Bison Nutrient Requirements

This information was extracted from: *Code of Practice for the Care and Handling of Bison: Review of Scientific Research on Priority Issues 2016*

Objective: The objective of this chapter is to ensure that bison producers are aware of the importance of minerals and vitamins in bison diets. Preventing the consequences of mineral deficiencies is important. Once a deficiency is identified, it will take time for the bison to recover and result in significant economic losses.

Bison will suffer from mineral and vitamin deficiencies if they do not have access to minerals and vitamins on a regular basis. By confining bison to boundaries, we have limited their opportunity to seek out their nutritional demands and limited them to what is available within their fenced boundary (Lefaive, 2009). Grazing bison that are not fed concentrates are often provided with minerals using various methods, including lick blocks and supplements. Minerals and vitamins can be provided through several sources: loose, powder/granular/crumble form mixed with grain, or salt; either top dressed, or offered alone free choice, through liquid supplement feeders, or as part of a fortified pellet or supplement (Saskatchewan Agriculture, 2000). Free choice feeding of minerals is probably the easiest and most widespread practice of supplying minerals; however, with this method of supplementation, wide variation can exist (Government of Saskatchewan, 2008).

A chronic nutrient/mineral deficiency may take two or more years to develop and will be manifested in poor growth rates, diseases and an increased parasite load (Lewis, 2010). Nutritional deficiencies can also lead to weak or crippled calves and should be carefully noted and studied with a local veterinarian so that an appropriate solution can be implemented (Klemm, 2009). With deficiencies being slow to develop, correcting them also takes time: there is no “magic shot” (Lewis, 2010). McDowell (1992) described phosphorus deficiency as the most widespread mineral deficiency in grazing livestock throughout the world.

The effects of both copper and phosphorus deficiencies are discussed in more detail below, as these are two of the most common deficiencies observed in bison. However, bison can be deficient in any of the essential minerals listed here.

<u>Copper Requirements</u>

It is very difficult to find specific information regarding nutrient deficiencies in bison; however, it is helpful to look at those found in beef cattle. According to Woodbury (2005), bison are at least as sensitive as cattle to Cu imbalance. Copper deficiency in beef cattle is a widespread problem in many areas of the

United States and Canada. It is one of the most common mineral deficiencies in western Canada (where the majority of bison production occurs). Signs of copper deficiency include anaemia, reduced growth, depigmentation (usually the earliest clinical sign) and changes in the growth and physical appearance of hair, cardiac failure, fragile bones, diarrhea, and low fertility characterized by delayed or depressed oestrus (Nutrient Requirements of Beef Cattle, 2000). Copper deficiency can be primary or secondary to other factors (either results in the same problems, but there is a difference in the approach to correcting either type) (Woodbury, 2005). Primary copper deficiency occurs when dietary copper levels are insufficient to meet metabolic demand, and secondary Cu deficiency develops when Cu absorption or metabolism is inadequate (Woodbury, 2005).

Cattle requirements for copper can vary from 4 to more than 15mg/kg depending largely on the concentration of dietary molybdenum and sulphur; however, the recommended concentration is 10mg Cu/kg diet (if the diet does not exceed 0.25% sulphur and 2 mg Mo/kg diet) (Nutrient Requirements of Beef Cattle, 2000). A concentrate diet less than 10 mg Cu/kg diet may meet requirements of feedlot cattle because copper is more available in concentrate diets than in forage diets (Nutrient Requirements of Beef Cattle, 2000). Ingestion of water containing sulfate at a concentration of 600 mg/L has been reported to induce Cu deficiency in Saskatchewan beef cattle (Smart, 1984). Requirements are greatly increased when molybdenum, sulphur, iron and zinc are present, resulting in the need for increased copper supplementation. For example, high levels of molybdenum (Mo) in the diet can bind with Cu in the reticulo-rumen creating an insoluble copper molybdate complex (Woodbury, 2005). Conversely, copper toxicity can also occur in cattle as a result of excessive supplementation of copper or the use of feeds that have been contaminated with copper from agricultural or industrial sources (Nutrient Requirements of Beef Cattle, 2000). By the time cattle show any signs of toxicity, large amounts of copper may have already accumulated in the liver.

