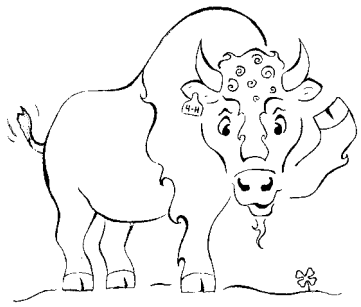
Nutrient Requirements of the Bison



Roll Call:

Name a nutrient.

_____

Name a feed item that is a good source of this nutrient.

_____

From the answers to the roll call in your club, complete this chart. Once your roll call is finished, work together with other members to add as many items as you can think of.

Nutrients	Good Sources of this Nutrient	

Welcome to the level three section of Nutrient Requirements of Bison!
By now you have learned plenty about bison nutrition. In this section we challenge you to take what you already know, combine it with some of the information we have presented for you and share your knowledge with other members in the club.

Vitamin and mineral deficiencies

In order for a bison to perform to its full potential, it must receive adequate amounts of all the essential nutrients. Underfeeding of vitamins and minerals will create a deficiency. Overfeeding may lead to toxicity.

The following chart provides a summary of the symptoms which may occur as a result of a deficiency of a particular vitamin or mineral. Note that many of the symptoms are similar for different minerals or vitamins. Keep in mind that these vitamins and minerals will often interact with one another.

Vitamin	Deficiency symptoms
A	night blindness, weakness, reproductive failure, reduced growth, increased susceptibility to disease
D	rickets, weakness, symptoms similar to calcium phosphorus deficiency
E	nutritional muscular dystrophy, staggering gait, symptoms similar to selenium deficiency
K	hemorrhaging, reduced blood clotting time, weakness, anemia
thiamine	reduced growth, diarrhea
riboflavin	leg paralysis, neural degeneration, reduced growth, diarrhea
niacin	lesions on the tongue, lips and mouth, dermatitis, reduced growth
pyridoxine	staggering gait, convulsions, reduced growth
Mineral	Deficiency Symptoms
calcium (Ca)	rickets in younger animals, osteomalacia in older animals, bones bend or break easily

Vitamin	Deficiency symptoms
chlorine (CI)	deficiency is very rare
magnesium (mg)	tetany - symptoms are unusual alertness and nervousness, muscle twitching, staggering, convulsions
phosphorus (P)	rickets, pica (depraved appetite, chewing on wood), stiffness in hindquarters, poor reproductive performance, reduced fertility
potassium (K)	hind leg stiffness, reduced feed intake, lethargy, in extreme cases - coma
sodium	deficiency is rare, emaciation, reduced appetite,

Mineral	Deficiency Symptoms
(Na)	rough hair coat, staggered gait, cobaltpale skin, loss of appetite, watery eyes
(CO)	anemic, listlessness, showing signs of starvation although food is plentiful
copper (CU)	related to molybdenum deficiency, diarrhea, hind leg paralysis, loss of hair, rough hair coat infertility, cardiac failure
iron (Fe)	unthriftiness, reduced growth, anemia
iodine (1)	goitre, birth of hairless calves
manganese (Mn)	enlarged joints, poor locomotion, poor reproduction, deformed legs, overall physical weakness, lower fertility, increased incidence of retained placenta

Mineral	Deficiency Symptoms
selenium (Se)	nutritional muscular dystrophy, skeletal and cardiac muscle degeneration
zinc (Zn)	skin lesions, rough hair coat, swollen joints, parakeratosis or mange like condition
Salt (Na & Cl)	salivation, thirst, muscular spasms, scouring, prostration, upsets the tissue/water balance in the body and may lead to death

Activity:

1. Take one of these vitamins or minerals and find out all that you can about its action in the body of the bison. Share your findings with others in the club.

2. Develop a game or activity to teach this information to the other members of your club. Keep it simple and keep it fun.

