PHOTOS BY SHAUNA ROSE HERMEL

Nutrition and Reproduction

Interactions

by ***Troy Smith***

Great advances have been achieved through genetic selection, but it's still difficult to select for increased reproductive performance. As they are currently measured, direct reproductive traits are not highly heritable. The environment, however, looms large in importance to reproductive success.

Fortunately, producers usually have some control over certain environmental factors, including the most important one — nutrition. So, producers need to know how nutrition can affect reproduction, for better or for worse. A review of the basics never hurts, so consider some specific nutrition and reproduction interactions (see Table 1).

First, producers should remember that providing a balanced diet to females is most critical during the last trimester of pregnancy and through the breeding season. Late gestation brings increased nutritional demands, and those demands increase even more during early lactation. Among the functions fueled by nutrients, reproduction typically takes a back seat to feeding a calf and the cow's own body maintenance. Consequently, thin cows often do not rebreed.

"Body condition is correlated with several reproductive events, such as postpartum interval, services per conception, calving interval, milk production, calving difficulty and calf survival. And all of those bear upon the net income of a cow-calf operation," says Rick Funston, University of Nebraska Extension reproductive physiologist.

"Body condition is the single most important factor controlling when beef heifers and cows will resume cycling after calving. Body condition at calving also influences response to postpartum nutrient intake. Cattle should have a body condition score (BCS) of 5 or 6 (on a 9-point scale) at calving and through breeding to assure optimum reproductive performance," Funston adds. (For tips on how to score your cows for body condition, visit *www.cowbcs.info*, which features photos, video clips and explanations.)

Energy and protein

The nutrients that bear most heavily on body condition are energy and protein. Inadequate daily energy intake is the most common cause of reduced performance among cattle on forage diets. This is particularly true for cattle on low-quality forage diets, because low energy intake often stems from a protein deficiency. According to Funston, rumen microbial activity necessary for efficient forage utilization is hampered when forage diets contain less than 7% crude protein (CP).

"If protein requirements are not met, forage intake and digestibility go down. Correcting a protein deficiency is usually the first step in formulating a supplementation program for cattle on low-quality forage," he adds. "But fixing the protein problem often fixes the energy problem, too."

Funston says problems also result from too much of a good thing. Overfeeding of either energy or protein is costly and can have negative effects on reproduction. Females carrying excess body condition (greater than BCS 7) may experience more calving difficulty and lower reproductive performance than cows or heifers in moderate condition.

Overfeeding protein during the breeding season may compromise fertility, particularly when animals also receive inadequate energy. This is thought to result from decreased uterine pH during the luteal phase of the estrous cycle. The combination of high levels of degradable protein and low energy concentrations in early-season grasses may result in lower fertility rates in females placed on such pastures near the time of breeding.

Minerals

Funston says current knowledge about the nutritional roles of minerals might be likened to the tip of an iceberg. Certainly, the complex interactions of minerals and other nutrients are important to all physiological processes, including reproduction. Salt (sodium chloride) is the most important mineral in terms of need. Normally, feedstuffs do not contain sufficient amounts to meet beef animal requirements, so salt

should be provided free-choice at all times.

An old rule of thumb says forages low in protein will also likely be low in phosphorus (P). Most mature forages are deficient in this mineral, and phosphorus deficiencies have been associated with reproductive problems. Diets should be evaluated and supplemented accordingly, but Funston cautions producers against overfeeding phosphorus. It is expensive and there is no added benefit to reproductive performance. Furthermore, excessive phosphorus supplementation may pose an environmental concern.

Funston advises a careful look at the mineral content of diets that incorporate coproducts produced by the ethanol or grain-milling industries. These products often contain high levels of phosphorus.

Calcium (Ca) is generally adequate in forage-based diets. However, it is included in most commercial mineral mixes because many phosphorus sources also contain calcium. Other macrominerals include magnesium (Mg), potassium (K), chlorine (Cl) and sulphur (S). Deficiencies and excesses of these minerals may hinder reproduction. The need for supplementation depends on the levels at which the respective minerals are present in the diet. The same is true for trace or microminerals, including copper (Cu), cobalt (Co), iodine (I), iron (Fe), manganese (Mn) and zinc (Zn). Funston reminds producers that analysis of stock water is advisable since water may be a significant source of minerals that affect reproductive function.