Phosphorus Requirements

Phosphorus and calcium work together in bone formation, with approximately 80% of phosphorus in the body being found in bones and teeth, with the remainder distributed in soft tissue (Nutrient Requirements of Beef Cattle, 2000). Phosphorus also has many other cellular functions. In beef cattle the estimated requirement of phosphorus is about 16 mg P/kg body weight. Phosphorus deficiency results in reduced growth and feed efficiency, decreased appetite, impaired reproduction, reduced milk production, and weak fragile bones (Underwood, 1981; Shupe et al., 1988). The skeleton provides a large reserve of phosphorus that can be drawn on during periods of inadequate phosphorus intake in mature animals and subsequently replaced during long periods of high intake (Nutrient Requirements of Beef Cattle, 2000). Sources of phosphorus include (but are not limited to) animal and fish products, and supplemental sources including dicalcium phosphate and defluorinated phosphate.

Selenium Requirements

Selenium is deficient in much of western Canada (Lewis, 2010). Deficiencies can show up especially at handling when bison run excessively, resulting in down animals due to muscle damage (capture myopathy) (Lewis, 2010). In beef cows, selenium deficiency is most commonly expressed as white muscle disease (of calves), but also results in reduced disease resistance, retained placenta and weak or dead calves (Government of Saskatchewan, 2008). Because a deficiency can manifest itself in a number of ways, sometimes these conditions are referred to as “selenium responsive disease” (Hauer, 1999). Since selenium is extremely toxic, great care should be exercised when including selenium in a mineral mix or a ration: feeding directions for this trace mineral must be followed carefully (Government of Saskatchewan, 2008). Selenium is required by livestock at low levels (about 1.0–3.0 mg/head/day) (Hauer, 1999). Injectable forms of selenium exist, but for elk and bison this is not practical, and consumption from a free choice mineral or salt lick is unpredictable; therefore, feeding grain that has selenium mixed in is the most reliable means of supplementation (Hauer, 1999).

Testing for Deficiencies and Supplementation

Examination of forage samples available to bison during different times of the year is necessary to determine the correct mineral supplements. Forage samples alone may indicate that the forage or feed is sufficient for the bison’s need, but examining the water might show that a critical element like copper could be tied up by iron and manganese resulting in a deficiency. Molybdenum, sulfate, nitrate, calcium and sodium can also cause mineral deficiencies due to interference (from cross binding).

Water sample analysis can provide an understanding of the minerals available for bison health. For example, hard water can have a drastic effect on bison feed, making something that would normally be otherwise sufficient become deficient (Lefaive, 2009). Samples of blood and/or tissue from harvested animals can also be evaluated to determine what the animals are lacking (Lefaive, 2009).
Liver samples can be tested post-mortem: this is much more accurate than blood sampling (Lewis, 2010). Diagnosis of trace mineral deficiencies should be based on a complete assessment of the animal group (and/or feed and water sampling). Individual animal diagnosis is generally not sufficient to adequately address trace mineral deficiency problems (Government of Saskatchewan, 2008). The variation amongst individuals, and within herds, can lead to marked variation in mineral status.

In cases of known mineral deficiency, or where extra energy is required due to limited forage or other circumstances, there is interest in supplementing the grazing diet during the breeding season (Anderson et al., 2002). A study by Church et al. (1999) compared the seasonal differences in daily intake and found that bison consumed more minerals daily (0.04–0.06 kg d-1) in summer than in winter (0.02–0.03 kg d-1).

There are at least 17 minerals required by beef cattle (Nutrient Requirements of Beef Cattle, 2000). Currently, all mineral (and vitamin) requirements for bison have been based on beef requirements (Saskatchewan Agriculture, 2000). Until research to determine the minimal requirements or maximum tolerances has been published, a broad-based mineral supplement suited for grain-fed beef cattle is also recommended for grain-fed bison (Anderson and Feist, 2015).

Vitamins

As well as minerals, vitamins are also vital to all ruminants. Vitamins are required in adequate amounts to enable animals to efficiently utilize other nutrients; furthermore, many metabolic processes are initiated and controlled by specific vitamins during various stages of life (Nutrient Requirements of Beef Cattle, 2000). Similar to the mineral requirements, the same recommendations used for cattle are normally used for bison. The vitamin requirements for cattle include vitamins A, D, E, K, B12, thiamine and choline.

Vitamins, while commonly present in liquid and fortified pellet supplements, may or may not be included in granular mineral supplements (Feist, 2000a). As an option, a producer might consider that Vitamin ADE injections be given to bison calves in the autumn or whenever the calves are weaned/processed to ensure vitamin deficiencies will not occur, and that vitamin supplements be fed throughout the year to all class of bison (Feist, 2000a). When the calves are first born, they will receive vitamins from the dams' colostrum (provided the dam has adequate stores).

For reference details go to: *Code of Practice for the Care and Handling of Bison: Review of Scientific Research on Priority Issues* at http://www.nfacc.ca/codes-of-practice/bison