plasma progesterone concentration after ovulation was lower for gilts that were restricted-fed throughout the whole period than for other treatments. These results indicate that undernutrition during early antral follicular development has a residual effect on follicle recruitment and quality.

In the third study, the effects of substituting 1 kg of a standard lactation diet with 1 kg of a sugar-rich or fat-rich diet during late lactation on blood glucose and insulin changes were investigated. The results demonstrated that a sugar-enriched diet during the last week of lactation elevates circulating glucose and insulin concentrations, and offer a means to improve post-weaning fertility in primiparous sows. Therefore, the fourth study investigated the effects of pre-weaning energy substitutions plus post-weaning altrenogest treatment as positive control on follicular development, endocrine characteristics and subsequent litter size in primiparous sows. The weaning-to-ovulation interval tended to be reduced in the sugar-rich treatment, although body weight loss during the treatment period, post-weaning follicle development, plasma oestradiol and pre-weaning leptin did not differ among treatments, except body weight loss was lower and leptin was higher in the altrenogest treatment. Post-ovulatory progesterone concentration in the sugar treatment was higher. Sows in the sugar-rich and altrenogest treatments had a greater proportion of litters with larger litter sizes. The outcome indicates that increasing circulating insulin and glucose concentrations during late lactation or a week of metabolic recovery produces large subsequent litter size in primiparous sows.

Industry will be able to achieve an improvement of reproductive performance by maximising energy intake (using an insulin-stimulating diet) during late lactation, or by post-weaning altrenogest administration for a week for energy restoration. Otherwise, adverse impacts of a negative energy balance during lactation will be carried over into the mating period, and will depress subsequent reproductive performance.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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Publication list

Chapter 3: Undernutrition during early follicle development has irreversible effects on ovulation rate and embryos

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Chapter 4: Effects of pre-weaning substitutions on plasma insulin and glucose profiles in primiparous sows

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Chapter 5: Effects of pre-weaning energy substitutions on post-weaning follicle development, steroid hormones and subsequent litter size in primiparous sows

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Contributions of jointly authored papers

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The (co)-authors give permission for the publications of their collaboration to be included in the thesis.

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