AGRI-FACTS
Practical Information for Alberta's Agriculture Industry

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Effects of Nutrition on Beef Cow Reproduction

The nutritional quality of feeds and forage can have a tremendous influence on the reproductive performance of cattle. Although reproductive failure may occur for several reasons, management and the environment are often important contributing factors. Part of the environment and management of any animal is nutrition.

Producers must be aware of daily changes in a cow's feed requirements if they want to wean calves from at least 90 per cent of cows exposed to the bull. For instance, cows in the last third of pregnancy or those producing milk have special needs. If these needs are not met, reproduction is the first body function that is sacrificed.

This document describes the effect of deficiencies and imbalances of both macro and micro nutrients.

Energy

Energy is probably the most important nutritional consideration in beef cattle production. Animals require energy to grow and to keep the body functioning. Cows need energy to maintain milk production as well as to initiate and maintain pregnancy. Carbohydrates and fats are the primary source of energy in the diet. Besides being a source of energy, carbohydrates are building blocks for other nutrients. The excess energy in a diet is deposited as fat, which provides insulation and protection for the body.

Energy in the diet must meet the needs of production, and in all animals, there is a priority for nutrient use. The most economically important function of the beef cow, reproduction and the initiation of pregnancy, is the last function to be supplied with energy. In addition, energy requirements increase significantly during the last third of pregnancy and while the cow is producing milk.

Low energy intake during late pregnancy can result in the following:

- slightly lowered birth weights
- higher death rates in newborn calves
- lower milk production
- lower weaning weights
- increased days to first heat
- reduced conception rates

Overconditioning due to high energy intake over a long period can also affect reproduction. Animals with "fat cow syndrome" have reduced fertility, which contributes to long calving periods.

Body condition scoring is a good method for assessing energy requirements and should be used for adjusting diets throughout the year (See *Body Condition: Implications for Managing Beef Cows,* Agdex 420/40-1).

Protein

Protein is the second limiting nutrient in most rations. It is the principal building block of most tissues. The amount of crude protein in an energy-sufficient diet ranges from 8 to 12 per cent. If dietary energy is not adequate to meet demands, it can be supplied by the breakdown of body fat and muscle. However, there is no way for the body to compensate for prolonged low levels of dietary protein. Therefore, diets deficient in energy, protein or both can result in a protein deficiency and a loss of body condition.

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Without adequate amounts of protein in the diet, daily feed consumption drops off, feed passage rates decrease and overall digestive efficiency declines. Reduced feed intake results in both a protein and energy deficiency; therefore, the clinical signs that are seen are those of an energy deficiency listed on page 1. A lack of protein in a diet can create a cyclical problem that magnifies itself (Figure 1).

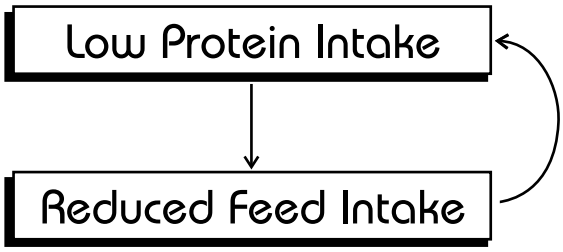

Figure 1. Low protein intake results in reduced feed intake, which, in turn, results in lower dietary protein.

Large excesses of protein in the diet may also depress fertility. The process by which this happens is still unclear, but recent research has shown that dairy heifers have lower conception rates when fed rations with extremely high protein levels.

Water

Water is the least expensive nutrient in the diet and should always be available to livestock. It makes up about 50 to 70 per cent of body weight. A mature cow drinks between 35 and 120 litres of water a day, depending on the temperature and humidity. Animals will lose their appetite, dehydrate and can possibly die if not enough water is available.

Water quality is also an important consideration – for example, high sodium and sulphate levels can affect free choice salt intake and the use of other trace minerals (see *Water Requirements for Livestock,* Agdex 400/716-1, and *Water Analysis Interpretation,* Agdex 400/716-2).

Minerals and reproduction

Minerals are loosely classified as macro or micro minerals depending on the relative amounts needed or present in the body. Macro minerals include calcium, phosphorus, magnesium, potassium, sulphur, sodium and chloride. Cobalt, copper, iodine, iron, manganese, molybdenum, selenium and zinc are considered micro or trace minerals.