Understanding energy

The importance of energy to an animal cannot be overemphasized. Energy is defined as the ability to do work. All energy originates from the sun. Plants trap energy using photosynthesis. Animals transform this energy from the plants into heat or body products such as milk or meat.

You may have learned in school about the "first law of thermodynamics". It states that energy can neither be created nor destroyed; it is only changed from one form to another. Thus, energy in feeds which is not digested is eliminated from the body. Energy in feeds which is digested and not incorporated into the body products is lost as heat.

We measure the amount of energy in megacalories (Mcal).

1 Mcal 1,000,000 calories
or
1,000 kilocalories

There are many types of energy. It is important that you understand what these types are and how you can use the information they give you.
Gross Energy (GE):

If we were to burn a feed and measure the total amount of energy released, we would obtain gross or total energy values as follows:

Feed	Gross Energy (Mcal/kq dry matter)
Corn Grain	4.43
Oat Straw	4.43
Oat Grain	4.68
Timothy Hay	4.51
Linseed Meal	5.12

These values are obtained through scientific experimentation. Note that these values do not tell us how much energy an animal can get from its feed. An animal digests its feed. Digestion is a much slower process than burning.

Digestible energy (DE):

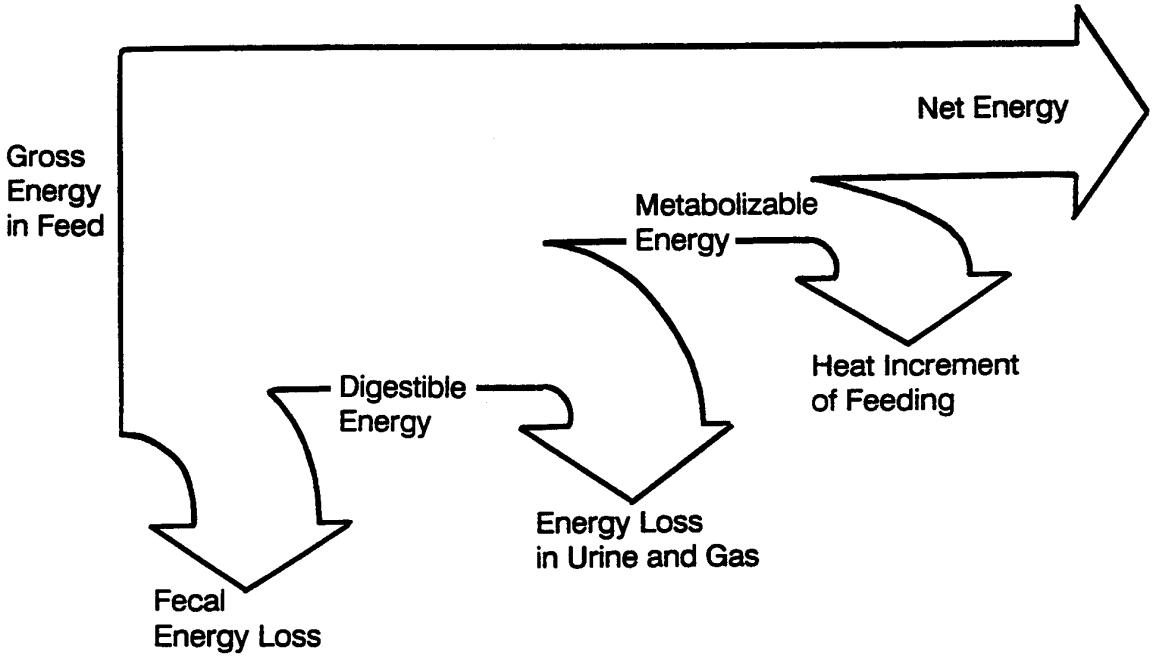
Digestible energy is the most popular way to express the energy values of feeds and the energy requirements of the animal.

The digestible energy of a feed is the gross energy consumed by the animal minus the energy eliminated or lost in the feces. The fecal energy may be as high as 10 to 70 percent of the energy consumed by the animal, making it the largest loss of energy in digestion.

