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Lactation and Reproduction: The Great Balancing Act

Milk production in the United States is a phenomenal success story. Over the past three decades, average milk production has improved by more than 75 percent, from about 12,000 pounds per cow in 1980, to 21,149 in 2010 (USDA).

Unfortunately, the same cannot be said about dairy reproduction. As milk production has gone up, reproductive performance has steadily decreased in the same time period. Is increased milk production to blame? "Yes and no," says Bill Thatcher, PhD, Professor Emeritus in the Department of Animal Sciences at the University of Florida, Gainesville, Fla. He says that, while the two factors are associated, the decline in reproductive efficiency is a multi-faceted issue influenced by:

- Increased incidence of postpartum diseases, including ketosis, mastitis, hypocalcemia, retained fetal membranes, metritis, cystic ovaries, fatty liver disease and subacute ruminal acidosis.
- Larger-sized herds, which present unique management challenges.
- An increased proportion of milking heifers, which cycle later.
- Increased genetic inbreeding.
- Lactation-induced shifts in hormone levels that affect a host of endocrine and metabolic processes, impacting fertility and embryonic viability. These factors are influenced by the intensity and duration of postpartum negative energy balance.

“Many of these conditions are interrelated, with delayed conception and/or early to late embryonic death the net results,” says Thatcher. “Addressing cow health and productivity in a holistic fashion appears to be the appropriate strategy for achieving more pregnancies.” He also strongly advocates utilizing hormone-based breeding programs with timed insemination, because high levels of milk production have been proven to be associated with reduced duration of estrus and increased frequency of multiple ovulations.

What’s more, Thatcher and his colleagues are researching precise nutritional and management adjustments that can be made to compensate for the influence of lactation and negative energy balance on fertility. Among them are:

- Increasing the number of days feeding prepartum diets with a negative dietary cation-anion difference (DCAD), combined with adequate energy, protein, amino acids and trace/macrominerals. In regions of selenium deficiency, supplementation with organic Se in the transition period into lactation also has shown promise in improving immune function, uterine health and pregnancy achievement.
- Increasing dietary nonstructural carbohydrates (glucogenic diets) early postpartum. This practice promotes glucose synthesis and increases blood insulin concentrations, which have a positive impact on the commencement of postpartum ovulation.
- Supplementing with omega n-6 fatty acids during the transition period up through 30 days postpartum to improve immune competence, and supplementing with omega n-3 fatty acids during the breeding period to improve reproductive performance. Such a nutritional program has integrated benefits on cow health, milk production and reproductive performance.
- Feeding high-producing dairy cows diets of 10.2 to 11 percent MP (metabolizable protein) and 15.2 to 16 percent crude protein (DM basis). Approximately 35 percent of the crude protein should be undegradable protein or 65 percent of the crude protein should be degradable protein for biosynthesis of microbial proteins. This guideline should avoid the detrimental effects of excess protein on cyclicity and embryo development.

Minnesota-based dairy nutritionist Rick Lundquist, PhD, has observed many of Thatcher’s recommendations work effectively in practice, noting that high milk production should never be an “excuse” for delayed breeding efforts and/or poor reproductive outcomes. He adds: “Achieving pregnancy efficiently is not only a profitable outcome for the dairy, but also a health benefit to the cow. The longer cows remain open, the harder they are to breed. They consume a nutrient-dense lactating ration that exceeds their needs, become too fat, and often start developing metabolic problems.”

Lundquist says the dual accomplishment of excellent milk production and reproduction is the best outcome for individual animals, and an achievable goal for every dairy.

SoyChlor® Supports Reproductive Health

Dairy nutritionist Rick Lundquist says SoyChlor is a flexible nutritional tool that helps him guide transition cows on a smooth path toward postpartum fertility and production success. “SoyChlor in the dry cow ration helps create a negative DCAD, which has been shown to improve fertility in the subsequent lactation,” says Lundquist. “I also like the ease with which it allows me to adjust for varying forage magnesium and potassium levels. And because it’s highly palatable, it helps keep dry cows eating well during the critical days just prior to calving.”

