Comparison of effect of artificial insemination and in vitro embryo production on gestation length, calf birth weight and calving difficulty

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Summary

- Increased usage of sexed semen will decrease the number of male dairy calves, thereby improving the sustainability credentials of the dairy sector. A new strategy to generate the next generation of elite genetic merit bulls will be required.
- In vitro embryo production can accelerate genetic gain by facilitating multiple matings between elite dams and sires.

Introduction

Every year, ≥60% of the calves born on Irish dairy farms are destined for beef production. Many of these are male offspring of dairy sires and are not genetically selected for beef production, resulting in low economic value. The usage of sexed semen from dairy bulls has rapidly increased in recent years. This has allowed dairy farmers to accelerate herd genetic gain by selecting the best genetic merit dams to breed replacements, and breeding all other dams to beef sires. There are two consequences of these changes to dairy breeding practices: (1) it will be necessary to generate elite genetic merit male dairy calves; and (2) more beef semen will be used than dairy semen, requiring greater efforts to generate beef bulls specifically suited for crossing with dairy dams. Assisted reproductive technologies, particularly in vitro embryo production (IVP) and embryo transfer (ET) can contribute to accelerating genetic gain in both dairy breeds and beef breeds suitable for mating with dairy cows by increasing number of offspring produced from genetically elite dams.

IVF-ET calves in Moorepark

The aim of this study was to determine the effect of embryo origin (artificial insemination, AI vs embryo transfer, ET), calf breed, and calf sex on gestation length (GL), birthweight (BW), and calving difficulty (CD) score. Lactating dairy cows were synchronised with a standard 10-day Progesterone-Ovsynch protocol and randomly assigned to receive timed AI (n =163; frozen-thawed conventional semen) or timed ET with fresh (ET-Fresh; n=291) or frozen (ET-Frozen; n=289) in vitro produced (IVP) embryos. Data were subsequently obtained from a subset (n = 273) of calves that were derived from these breeding events. Calves derived from the IVP embryos were either dairy (Holstein-Friesian, FR, n = 81 or Jersey, JE, n = 38) or beef breed (Angus, AA, n = 94). For all calves, weight was recorded immediately after birth and calving difficulty was scored on a scale of 1 to 4: 1 = unassisted calving (n =173), 2 = minor assistance (n = 52), 3 = considerable difficulty (n = 45) or 4 = veterinary assistance/ caesarean (n = 3). The effects of embryo origin (AI, ET-fresh, ET-Frozen), breed (FR, JE, AA) and calf sex on GL, BW and CD score were examined.

Results

There were positive correlations between GL and BW (r = 0.33) and between BW and CD score (r = 0.55). This means that as GL got longer, calf birthweight increased, and that as calf birthweight increased, CD score also increased. Overall, origin of the calf affected BW, GL and CD (Table 1). Amongst calves born from ET, AA calves were heavier, had longer GL and greater incidence of CD than FR or JE calves. When the analysis was restricted to FR calves only, calves born from ET (fresh or frozen) were slightly heavier than those born from AI (+3.7 kg). Overall, male calves were heavier than females (40.8 ± 8.2 kg vs. 37.2 ± 8.0 kg.

Table 1. *Mean ± SD gestation length (GL), birth weight (BW) and calving difficulty (CD) score following timed AI or ET with fresh or frozen IVP embryos*

Embryo origin	Breed	Number	GL (days)	BW (kg)	CD score
AI	FR	52	276.5 ± 4.2	35.7 ± 5.1	1.3 ± 0.5
	JE	8	277.8 ± 4.0	26.8 ± 3.7	1.0 ± 0.0
ET-fresh	AA	52	281.8 ± 4.9	46.9 ± 8.3	2.2 ± 1.0
	FR	47	278.9 ± 4.5	39.2 ± 5.5	1.4 ± 0.7
	JE	p	282.8 ± 4.7	29.9 ± 4.0	1.1 ± 0.3
ET-frozen	AA	42	281.0 ± 5.9	44.1 ± 6.8	1.6 ± 0.9
	FR	34	279.6 ± 4.4	39.6 ± 4.6	1.6 ± 0.8
	JE	16	280.6 ± 3.2	29.2 ± 4.3	1.3 ± 0.6

Conclusions

In conclusion, calves originating from IVP/ET were heavier at birth, had up to three days longer GL and had a slightly increased incidence of CD compared with calves derived from AI. Given the small numerical difference between the calves derived from the different embryo origins, however, the impact at farm level of these differences is likely to be minimal. The AA calves were, as expected, heavier than dairy breed calves, and hence careful selection of elite genetic merit DBI donors and sires for the production of beef embryos is necessary to ensure low BW, GL and CD of beef ET calves born from dairy dams. Furthermore, beef breed embryos should be transferred into mature cows with a large frame, whereas dairy breed embryos can be safely transferred into all cows.

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