Australasian Pork Research Institute Ltd APRIL

PROJECT SUMMARY

Project Number and Title: 6A-109 Review: *Identifying knowledge gaps and strategies to improve progeny uniformity of pigs*.

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Project Participants: Rivalea (Australia) Pty Ltd.

Aims and Objectives: Improving the uniformity of carcass weight and backfat increases the revenue for the pig producers. This literature review aimed to increase understanding of the factors contributing to carcass weight and fatness variation within a production batch. The review identified knowledge gaps in some specific aspects of carcass variation. The review also aimed to provide background information for developing effective strategies to improve carcass uniformity.

Methods of the review:

This literature review discussed the aetiology of causes of variation in tissue deposition rate within a progeny batch, covering the physiological and nutritional factors during the pre-mating, prenatal, pre-weaning and post-weaning phases. The studies conducted in pigs and published in peer-reviewed (English-written) journals are reviewed. The effectiveness of the strategies that attempted to reduce the variation and novel candidate strategies are proposed for developing a future research program.

Key Findings:

For the pre-mating factors, the protein content loss from the previous lactation and different ovulation timing of follicles are two novel factors influencing the within-litter coefficient of variation (CV) of foetal development. Grouping progeny pigs born to the sows with a widespread weaning-to-oestrus interval (WOI) can expand age-related carcass variation. Technologies that can standardise WOI would help reduce between-litter age variations and age-related carcass variation.

Among prenatal factors, the non-uniform foetal development amongst littermates is a key source for the variation in the predisposition of tissue growth. Myofibre proliferation during the foetal phase is associated with lifetime muscle deposition and lean percentage. Comparative physiology between Meishan and Western breed sows indicates that placental vascularity contributes to within-litter uniformity, but the direct association has not been validated in sows. The effective strategies to improve placental vascularity and uteroplacental blood flow in sows remain to be investigated. Laboratory animal studies have provided valuable potential solutions. Increasing feeding allowance above 30 MJ ME/day does not improve litter weight or within-litter uniformity of birth weight.

During the pre-weaning phase, the within-litter growth variation is affected by colostrum/milk consumption during lactation. Providing milk supplements to born-light piglets can temporarily increase weaning weight, but the advantage diminishes after weaning and does not lead to increased slaughter weight. Increasing myonuclear accretion through stimulating satellite cell

proliferation during the neonatal phase may be a novel strategy to restore the inferior muscle deposition of born-light progeny. However, fundamental research is required to quantify the contribution of satellite-cell-derived myofibers to muscle deposition.

Post-weaning factors, such as insufficient feeder space and low health status during the grower-finisher phase, can increase the pig-to-pig variation of growth rate in a production batch. Increasing floor space above 0.62 m^2 per pig (av. 60 kg live weight) does not improve growth uniformity. Sorting pigs by weight at weaning does not maintain body weight uniformity at slaughter, as it is overwhelmed by the increased standard deviation of bodyweight with age. Sorting pigs by weight at the grower phase and custom feeding the lightweight subgroups can improve the within-batch uniformity. Catch-up growth of born-light piglets requires sufficient predisposition factors such as myofibre number and digestive function. Emerging evidence showed a causal role of the gut microbiota in the tissue growth of pigs, highlighting a new area for understanding the aetiology of variation of carcass traits.

A list of recommended experiments is proposed to increase our understanding of the pre-mating, prenatal, pre-weaning and post-weaning factors that affect uniformity and to develop strategies:

1. Validate the relationship between protein loss of lactation on subsequent WOI and within-litter birth weight variation in modern sows, particularly when catabolism occurs, e.g., summer lactation.
2. Develop strategies to reduce the WOI for the primiparous sows to improve the uniformity of weaning age in the subsequent parity.
3. Can feeding gestating sows to the predicted litter size achieve improved within-litter uniformity in birth weight?
4. Strategies to increase ovulation uniformity to improve birth weight uniformity.
5. Compare uteroplacental haemodynamics in small vs large foetuses in order to understand the role of placental blood flow in foetal development.
6. Investigate the effect of placental angiogenesis or vasodilator candidates on within-litter uniformity in pigs.
7. Validate neonatal myofibre proliferation in modern genetics and develop strategies for stimulating muscle fibre proliferation of born-light piglets within the first four weeks after birth.
8. Investigate the initial sorting at the grower phase with an optimised grower-finisher feeding program or functional nutrients for the lightweight cohort.
9. Investigate the contribution of individual variation of gastrointestinal microbiota composition to the carcass variation within a production batch.

Applications to Industry:
The current literature reiterates the importance of within-batch carcass uniformity in the piggery economics. The literature summarised in this review serves as background knowledge for guiding pig industry researchers to develop implementable strategies for improving carcass uniformity.