It is known that beef cattle digest 60 to 90 percent of the energy in grains and high quality forages. However, in low quality forages such as straw, they digest only 40 to 50 percent of the energy. Do research and see if you can find if the same would be true for bison.

The following diagram will help you understand how the gross energy of feeds is utilized by the animal.

Division of energy losses



Metabolizable energy (ME):

The metabolizable energy is equal to the digestible energy minus the energy in urine and gaseous products of digestion. The cow loses 4 to 5 percent of the gross energy through the urine and approximately 7 percent through the production of methane gas in the urine.

Net energy (NE):

Net energy is equal to the metabolizable energy minus the heat increment. The heat increment is the heat which is produced when feed is taken in and digested.
Total Digestible Nutrients (TDN):

TDN is an old system of measuring the available energy of feeds and the requirements of animals. It is hard to measure, inaccurate, and very confusing. The formula for the calculation of TDN is:

TDN% (%Crude Protein X %Digestibility)

(%Crude Fiber X %Digestibility)

(%Nitrogen-free Extract X %Digestibility)

(%Ether Extract X %Digestibility X 2.25)

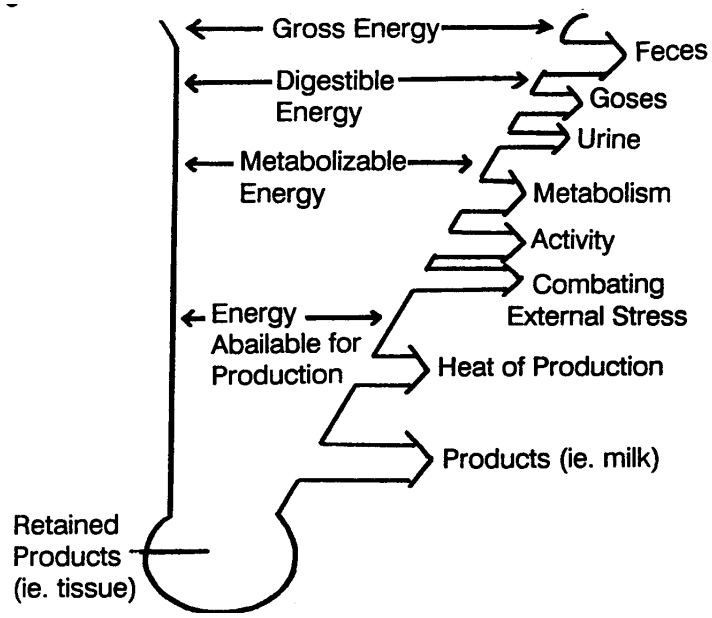
Using energy:

All of the energy consumed is made into one of these:

wastes - feces, gas, urine heat

body products - milk, meat, offspring fat

The following diagram summarizes the manner in which the gross energy is used by the bison.



In summary, digestible energy is the value most commonly used as it is the easiest to determine and understand. However, it is important that you understand all of the values and how they are derived.

Activity:

1. Now that you understand energy, explain the concept to others in your club.

2. Arrange to have a veterinarian or nutritionalist come in and discuss nutrition.

Word find…

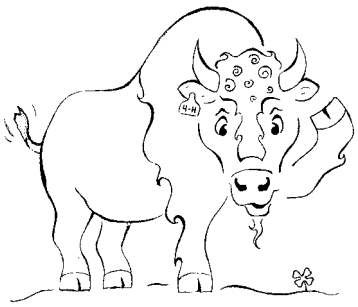
In the puzzle below, find each of the mentioned minerals in the following puzzle. Each one is in a straight line - up, down, across or diagonally.

