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Embryo survival in dairy cows managed under pastoral conditions☆

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Abstract

Efficient pasture-based milk production systems require a compact calving pattern aligned to the onset of the grazing season, a 365-day calving interval and low culling rates for infertility. Achievement of these targets requires high herd reproductive performance. While high genetic merit Holstein cows produce more milk in grass-based systems their fertility is compromised. Management of the modern high genetic merit Holstein dairy cow presents a major challenge in pasture-based systems of production. It appears that the extent of early embryo loss is greater (up to 20% points greater) in the modern high-producing dairy cow and that a much higher proportion of the embryos die before day 7 following insemination in contrast to heifers and lower yielding cows. About 7–8% of pregnancies are lost between days 30 and 90 of gestation with no evidence that loss rate is related to cow genetic merit, parity or level of production. Systemic concentrations of progesterone during both the cycle preceding and following insemination affect embryo survival rate with evidence that too low or indeed too high a concentration of progesterone been negatively associated with embryo survival rate. Peripheral concentrations of both progesterone and oestradiol are lowered by increased plane of feed intake due to increased metabolic clearance rate of the steroids, which is related to liver blood flow. It appears that high producing dairy cows have an increased risk of embryo death as a result of lowered peripheral concentrations of progesterone as a consequence of increased hepatic metabolism of progesterone. Uterine expression of mRNA for progesterone receptor, oestradiol receptor and retinol binding protein mRNA appears to be sensitive to changes in peripheral concentrations of progesterone during the first week after AI. It would appear that energy balance and dry matter intake during the 4 weeks, immediately after calving are critically important in determining conception rate when cows are inseminated at 70–100 days post-calving. Concentrate supplementation of cows at pasture during the breeding period has minimal affects on conception rates though sudden reduction in dietary intake should be avoided. For pasture-based

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systems of milk production more balanced breeding strategies, with greater emphasis on fertility and feed intake must be developed.

Keywords: Dairy cows; Pasture-based systems; Embryo survival; DM intake; Genetic merit; Progesterone; Insulin; IGF-I

1. Introduction

Intensive selection for increased milk production, coupled with improved nutrition and liberalisation of semen import and export regulations has led to significant improvements in milk output per cow over in recent decades. However, this increase in milk yield has been accompanied by a decline in cow fertility both in intensive systems based on high input maize-based diets (Nebel and McGilliard, 1993; Beam and Butler, 1999) and in less intensive, pasture-based systems of milk production such as practiced in Ireland (Mee, 2004). Efficient pasture-based milk production systems require a compact calving pattern aligned to the onset of the grazing season, a 365-day calving interval and low culling rates for infertility. Achievement of these targets requires high herd reproductive performance. While it is now well established that high genetic merit Holstein cows selected for milk production on intensive production systems, also produce more milk in grass-based systems (Kennedy et al., 2003; Horan et al., 2004), their fertility is compromised. As a consequence, their suitability and ultimately their sustainability for pasture-based systems of production are questionable unless their reproductive performance can be significantly increased. Management of the modern high genetic merit Holstein dairy cow clearly presents a major challenge in pasture-based systems of production. The objective of this paper is to review current information on reproductive parameters in cattle and in particular on the factors that affect conception rate in modern dairy cows in a pasture context and to propose potential avenues to improve herd reproductive performance.

2. Fertilisation rate and early embryo loss in cattle

There are a large number of published estimates of fertilisation rate in heifers and in moderate yielding dairy cows (see review by Sreenan and Diskin, 1986). Where semen of known high fertility is used in artificial insemination (AI), fertilisation rates are of the order of 90–100%. In contrast, for higher-producing dairy cows, there is a paucity of quantitative information on fertilisation rate with only three published reports (Wiebold, 1988; Ryan et al., 1993; Sartori et al., 2002). Wiebold (1988), using a non-surgical embryo recovery technique on day 7 following oestrus, recovered 25 ova/embryos from 23 lactating cows with all recovered ova having been fertilised. Ryan et al. (1993) in a study on the effects of ambient temperature on fertilisation rate reported no effect of temperature and quoted fertilisation rates of 82.4 and 79.5% for cows in high and low temperature environments, respectively. Sartori et al. (2002) recorded a low fertilisation rate of 55.6% in lactating dairy cows compared to 100% for heifers under high ambient temperatures, while in a subsequent study during the cool season reported fertilisation rates of 87.8 and 89.5% for lactating and non-lactating dairy cows, respectively. Cumulatively, these studies suggest that fertilisation rate is similar in high and moderate producing dairy cows, at least during the cool season. Indeed, the highest temperatures likely to be experienced by cows during the hottest months in temperate grazing areas are unlikely to be higher than the maximum temperatures recorded during the cool seasons in the study of Sartori et al. (2002).