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Review Article

IMPORTANCE OF ENERGY ON REPRODUCTION IN DAIRY CATTLE

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Abstract: Maintaining energy balance in the early lactating dairy cow is extremely difficult, especially with low energy forages. Most early lactation cows, because of their slow response to increasing dry matter intake (DMI), usually are in negative energy balance from one or two days after calving until 70 to 85 days into lactation. This issue of balancing energy in early lactation is complex because of the interaction between body condition (reflecting degree of fat deposition) and the period of time after calving that cows reach their peak dry matter intake and the influence of forage quality on voluntary dry matter intake.

INTRODUCTION

Energy intake may be most important nutritional factor affecting reproduction on most dairy farms. Inadequate energy intake in heifers and early lactation cows reduces reproductive performance. Excessive energy intake during late lactation and the dry period can cause “fat cow” problems which lower reproductive efficiency in the next lactation. When heifers are fed inadequate amounts of energy, they reach sexual maturity later. If energy deficient rations are fed to heifers that have begun to have normal estrous cycles, they may stop cycling. An example is heifers fed diets composed mainly of poor quality hay. They often will not show signs of estrus during late winter. If grain is provided, or they are put on good pasture, normal estrous cycle activity will resume as they begin to consume adequate amounts of energy. Many high producing cows are in negative energy balance during early lactation because they cannot consume adequate feed to meet the nutrient requirements for high levels of milk production. Energy stores in body tissues are mobilized and weight losses occur. A Cornell study examined the effect of negative energy balance during the first 3 weeks of lactation. The greater the negative energy balance, the longer the interval to first ovulation (Butler, 2005).

Cows fed diets deficient in energy also have been reported to have an increased incidence of silent estrus. Other research has indicated that lower conception rates and longer

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calving intervals are associated with severe weight loss during early lactation. In one study, conception rate was 67% in cows that were gaining weight at the time of breeding while conception rate was 44% in cows that were losing weight. The changes in body condition were determined between calving and 2-3 weeks after calving. The 5-point scoring system developed (1=thin, 5=obese) was used. Cows with severe body condition loss (more than 1 point on the scoring scale during the first 2-3 weeks after calving) had longer intervals to first ovulation and first estrus, lower first service conception rates and more days open.

Effect of body condition score on conception

Reduction in body condition score	Conception rate
Reduction in 1 unit	50%
1-2 unit reduction	34%
More than 2 units	21%

Energy deficiency should be considered a problem in herds where cows lose excessive amounts of body condition during early lactation and are not cycling normally by 30-40 days after calving. Excessive energy intakes during the late lactation and dry periods can lead to “fat cow” problems. Cows that are over conditioned, when they calve have a higher incidence of retained placenta, more uterine infections and more cystic ovaries. They also have a higher incidence of metabolic disorders and have a greater tendency to go off feed. All of these problems can result in poor reproductive performance.

BCS to achieve optimal reproductive status

	Ideal score	Range
Dry off	3.50	3.25 - 3.75
Calving	3.50	3.25 - 3.75
Early lactation	3.00	2.50 - 3.25
Mid lactation	3.25	2.75 - 3.25
Late lactation	3.50	3.00 - 3.50
Growing heifers	3.00	2.75 - 3.25
Heifers at calving	3.50	3.25 - 3.75
Pregnant cows	3.50	3.50 - 4.00

Effect of energy on progesterone release

Energy diet	Level of energy	Progesterone level
High energy ration	9.0 Mcal of net energy /day	5.7ng/ml
Low energy ration	4.0 Mcal of net energy /day	3.7ng/ml

(Escherich and Lotthammer, 1987)

Energy status and fertility

Parameter	Control	Energy deficiency group
% of pregnancies	94.4	81
Insemination per cow	1.22	2.19
Days taken for conception	48.5	66.70

(Escherich and Lotthammer, 1987)

It is now widely accepted that negative energy balance (NEB) in early lactation is associated with reduced fertility performance (Roche *et al*., 2000). The physiological basis for this association has been cited as: a reduced LH pulse frequency; reduced circulating concentrations of insulin and IGF-1; reduced production of oestradiol by ovarian follicles during NEB; and possible deleterious effects of the metabolites NEFA and BHB (beta hydroxybutyrate), together with low circulating glucose concentrations on oocyte development (Leroy *et al*., 2005; Leroy *et al*., 2006). It has often been demonstrated that where the severity of NEB (as measured by BCS loss) is exacerbated, the resultant fertility performance is reduced (Buckley *et al*., 2003). Hence an important part of the nutritional management of dairy cows to ensure optimal fertility performance is to limit the extent and duration of NEB in early lactation. One of the most fundamental aspects of preventing BCS loss in early lactation is to avoid over conditioning in the dry period and at calving. Several authors have reported that increased BCS at calving causes an increase in BCS loss in the following lactation (Garnsworthy and Webb, 1999; Dechow *et al*., 2002). Furthermore, Mayne *et al*., (2002) reported that in dairy herds where the dry cow BCS was elevated, fertility performance in the next lactation was significantly reduced.

CONCLUSION

These situations may arise due to under-feeding, poor grazing conditions (soil conditions, grass availability or bad weather), poor silage quality (for indoor diets) or simply because the genetic potential for milk yield in the herd is inconsistent with the chosen feeding-management system and therefore makes excessive NEB virtually unavoidable.

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