COPPER IRON IODINE MANGANESE

SELENIUM SALT ZINC

F	S	L	D	T	A	F	E	I	S	I	T
U	S	E	G	R	C	R	P	D	E	P	E
G	M	O	T	N	I	E	C	I	L	E	R
H	R	A	I	O	N	E	R	T	E	L	N
I	R	Z	N	I	E	N	E	R	N	I	O
E	O	A	D	G	I	H	A	R	I	E	R
I	A	O	S	Z	A	I	T	N	U	R	I
O	I	Z	W	I	A	N	D	L	M	E	E
D	H	I	C	O	P	P	E	R	A	C	H
T	O	N	M	A	S	U	U	S	W	S	I
S	R	G	U	M	V	O	E	E	E	U	E
A	I	T	E	E	H	I	R	I	A	M	N

Digestion of the Bison



Roll Call:

Name an animal.

_____

Is this animal ruminant or monogastric?

Welcome to the level three section of digestion of the Bison. Now that you have learned all the parts and their functions it is time to get a further understanding of what is happening inside the bison's digestive system. This is important to know for proper management and health of a bison herd.

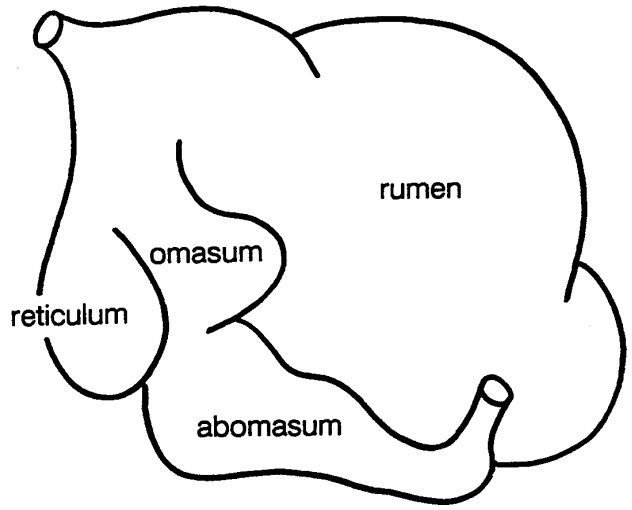
Bison, like any other living thing, has many processes occurring at one time. These processes are interacting and dependent upon one another. In this unit, we provide information on several topics for you to examine more closely. Just picture all of these things going on at once, each with their own cycle. Most importantly, try to appreciate the complexity of the procedures.

Development of the ruminant stomach

The ruminant stomach is very unique in the way in which it develops. There are several special features the ruminant has which enable it to digest roughages and other materials.

As we have already learned, the mature ruminant stomach has 4 compartments, each with a specific function.

Let's review: The Ruminant Stomach

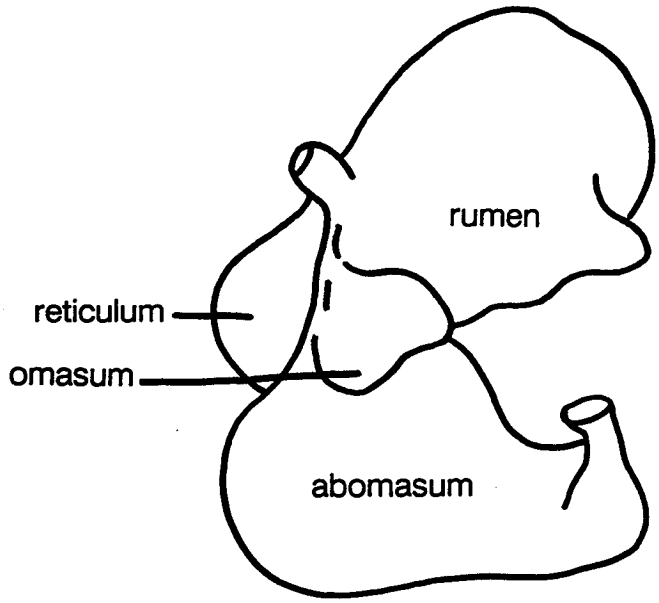


Rumen or "paunch"
largest stomach compartment in the mature ruminant animal
bacteria and microbes found here begin to break down the food, attacking the fibre in the roughages
separated from the reticulum by the rumeno-reticular fold

Reticulum or "honeycomb"
lined with many honeycomb-like compartments
liquid and finer material is moved to the next compartment
coarser material is returned to the mouth for more chewing
any foreign objects the animal takes in will lodge here
Do you know what "hardware disease" is?

