MILK SPECIALTIES
GLOBAL
ANIMAL NUTRITION

ENERGY BOOSTER AND EARLY LACTATION COWS

Richard Shepardson, M.S. and Matthew Sellers, Ph.D
Milk Specialties Global, Animal Nutrition

OVERVIEW

The onset of lactation is accompanied by extreme physiological shifts for dairy cows and causes a gap between the biochemical energy necessary to support lactation and the dietary energy taken in through dry matter intake (**DMI**). If cows are not obtaining adequate nutrients through feed, they enter negative energy balance (**NEBAL**) and must utilize body reserves (i.e. adipose tissue) to make up the difference. Cows in NEBAL, and those that remain in NEBAL for extended periods of time, will decrease in body weight and condition which can lead to a variety of metabolic and reproductive issues. Minimizing the time spent in NEBAL improves peak milk and reproductive performance.

IMPROVING ENERGY BALANCE AND REPRODUCTIVE SUCCESS

Minimizing days spent in NEBAL is an important strategy to improve reproductive success. Effects of energy balance on reproductive performance have been well documented. Butler (2000) and Gumen et al. (2011) will be briefly reviewed for the purposes of this paper. Energy balance can impact the ability of the cow to return to estrous and ability to carry a calf. Decreased reproductive success is also associated with increased plasma non-esterified fatty acids (**NEFA**) and beta-hydroxybutyrate (**BHBA**) concentrations present during NEBAL as the body mobilizes energy reserves. Negative energy balance alters luteinizing hormone (**LH**) pulse frequency and decreases ovarian sensitivity to LH. Circulating blood progesterone, often referred to as the "pregnancy hormone," is decreased when cows are in NEBAL, meaning that these cows also have decreased fertility. Oocyte quality and function of the corpus luteum are also negatively impacted by prolonged NEBAL. Carvalho et al., (2014) demonstrated that pregnancies per artificial insemination (**P/AI**) at 40 days in milk for cows that lost, maintained, or gained body condition in the first 21 days of lactation was 25%, 38%, and 84%, respectively. These numbers were mirrored by the P/AI at 70 days as well. Interestingly, energy corrected milk yield of all three groups was not different, nor was body condition score at calving. Finally, Domecq et al. (1997) showed that cows that lost 0.40 units of body condition decreased first service conception rate by 17%, and cows that lost 0.80 units of body condition decreased by 20%. In order to improve reproductive success and peak milk yield, dairy managers and nutritionists must focus on returning their cows to positive energy

balance (**PEBAL**) as quickly and efficiently as possible.

FATTY ACID BALANCING AND ENERGY OUTCOMES

Supplemental fat has been utilized in lactating dairy cow rations for decades. Fat is the most energy-dense nutrient available and is an excellent means of increasing energy density of the ration. A preferable fatty acid source for postpartum cows would be one that maintains or increases DMI, helps maintain or improve body condition, has a positive effect on milk and component production, and does not negatively affect rumen function.

Modern research has increasingly characterized the roles of individual fatty acids in lactating dairy cow physiology. Recent publications have highlighted the benefits of palmitic acid (**PA**, C16:0) in lactating cow rations for ECM and milk fat concentration, but we have also learned that supplementing PA to post-fresh cows can increase NEFA concentrations and further exacerbate body condition loss, which can negatively impact reproduction. Blending or substituting PA for calcium salts of palm fatty acid distillate, which contains a combination of PA and oleic acid (**OA**, C18:1), can mitigate this to some degree, as OA may assist in energy partitioning towards body reserves. An issue with feeding calcium salts, especially at higher inclusion rates, is that the large amount of unsaturated fatty acids can decrease DMI and disrupt rumen health. Research with omega-3 and omega-6 fatty acids has shown positive effects on the immune and reproductive systems in cows, but these polyunsaturated fatty acids can also disrupt rumen health and increase chances of diet-induced milk fat depression. If cows decease DMI, they may not reap the full benefits of added dietary energy and will not return to PEBAL as quickly. Stearic acid (**SA**, C18:0) is a saturated fatty acid that is well-utilized by the cow and typically does not decrease DMI. In recent meta-analyses (Sellers et al., 2017; Harris et al., 2017), blends of PA and SA did not impact DMI while calcium salts of palm fatty acids decreased DMI.

