HUBBARD DAIRY SERVICES

Timely Topics

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ENERGY, PROTEIN AND PHOSPHORUS NUTRITION IN THE REPRODUCTIVE PERFORMANCE OF DAIRY COWS

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ENERGY

- Negative energy balance (weight loss) in early lactation has a detrimental effect on reproductive performance.
  - Cows should be in the greatest negative energy balance within the first 2 weeks after calving.
  - Positive energy balance (weight gain) should be achieved by 5 weeks after calving.
- Body condition score (BCS), reproduction and energy balance
  - Butler (2000) reported low conception rates (17% to 35%) when cows lost more than 1 BCS.
  - Cow most likely to become pregnant have a BCS of 3 at the time of insemination (Loeffler et al., 1999).
  - BCS is not well correlated with energy balance as a single score gives no indication of whether a cow is gaining or losing weight and secondly, when a cow initially gains weight it is internal and not apparent by BCS measures.

DIETARY FAT

- The addition of fat to dairy cow diets has been shown to improve reproductive performance. Staples et al. (1998) reported 11 of 20 studies found increased first service conception and overall pregnancy when supplemental fat was included in the diet. Supplemental fat sources fed in these 11 studies were: calcium soaps of long-chain fatty acids (n=5), fish meal (n=4), tallow (n=1) and prilled fat (n=1).

- Hypothesis on how fat increases reproductive measures:
  - Improved energy status: Adding fat to improve the energy balance of cows can help them cycle sooner, but it does not appear to be the major reason for improved reproductive performance reported in the studies above. To prevent a reduction in energy or dry matter intake, fat in lactating cow diets should not exceed 6-7% of the dietary dry matter.
  - Increased concentration of plasma progesterone: In lactating ruminants, an increased concentration of progesterone in plasma is associated with increased conception rates. Fat supplementation increases the circulating concentration of cholesterol, which is the main precursor required to synthesize progesterone.
  - Suppression of prostaglandin $F_{2\alpha}$: Fatty acids such as linoleic (C18:2), linolenic (C18:3), eicosapentaenoic (C20:5) and docosahexanoic (C22:6) can inhibit the ovarian and endometrial synthesis of prostaglandin $F_{2\alpha}$. This prevents the regression of the corpus luteum and pregnancy is maintained.
  - Cows receiving fat have been found to have larger follicles, which result in larger corpus luteums and ultimately greater concentrations of circulating progesterone.

- Fatty acid profile: Not all fats are equal in improving reproductive performance. Fats that provide greater amounts of the fatty acids linoleic (C18:2), eicosapentaenoic (C20:5) and docosahexanoic (C22:6) to the lower gut appear to improve reproductive function and fertility. Fish products contain a significant amount of eicosapentaenoic and docosahexanoic acid while seeds or seed oils contain a large proportion of linoleic acid.

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PROTEIN

- Feeding crude protein (CP) as rumen degradable protein (RDP) or rumen undegradable protein (RUP) in considerable excess of requirements or generally greater than 19% of the diet dry matter has been implicated in decreased reproductive performance. This includes a decrease in conception rates, increased days to first ovulation, and an increase in embryonic deaths (Thatcher, 2000).

- Either milk urea nitrogen (MUN) or blood urea nitrogen (BUN) can be used as a measure to evaluate protein intake or protein/energy relationship within the rumen environment. Normal MUN levels are between 11 and 14 mg/100ml. A value greater than 19 mg/100ml may indicate the animal is at risk of reduced reproductive performance or sick.

- Potential reasons for decreased reproductive performance:
  - Increased energy cost to detoxify ammonia from excess protein in the diet. For cows in negative energy balance, this may increase the anestrus period.
  - Excess RDP feeding can reduce plasma progesterone concentrations.
  - High protein diets may increase urea levels in the uterine decreasing uterine pH. Uterine pH decreases by .1 for every 5 mg/100ml increase in BUN. Decreasing uterine pH may not affect conception rate, but may decrease embryo survival.

  Minimize the effect of high dietary protein levels on reproduction:
  - Replace SBM with a feedstuff lower in RDP. (fish meal, corn gluten meal etc.)
  - Monitor MUN or BUN to assess urea production by the liver. MUN is inexpensive and noninvasive. Reproductive performance of dairy cattle has been decreased when MUN concentrations were greater than 19 mg/d or BUN concentration was greater than 20 mg/d.

PHOSPHORUS

Phosphorus (P) has long been linked to reproductive performance. Feeding high levels of P was thought to increase both expression of heats and conception rate in cows . However, current research has refuted this perception. Research by Satter at the Dairy Forage Center in Wisconsin has shown dietary P concentrations need to be less than .25% (dry matter basis) for reproductive performance to be affected. Phosphorus levels of .40 to .42% of the diet dry matter are adequate to meet requirements for milk production and reproduction with normal dry matter intakes.

Note

This paper deals with the impact of energy, protein and phosphorus on reproductive performance. It is important to remember that as long as a cow is cycling, the management and implementation of the breeding program (heat detection, insemination, timed breeding, etc.) will generally have a much larger impact on the dairy's reproductive success than nutrition.