CONSULTANT'S CORNER

Efficient Milk Production Reproduction Can Coexist

By Rick Lundquist, PhD, Consulting Nutritionist, Lundquist & Associates, Duluth, Minn.

There is a school of thought in dairy management that high milk production and efficient rebreeding are opposing objectives. My personal experience has been that not only can the two happen concurrently, but that they actually are complementary to one another.

The herds with which I consult range from 2,000 cows up to 15,000, and cover a broad geography. From the humidity-haunted Southeast to the sun-soaked Southwest and points north, I've seen many herds that do an outstanding job of achieving excellent milk production and rebreeding the majority of their cows by 120 days in milk or less. The keys to doing both well include:

- **Heat abatement and cow comfort** — Cows hampered by heat stress, faulty stall design and sore feet and legs are set back in terms of feed intake, milk production, cyclicity and estrous expression. The most successful herds address these fundamentals first.
- **Transition ambition** — I am encouraged to see that the first dollars going into many new dairies and dairy remodels are for calving, transition and fresh-cow facilities. Working hard to prevent fresh-cow diseases pays off in terms of cows that are both reproductively healthy, and able to take off eating and milking without interruption.
- **Estrous detection** — I see in practice the same conclusion of recent research — that high-producing cows do exhibit estrous more subtly and for a shorter duration. The best-managed herds redouble their efforts in estrous detection via labor allocation and training; heat detection aids; and hormone-based breeding programs.
- **Ration consistency** — Feed a balanced, palatable ration that is well-mixed and delivered in a consistent manner every day. Cows don't like change, nor do rumen microbes. That's why I like to feed a steam-up ration to close-up dry cows, and make ration changes very gradually throughout lactation.
- **Nutritional fine-tuning** — While excessive rumen degradable protein (RDP) can be detrimental to fertility, a quality source of rumen undegradable protein (RUP) and essential amino acids is an early lactation necessity. Supplying RUP and bypass amino acids supports gluconeogenesis to supply glucose for milk production, and limits the mobilization of body tissue that can delay cyclicity in fresh cows. I also believe in feeding a limited amount of bypass fat in the early lactation ration to help maintain body condition and potentially support embryo development. Herds feeding whole cottonseed also need to monitor levels of the potent toxin gossypol, which can render bulls sterile and disrupt reproductive processes in cows as well.

Rather than delaying rebreeding, high milk production can be a precursor to efficient reproduction, because it is an indicator of comprehensive management that supports both.

FROM THE MATERNITY PEN

Cow and Calf Health Impacted by Trace Minerals

Though slight in quantity, trace minerals have a tremendous impact on animal health and productivity, influencing vitamin synthesis; hormone production; enzyme activity; collagen formation; tissue synthesis; oxygen transport; and other physiological processes related to growth, reproduction and health.

University of Minnesota researcher Greg Golombeski, PhD, is exploring the role of trace minerals during the transition period for dairy cows and their offspring. He says previous research indicates that stress can potentially reduce an animal's ability to retain trace minerals, which is an important consideration for the stressful two to three weeks pre- and postpartum. And, although they may exhibit no outward signs of deficiency, pregnant cows fed inadequate levels of trace minerals are unable to transfer these critical elements to their calves, both in-utero and via colostrum.

Golombeski says as trace mineral status in the calf declines, immunity and enzyme function suffer first. Next comes a reduction in maximum growth, followed by impairment of normal growth patterns, and, finally, clinical deficiency.

Because the fetus depends entirely on the dam to acquire trace minerals, supplementation of the pregnant cow is essential. Golombeski recommends feeding to NRC-recommended levels of cobalt, copper, iodine, iron, manganese, selenium and zinc via supplements, regardless of additional amounts that may be supplied by basal feedstuffs.

While specific research exploring the transmission of trace minerals via colostrum is limited, Golombeski cites one study (Kincaid and Socha, 2004) in which cows were supplemented with trace minerals starting at 21 days prepartum and continuing through 150 days in milk. The result was an increase in colostrum IgG concentration and a tendency for increased serum IgM concentration in calves born to the supplemented cows.