Energy Booster 100™ (**EB100**) is a fatty acid supplement that is a blend of mostly SA and PA, with some OA as well. Throughout published literature, EB100 has increased energy of rations and ECM without decreasing DMI, especially in comparison to calcium salt fat products. Feeding EB100 to postpartum cows will assist in maintaining body condition while returning cows to PEBAL sooner than other supplemental fat products, improving reproductive success and helping achieve higher peak milk targets.

ECONOMICS OF IMPROVED BODY CONDITION AND REPRODUCTION IN FRESH COWS

Feed is by the far the greatest expense and adding supplemental fat of any kind certainly adds to that cost. However, with improved body condition to increase reproduction performance (on top of any gains in milk and component yield), farms can certainly have a positive return on investment when adding fat. De Vries (2011), among other publications, estimate a cost of $2.75/cow/day for increased days to conception. If a cow is taking more reproductive cycles to get pregnant, this is costing the farm money every day. Marsh et al. (1987) and Boichard (1990) estimate that first service conception rate is worth roughly $2.19 per percentage unit per cow/year. This

means that even increasing first service conception rate a few percentage units can have positive impacts on the farm's economics. Lastly, there is time, labor, and the cost of the semen to perform reproductive services. If there is a $15/cow/service cost estimation, this factors in as well. The total cost of losing one or more units of body condition in early lactation could cost the dairy over $100 per cow in lost reproductive efficiency.

CONCLUSIONS

Cows in the weeks following parturition are in NEBAL due to the fact that the energy required for the onset of lactation cannot be met entirely by dietary nutrient intake. Cows in NEBAL mobilize body reserves for energy, causing them to lose body condition. The change in energy balance causes reproductive hormone levels to shift, decreasing fertility. Fat can be added as an energy-dense nutrient source, but supplements based on PA can exacerbate body condition loss in early lactation. Blends of PA and OA can assist in energy balancing, but large amounts of OA may decrease DMI. Stearic acid does not decrease DMI and helps with energy intake. Energy Booster 100™ is a blend of fatty acids with a large amount (>50%) of SA to help maintain DMI and improve body condition and milk production. Feeding EB100 to increase energy density of the ration can help cows return to PEBAL sooner and help reproductive success.

BCS Loss and First Service Conception Rate

Study	Body Condition Loss	1st Service Concep. Rate
Domecq et al., (1997)	0.40 units	-17.25%
Domecq et al., (1997)	0.80 units	-20.13%
Pryce et al., (2001)	1 unit	-9.0%
Butler and Smith (1989)	>1 unit	-48%
Lopez-Gatius et al., (2003)	>1 unit	-4.5%

BCS Loss and Days to Conception

Study	Body Condition Loss	Days to Conception
Ruegg and Milton, (1994)	>1 unit	+ 31.0
Lopez-Gatius et al., (2003)	>1 unit	+ 10.6
Gillund et al., (2001)	1 unit	+ 12.2
Avendano-Reyes et al., (2009)	1 unit	+ 27.7
Pryce et al., (2001)*	1 unit	+ 15.5

*calculated from reported calving interval

REFRENCES

Boichard, 1990. Estimation of the economic value of conception rate in dairy cattle. Livest Prod Sci. Vol 24 (3):187-204.

Butler, 2000: Nutritional interactions with reproductive performance in dairy cattle. Anim Reprod Sci 60, 449–457.

Carvalho et al., 2014. Relationships between fertility and postpartum changes in body condition and body weight in lactating dairy cows. J Dairy Sci. 97: 3666-3683.

De Vries, 2011. Economics of reproductive performance. In: Risco, CA, Melendez P (Ed.). Dairy Production Medicine. pp 139-151.

Domecq, et al. 1997. Relationship between body condition scores and conception at first artificial insemination in a large dairy herd of high yielding Holstein cows. J Dairy Sci 80: 113-120.

Gumen et al., 2011. Dry period management and optimization of post-partum reproductive management in dairy cattle. Reprod Dom Anim 46 (Suppl 3), 11-17.

Harris et al., 2017. Effect of supplementation with calcium salts of palm fatty acid distillate on dry matter intake, milk yield, and component production: a meta-analysis. ADSA Abstr.

Marsh et al., 1987. An economic comparison of four culling decision rules for reproductive failure in the United States using DairyORACLE. J Dairy Sci. 70:1274-1280.

Sellers et al., 2017. Effect of supplementation with a combination of palmitic and stearic acids on dry matter intake, milk yield, and component production: A meta-analysis. ADSA Absr.