Science and Nutrition: New Ideas in Bison Nutrition

As the bison industry continues to mature, it stands to reason that producers look toward new production practices to enhance their own operations. Feeds, feeding and nutrition are always areas of concern as they can contribute up to two thirds to the cost of production! New technologies and insights gained from dairy and beef production systems can have benefits to the bison industry.

The evaluation of how energy flows from the feed to the animal is an area of science that has gained considerable attention by animals scientists. The whole concept of energy in nutrition is to balance the energy from feed to meet the energy requirements of the animal. The current energy partition system shows that a feed has an energy value assigned to it through measurement of the total energy available in a feed, then subtracting energy losses due to feces, urine, gas (methane), maintenance of body heat, lactation and growth. A value of use to the bison industry is digestible energy: defined as the difference in energy by subtracting the caloric energy content in the feces from the caloric energy content or total energy in the feed prior to feeding. Digestible energy is very closely related to total digestible nutrients (TDN). The usefulness of this system illustrates that a grass hay, containing more fiber and less starch, has a TDN value of 55 percent while a low fibre high starch grain like wheat has a TDN value of 89 percent.

Now obviously, grass hay and wheat grain are two different ingredients. The art of animal husbandry tells us that a bison's diet containing 100% grass hay is considerably different than a diet containing 100% wheat. In this scenario, grass hay is considered safe to feed at high dietary levels while equal levels of wheat grain diet can cause grain overload, bloat and death. However, husbandry also tells us that attempting to finish bison on grass hay takes too long because it does not contain enough energy to drive growth or support lactation. It works well as a maintenance feed but if the goal is to enhance growth and performance, it falls short. Therefore, in practice we could blend the wheat grain with the hay to provide more energy in the diet to meet the extra energy demands that come with growth or lactation. The trouble is we don't accurately know the energy requirements for growth or production of bison. An accurate energy requirement is needed not only to ensure optimal feed mixes to support growth for bison (or to sustain lactation in cows) but it also to "predict" what kind of performance we can expect.

It wasn't long ago that the beef and dairy industries were limited to simply using husbandry practices to create healthy animals and various production results. What has changed however is the ability to predict animal performance based on their nutrient requirements and better feed testing capabilities. The interaction of different feeds and feed blends, from hays to grains to byproducts has been studied. For example, it is know than feeds like cereal grains digest rapidly in the rumen whereby feeds like hays and straws digest quite slowly. By fractionating the feeds even further, scientists have discovered that different fractions behave differently in the rumen which then affects animal performance.

Previously I had written how science measured a feeds energy content based on measured energy in the feed and feces and the difference between the two. This system still works and is still in practice. However, scientists are new examining feeds based on fractions of carbohydrates and protein and how those fractions are digested. This example will illustrate carbohydrate feed fractions and how they behave.

Scientists fractionated feed carbohydrates by the rate of rumen degradation in terms of percent per hour. In their description of rate of disappearance, Fraction A is soluble sugar that degrades at a rate of 200-350 percent per hour. Fraction B1 is starch, pectin and beta glucans that degrade at a rate of 20-40 percent per hour. Fraction B2 is insoluble but available cell wall contents that degrade at a rate of 2-10 percent per hour. Finally, Fraction C is unavailable cell wall composed of lignin and acid detergent fibres, totally undegradable by the rumen microbes. Table 1 shows the carbohydrate fractions of three commonly fed cereal grains for bison: barley, corn and oats.

Table 1

Fraction	Description	Rumen Degradation Rate (%/hr)	Composition (% of carbohydrates)		
			Barley	Corn	Oats
A	Soluble sugars	200-350	3	9	5
B1	Starch, pectin, beta glucans	20-40	76	82	43
B2	Insoluble Available cell wall	2-10	15	6	40
C	Unavailable cell wall (ADF lignin)	0	6	3	12

Drawing your attention to compare corn and oats in Table 1 shows that corn has over 91 percent (adding fractions A and B1 = 9 + 82 = 91) of its digestion occurring at a very rapid rate. Based on trial and error and basic animal husbandry we know that corn is a "hot" feed. Table 1 shows us that the majority of the corn is digested quite rapidly (the cut off between rapid and slow digestion is between fractions B1 and B2) thus has the potential to create a large pool of acid in a very short period of time equalling grain overload and acidosis. Oat grain on the other hand digests much more slowly and over a longer period of time, and Table 1 shows that only 48% of the grain is included in Fractions A and B1. It takes longer to digest. What the table does not show is the effect of grain processing, but that is a topic unto its own.

So what is the point in describing carbohydrate fractions in Table 1 and what does it have to do with bison? Beef and dairy cattle scientists have been able to define how each

fraction behaves in cattle rumens and how they contribute to meeting the animal's energy requirements. As well, they have been able to model animal performance based on what is in the diet. In other words, they have unlocked the ability to predict how fast a beef feedlot steer will grow or how much milk a Holstein dairy cow will produce. With science like this, the bison industry can "look over the fence" at these industries and some day unlock the ability to not only predict how their bison will perform on certain feed mixes.

Hopefully some day we will be able to use this information to be able to model bison performance and maybe even resolve production barriers such as limited daily gains in finishing bulls or optimal cow lactation and calf growth….. all the while maintaining the "bison advantage" that we all have come to recognize. I am optimistic that some day, such modelling and performance predictions using new feed evaluation systems will become a reality for the bison.

Murray Feist
Ruminant Nutrition Specialist
Agriculture Knowledge Centre
Saskatchewan Agriculture and Food