Vitamins

While vitamins are important to all animal diets, requirements for most of them are met without supplementation. Vitamins C, D, E and B-complex are either synthesized by rumen microorganisms, synthesized by the body or available in common feedstuffs. Vitamin A, however, typically is deficient in mature range and pasture, crop residues, and other low-quality forages. Funston says vitamin A does play a role in embryo development. Supplementation before and after calving may increase conception rates.

Ionophores

Research has shown that feeding an ionophore can enhance reproductive performance. Cows and heifers whose diets include sufficient energy and an ionophore usually exhibit shorter postpartum intervals. Studies also have demonstrated that adding an ionophore to heifer development rations will encourage earlier onset of puberty.

Fat supplementation

There has been much discussion about feeding fat to increase energy density of high-roughage diets and to exert a direct effect on reproduction. Evidence suggests fat supplementation can affect several organs involved with reproduction, including the hypothalamus, anterior pituitary gland, ovaries and uterus. Funston says researchers haven't figured out exactly how to supplement fat to enhance reproductive performance beyond the energy contribution. Complicating the matter is the fact that negative responses also have been reported.

For example, some studies indicate fat supplementation during late gestation may help improve pregnancy rates during the upcoming breeding season. However, most studies show fat supplementation after calving is of limited value. Some recent research associated the feeding of fat high in linoleic acid with increased prostaglandin production in postpartum females and a decrease in production of several hormones important to normal reproductive function.

Research, Funston says, has produced varied and inconsistent results, including positive, negative and no apparent effect. Animal response appears to be dependent upon body condition, age, nutrients available in the basal diet and the type of fat supplement fed. Positive responses reported in some studies may be a result of adding energy to the diet through the fat supplement or direct effects of specific fatty acids.

"The fat source may be the key, because fats are not all the same. Different fats may have different effects," Funston says. "Until these interrelationships are better understood, producers are advised to strive for low-cost, balanced rations. If a source of supplemental fat can be added with little or no change in the ration cost, producers would be advised to do so."

If the addition of fat significantly increases the total ration cost, the practice might only be advised when the risk of lower reproductive performance is greatest. This might apply, for example, to precalving diets for young, growing cows in less-than-optimum body condition. Postpartum fat supplementation appears to have limited benefit and, if the fat source is high in linoleic acid, may have a negative effect on reproduction.

Certainly, it's not only the reproductive function of females that is affected by too little or too much of certain nutrients. Suppressed libido in bulls can result from inadequate or excessive energy intake. Low energy intake also may impair sperm cell production, as can deficiencies of vitamin A or zinc. Making sure the total diet meets breeding animals' nutrient requirements is the surest way to achieve reproductive potential.

"Deficiencies must be corrected, but overfeeding nutrients can cause adverse effects as well," Funston stresses. "Balance is the key."

Table 1: Effects of nutrient excesses or deficiencies on reproduction

Nutrient consumption	Reproductive consequence
Excessive energy intake	Low conception, abortion, dystocia, retained placenta, reduced libido
Inadequate energy intake	Delayed puberty, suppressed estrus and ovulation, suppressed libido and spermatozoa production
Excessive protein intake	Low conception rate
Vitamin A deficiency	Impaired spermatogenesis, anestrus, low conception, abortion, weak offspring, retained placenta
Phosphorus deficiency	Anestrus, irregular estrus
Selenium deficiency	Retained placenta
Copper deficiency	Depressed reproduction, impaired immune system, impaired ovarian function
Zinc deficiency	Reduced spermatogenesis

Source: Taken from "Proceedings: Applied Reproductive Strategies in Beef Cattle," courtesy of North Central Region Bovine Reproductive Task Force and University of Nebraska. Reprinted from summary by H.J. Bearden and J.W. Fuquay, 1992, "Nutritional Management, Applied Animal Reproduction."