Factors affecting ovulation potential in Holstein-Friesian dairy cows

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Introduction Reproductive performance in high yielding Holstein-Friesian (HF) dairy cows has severely declined over the last 40 years. The cause is multifactorial, however, there is substantial evidence suggesting that the degree of negative energy balance (NEB) is highly influential (Beam and Butler, 1999). During early lactation, high yielding dairy cows are unable to consume sufficient food to support the high level of milk production and therefore experience severe and prolonged NEB, causing excessive mobilisation of body energy reserves. Severe NEB has been shown to extend the interval from calving to the commencement of luteal activity and the interval to EB nadir is correlated with the number of days to the first post-partum ovulation (Staples *et al.,* 1998). The aim of the current study was to assess the effects of NEB on growth of the dominant follicle (DF), on the pulsatility and surge of LH preceding ovulation and on the growth of the corpus luteum thereafter.

Materials and methods Post-calving; ten multiparous HF dairy cows (mean parity, 4.2) were offered, *ad libitum*, a total mixed ration comprised of 55% concentrate and 45% forage (80% grass silage + 20% maize silage; DM basis). The diet contained 12.5 MJ metabolisable energy and 186 g crude protein per kg DM. Animals were synchronised to ovulate at days 42, 70 and 98 postpartum using controlled intra-vaginal drug release (CIDR) of progesterone. A rectal ultrasound scan was performed on alternate days after CIDR insertion to assess follicular growth; then at 6 hr intervals for 72 hrs after CIDR removal to detect ovulation; and also on alternate days from 72 hrs after CIDR removal to day 7 post-insemination, to assess growth of the corpus luteum. Prior to CIDR removal, an indwelling catheter was placed in the jugular vein. Following CIDR removal, blood was collected at 10 minute intervals for 8 hrs to determine LH pulsatility and at 3 hr intervals thereafter, for a total of 72 hrs, to detect the LH surge preceding ovulation. Milk progesterone was assessed daily from CIDR insertion to day 7 post-insemination. Animals were inseminated 56 hrs after CIDR removal and upon detection of ovulation. Data were analysed using REML and linear regressions via Genstat.

Results During the experimental period, cows had an average milk yield of 41.4 kg/d (S.E.D. 2.3), average dry matter intake of 21.7 kg/d (S.E.D. 0.4) and average EB of -33.4 MJ/d (S.E.D. 13.2)**.** There was no difference in milk yield between cows that ovulated and those that did not but cows that ovulated had a significantly higher DMI (20.2 vs. 18.5 kg DM/d; SED, 0.76; $P<0.05$) during weeks 1 to 5 postpartum. Animals that ovulated had higher peak LH concentration, a higher DF growth rate and a larger DF at ovulation than those that failed to ovulate (Table 1).

Table 1 Effects of energy, blood and follicular parameters on ovulation.

	Ovulated	Not ovulated	SED	Sig
LH peak concentration (ng/ml)	9.28	4.70	1.87	*
Interval from CIDR removal to LH peak (hrs)	37.0	44.0	5.49	NS
DF growth rate from CIDR insertion to CIDR removal (mm/day)	0.9	0.4	0.16	**
DF growth rate from CIDR removal (mm/day)	2.9	1.4	0.25	***
DF diameter at CIDR removal (mm)	23.7	18.2	0.91	***
DF area (mm^2)*	241	133	27.35	***
DF max diameter (mm)*	27.9	20.3	1.71	***
Milk progesterone concentration (ng/ml) on d7 post-insemination	14.4	6.60	2.68	**

* DF area/ maximum diameter at ovulation or 69 hrs post CIDR removal in ovulated and non-ovulated animals respectively

There were no significant effects of blood metabolites during weeks 1 to 5 postpartum on ovulation; however, significant ($P<0.05$) relationships were observed between plasma NEFA concentrations and the interval from CIDR removal to LH peak (positive relationship) and between plasma glucose concentrations and the interval from CIDR removal to the LH peak (negative relationship).

Conclusions High yielding Holstein-Friesian dairy cows that did not ovulate showed reduced follicular development, delayed LH peak and reduced peak LH concentration compared to animals that ovulated. Increases in blood metabolite concentrations associated with the mobilisation of body reserves negatively affected DF growth and the interval to peak LH, both of which have previously been associated with reduced reproductive performance.

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