Rations that contain a high percentage of forage usually supply adequate amounts of calcium but may be low in phosphorus. However, rations high in grain contain adequate phosphorus but may be deficient in calcium and other minerals. Micro or trace mineral deficiencies are associated with soil type and are usually geographically related.

Abnormal levels of some minerals such as iron and cobalt do not usually cause a problem with reproduction. Other minerals, including those that follow, can significantly affect reproduction.

Calcium

Cattle need calcium for skeletal growth and milk production. From mid to late pregnancy, a bred cow's requirement for calcium increases by 22 per cent and after calving, by an additional 40 per cent. A deficiency can lead to "milk fever" around the time of calving, particularly in high milk-producing beef breeds. A greater incidence of calving difficulty, retained placenta and prolapsed uterus may also occur.

Calcium interacts directly with phosphorus and Vitamin D. If dietary calcium levels are extremely high, phosphorus availability is reduced. Conversely, high levels of phosphorus impair calcium absorption. In addition, other complex macro and micro mineral interactions occur: high levels of phosphorus and magnesium reduce calcium absorption while high levels of calcium reduce the absorption of iron, magnesium, manganese, phosphorus, zinc and iodine.

Phosphorus

Phosphorus has more known functions in the animal body than any other mineral. It is required for bone and tissue development, energy utilization and milk production. Phosphorus requirements increase by 12 per cent from mid pregnancy to the last month of gestation. After calving, phosphorus requirements increase by 50 per cent.

Phosphorus is commonly referred to as the "fertility" mineral. A deficiency can severely affect reproductive performance and may be expressed as delayed puberty (associated with poor appetite and growth rate) and increased number of services required per conception. Insufficient amounts of phosphorus in the ration results in reduced milk production and consequently lower calf weaning weights.

Selenium

Selenium is an important component of enzyme systems and interacts with vitamin E to prevent tissue damage. Selenium deficiency has been associated with significantly reduced fertility in affected cattle, a higher than expected

number of retained placentas, occasional abortions, premature or weak calves, reduced ability to resist disease and "white muscle disease" in calves.

Selenium is the trace mineral that gets the most attention in Alberta because selenium toxicity can also be a problem. The levels at which selenium can be added to feeds are regulated due to the narrow range between deficiency and toxicity.

Copper

Connective tissues, red blood cells and key enzymes in the body need copper. The most important reproductive effects of copper deficiency are similar to deficiencies of other minerals and include delayed puberty and poor fertility. Other signs of copper deficiency include repeat breeding and a higher than expected number of retained placentas. Bulls may have reduced libido and poor semen quality. If the deficiency is severe, the bull can become sterile because of damage to testicular tissue.

Affected animals may be anemic and have an unthrifty appearance and, in severe cases, a bleached hair coat.

Both high sulphate levels in water and high molybdenum levels in feeds reduce the availability of copper.

Manganese

The amount of manganese required for reproduction is at least 30 per cent higher than the requirement for growth. Manganese plays an important role in the process of energy metabolism and enzyme activation.
A deficiency seriously affects reproductive performance. Cows with a manganese deficiency do not show heat, have decreased conception rates, higher abortion rates and low birth weight calves. Calves are generally born weak and may be deformed with twisted legs and enlarged joints.

Zinc

Low zinc diets affect the testicular development of bulls and therefore can affect fertility in a herd. A zinc deficiency results in reduced sperm production and delays maturation of sperm. in addition, cows may have low conception rates even though the bulls are normal. Calves grow slowly and reach puberty at a later age than normal.

Zinc deficiency also results in reduced Vitamin A utilization and signs of a Vitamin A deficiency may be seen. In addition, high calcium and phosphorus levels decrease zinc absorption from the intestine.

Iodine

Cattle need iodine for the formation of two hormones that are produced by the thyroid gland. The thyroid gland is responsible for controlling the metabolic rate of the body. A lack of iodine indirectly influences growth rate, milk production and feed consumption. Iodine-deficient animals may have delayed puberty and frequently do not show signs of heat. Other deficiency symptoms include poor conception rates, abortions, longer gestation periods and the birth of dead, weak or hairless calves. Goitres develop when an iodine deficiency is severe.

