The effects of genetic merit for fertility traits on ovarian dynamics during the oestrous cycle in lactating dairy cows

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Introduction The incorporation of fertility traits into selection indexes has allowed identification of animals with similar genetic merit for milk production traits, but divergent genetic merit for fertility traits. Using a high and low fertility genetic model established in this manner, Cummins *et al*. (2009) demonstrated similar phenotypic milk production, but divergent phenotypic fertility performance. The aim of this study was to characterise the ovarian dynamics of a complete oestrous cycle in cows with divergent genetic merit for fertility traits but similar genetic merit for milk production traits.

Material and methods The Estimated Breeding Values (EBV) of the high (n = 19) and low (n = 12) fertility cows used in this study are summarised in Table 1. Cows were synchronised with a CIDR based protocol (GnRH + CIDR in on day 0, $PGF_{2\alpha}$ on day 7 and CIDR out on day 8). Starting on the day of synchronised oestrus, transrectal ovarian ultrasound examinations were carried out daily, and continued until ovulation at the end of the ensuing cycle. The number, size and location of all ovarian structures were recorded daily. Statistical analysis was carried out using SAS. The number of follicular waves (NumWaves) was analysed using PROC NPAR1WAY and the Kruskal-Wallis test. Mixed model methodology was used to analyse continuous data using the model Y = μ + genotype + lactation + NumWaves + e. Repeated measures was used to compare corpus luteum (CL) volume from day 0 to 16, and the number of small follicles (<5mm) during the first follicle wave. The model used was Y = μ + genotype + lactation + day of cycle + day of cycle*genotype + e. Cow nested within genotype was included as a random effect in all mixed models.

Table 1 The EBV (and SD) for milk production and fertility in cows with high and low EBV for fertility traits

Trait	High Fertility	Low Fertility
Milk BV (kg)	232 (69)	213 (64)
Calving interval BV (days)	-3.3 (0.7)	2.5 (1.0)
Longevity BV	1.6 (0.4)	-0.1 (0.5)
EBI production sub-index (€)	46 (16)	43 (12)
EBI fertility sub-index (€)	54 (8)	-30 (14)

Results Oestrous cycle measurements are summarised in Table 2. The high fertility sub-index group tended (P <0.07) to have fewer follicular waves (2.2 vs. 2.7), and on average a shorter oestrous cycle than the low fertility sub index group. Both groups commenced first wave follicular growth on similar days (1.4 days), but the low fertility group took longer (P<0.05) for the first wave dominant follicle (DF) to achieve its peak diameter; this peak diameter tended to be larger (16.1 vs. 14.7 mm) in the low compared to the high fertility group. There was no difference in the number of follicles <5 mm in diameter during the first follicle wave. The largest diameter of the ovulatory DF tended to be greater in the high than the low fertility group. Average CL volume was greater in the high than the low fertility group during the first 16 days of the oestrous cycle.

Table 2 Oestrous cycle characteristics (and s.e.) of high and low fertility sub-index groups

	High Fertility	Low Fertility	P
Day of 1st wave DF peak (Days)	7.7 (0.6)	9.9 (0.7)	0.019
Day of ovulation (Days)	21.9 (0.7)	24.1(1.0)	0.054
Ovulatory DF max diameter (mm)	17.6 (0.4)	16.4 (0.5)	0.059
No. of follicles <5mm in 1st wave	18.5 (1.4)	16.8 (1.7)	n.s.
CL volume (mm^3)	6757 (280)	5737 (353)	0.026

Conclusion Some differences in ovarian follicular and CL dynamics were observed, demonstrating that genetic merit for fertility traits may be manifest in measurable changes in ovarian function. Further work is necessary to characterize the reproductive hormone profiles associated with the recorded differences in ovarian follicular and CL dynamics.

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References

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