BEYOND BYPASS

Feeding Strategies to Reduce Manure Output

Manure and dairying go hand-in-hand, but too much manure can create a drag on a dairy's resources. Ohio State University Department of Animal Sciences researcher Bill Weiss, PhD, points out that excess excretion of manure and manure nutrients represents inefficiencies in increased feed costs, environmental impact, and manure moving and storing expenses.

Weiss and his colleague, Normand St-Pierre, PhD, have analyzed a large body of data related to dairy cow manure levels, and investigated nutritional methods to reduce manure output (measured in both solids and urine). Their work was funded by the USDA's National Research Initiative. They found that manure output and milk production were correlated but not strongly related. Dry matter intake (DMI), on the other hand, has a direct impact on manure production.

"As intake increases, digestive efficiency tends to decrease, because feed passes through the digestive system more quickly," Weiss explains. "However, you should not reduce intake so that cows produce less manure, because it will likely also reduce milk production." Rather, the researchers suggest:

- **Monitoring feed efficiency (pound of fat-corrected milk per pound of DMI) to evaluate diet digestibility.** "In most herds, average feed efficiency should be around 1.5 to 1.6," Weiss advises.

- **Adjusting the ratio of corn silage to haycrop forage fed.** Because corn silage almost always has lower concentrations of potassium than haycrop forages, feeding a greater proportion of corn silage will likely result in lower manure output, attributed mostly to a reduction in urine excretion.
- **Keeping protein levels in check.** Increasing the concentration of protein in the diet typically increases manure output, although Weiss says protein levels are less of an indicator of manure output than other dietary factors. Increasing protein (especially rumen degradable protein), would be expected to increase urine output with little effect on fecal output.
- **Replacing dietary fiber and feeding higher-starch (but not excessive starch) diets.** On average, one percentage unit increase in starch (approximately equivalent to one percentage unit decrease in NDF), decreases manure output by about 1.85 pounds, mostly impacted by reduced fecal output. “Most diets for lactating dairy cows will contain between 20 and 30 percent starch, so the maximal change in manure output caused by changing dietary starch would be about 17.5 to 20 pound/day,” says Weiss. “That’s about 10 percent of average manure output.”

Collectively, these measures can reduce total manure output by 15 to 20 percent. “These dietary changes should not influence milk production if done correctly,” says Weiss.

QUALITY CORNER

Correct Prepartum DCAD Improves Postpartum Performance

In Dr. Thatcher’s contribution to this edition, he listed many nutritional and non-nutritional factors that could impact reproduction in the lactating cow. Among those were the postpartum diseases that dairy managers focus so much time and effort on treating and preventing. When we review the suspected root of many of these postpartum diseases, it is interesting how many of them seem to be associated with poor feed intake immediately after calving. Our commonsense tells us that anything we do to improve feed intake postpartum will help the cow. Scientific support for this concept is provided by DeGroot et al., (2010). In their research, decreasing DCAD of the diet during the prepartum period increased postpartum dry matter intake, and milk production. As Dr. Lundquist points out in his accompanying article, he has had great success using a negative DCAD program in prepartum cows as a means of improving several aspects of postpartum performance, including reproduction. That’s about as strong an endorsement as you can get for any management concept, because dairymen and their nutritionists don’t usually continue using something that doesn’t provide a good return for the time and dollars. It is great to have published scientific literature to explain why certain management practices work, but it is even better to see consistent results on the farm.

References: DeGroot et al., 2010. Journal of Dairy Science 93:5268.

HAPPENINGS

College Students Spending 12 Weeks at West

Central

West Central has hired 19 college students this year as part of the organization's 12-week summer internship program.

The students are spending the summer enhancing their knowledge and career skills through hands-on experience in various departments ranging from accounting to agronomy and from outside operations to network administration. This year's interns represent five different universities throughout the Midwest.

"We have carefully selected students with varied talents from different places," says Barbara Quandt, director of human resources. Quandt adds that each intern will complete a capstone project to demonstrate a significant contribution that he or she has made to the organization.



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