High nitrate feeds reduce the uptake of iodine in the digestive tract. Grazing on pastures containing many plants belonging to Brassica spp. (i.e., kale, forage rape, cabbage or turnips) can also cause goitre by interfering with iodine utilization.

Cobalt

Cobalt is required for the synthesis of Vitamin B_{12}, which, in turn, is required for energy metabolism. Animals deficient in cobalt are weak, lose body condition and have a poor appetite. The conception rate of cows in an affected herd may decline.

Low cobalt levels reduce the storage of copper in the liver and can interfere with the activity of manganese, zinc and iodine.

Sodium and Chloride

Sodium and chloride, the components of salt, are essential nutrients. Salt is required to regulate body fluid levels. In addition, sodium affects the absorption of sugar and proteins from the digestive tract. Salt deficiencies can affect the efficiency of digestion and indirectly the reproduction performance of cows.

The role of vitamins

Vitamin A

Vitamin A is found in actively growing green plants. When forages are cut for hay or greenfeed, vitamin A precursors are oxidized, and levels decline with time. Approximately 90 days after cutting forages, all vitamin precursors are considered to be oxidized and not available to animals, which is why most deficiencies are observed in late fall and winter. Supplementation should be provided from this time forward.

Vitamin A is involved in the maintenance of body tissue, so requirements of the pregnant cow are higher in the last third of pregnancy and immediately after calving. Cows that have a vitamin A deficiency may have night blindness, excessive tear production and problems walking or moving around. Pregnant animals may abort, retain their placenta or develop uterine infections after calving.

Calves may be born weak or blind, or dead. Cows with a vitamin A deficiency conceive normally but return to heat due to the early death of the embryo. Bulls affected by a

vitamin A deficiency produce fewer and abnormal sperm that contribute to infertility problems.

Vitamin D

Cattle usually form adequate amounts of vitamin D through exposure to the sun and the consumption of fresh forages. This vitamin interacts with calcium and phosphorus in bone development and maintenance.

Deficiencies of vitamin D are diagnosed more frequently in animals that are either housed indoors or in areas where sunlight hours are minimal in the winter.

Animals with vitamin D deficiency symptoms have a stiff gait, laboured breathing, weakness and possibly convulsions. Swollen knees and hocks can also occur. Bones may be soft (rickets) or be re-absorbed in older animals. Calves may be born dead, weak or deformed. Cows may not show heat when exposed. Recent research has implicated Vitamin D with heart health, cancer and infectious diseases.

In areas where sunlight is limited or on operations where animals are housed indoors, supplemental vitamin D is required. If an animal is losing weight or has a poor body condition score, vitamin D can be deficient.

Vitamin E

Vitamin E interacts with selenium, and the two nutrients work together to prevent damage to body tissue. A deficiency of selenium or vitamin E or both can cause white muscle disease in calves and reduce growth rates. In mature animals, reproductive performance can be impaired. A vitamin E deficient ration causes the incidence of retained placentas and mastitis to increase while colostrum and milk quality are reduced.

The best source of vitamin E is fresh, green forage. Unfortunately, vitamin E content declines in baled forage or silage as storage time increases. After 90 days of storage, baled dry forage has little or no vitamin E precursors available. With silages, either round bale silage or chopped silage, 40 to 50 per cent of the vitamin E precursors present are lost after 6 months of storage.

Supplemental vitamin E should be provided in the ration when animals are not grazing fresh, growing forages.

Summary

In Alberta, unbalanced and nutrient deficient rations are an important cause of poor reproductive performance. Problems associated with protein/energy malnutrition as well as calcium, phosphorus, selenium, zinc, manganese, copper and vitamin A deficiency are frequently encountered. Trace mineral deficiencies occur in 75 to 95 per cent of the feeds grown in Alberta.

Because symptoms of various deficiencies can be similar, the exact problem is sometimes difficult to identify. Diagnosis may require the help of a veterinarian. Better yet, imbalances and deficiencies can be prevented by nutrient analysis of all forages and grains every year and using these results to formulate the best ration for each class of livestock in a herd.

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