Omasum or "manyplies"
Consists of many leaves and folds
the contractions squeeze out more fluid, grind, and move the contents to the abomasums

Abomasum or "true stomach"
most similar to the simple stomach found in other animals
digestive juices are secreted here. They break down the food material further, getting it ready for nutrients to be absorbed into the blood stream.
At birth, the ruminant stomach looks quite different:
The Stomach of a Newborn Calf



In the newborn calf, the rumen is smaller in comparison to the other stomach compartments.

The Esophageal groove is a unique feature in the stomach of the newborn ruminant.

What is it?

The esophageal groove is a tunnel created in the digestive system which allows milk to bypass the rumen.

How does it work?

When the calf sucks, reflex causes the heavy muscular folds of the rumen and the reticulum to meet. This creates the tunnel.

What is its purpose?

This tunnel leads from the esophagus to the abomasum. Liquids that the calf takes in will bypass the rumen and go directly into the abomasum.

How can you make sure it works?

Don't try to feed the newborn from a pail. If your calf is not nursing, make sure the calf suckles from a nipple pail or bottle. It is the suckling action and the sensitivity of the nerves to the milk that create the esophageal groove.
If the esophageal groove is not closing properly, the milk will enter the rumen. Bacteria in the rumen will begin to ferment the milk. This will cause the production of gas. Because the belching mechanism is not yet working in the calf, the calf cannot expel the gas properly. Calves with this problem will become paunchy or "pot-bellied".

At birth, the rumen and reticulum have only a few microbes, so the calf cannot yet digest solid foods. Shortly after birth, once the calf begins to nurse and explore its environment, the microbes will multiply.

You should begin to provide some solid food at a few weeks of age. This will help the development of the rumen microbes. Since the esophageal groove closes only with suckling and liquid feeding, the solid food will go directly into the rumen. Once you have started feeding solid food, you can speed up the development of the stomach by increasing the amount of solids fed.

Between birth and maturity, the rumen and reticulum increase ten times in size in relation to the abomasum.

Compartment size as a percentage of the size of the stomach

	At birth	At maturity
Rumen	25%	80%
Reticulum	25%	6%
Omasum	10%	3%
Abomasum	40%	11%

Special features of the mature ruminant stomach:

Eructation or "belching":

When the microbes work in the rumen, large amounts of gas are produced. This gas needs to be eliminated. The rumen contracts. The gas is forced upward and out through the esophagus. The cow "belches".

Rumination or "chewing the cud":

Rumination allows the animal to take food in quickly, then complete the chewing later. Once the animal is finished eating, the reticulum will force "cuds" or balls of coarser material back up to the mouth for more chewing. The animal chews leisurely on its cud before swallowing it again. The cow spends about 8 hours per day ruminating or "chewing its' cud". This is 1/3 of its life!

Activity:

Share your findings from one of these activities with other members in your club:

1. Find out as much as you can about the esophageal groove. Talk to your veterinarian, a local feed company salesman or nutritionist, or contact the Bison Centre of Excellence. They can provide you with further information about how this important little tunnel works and why.

2. You all know what a happy, suckling calf looks like. Draw up a chart that compares the appearance of a calf whose esophageal groove is working well with one whose milk is going into the rumen.

3. Summarize the changes that occur in the ruminant stomach as the animal matures.

Factors affecting feed intake

There is much variation in the feed intake between animals. Let's look at some of the different factors which can affect how much individual bison will eat.

Palatability

Palatability is ... the overall acceptance of the animal to the feedstuff or ration. Palatability is actually determined by many factors that affect the locating and consuming of the food. These include appearance, odour, texture, taste and temperature.

Appetite

Appetite includes those internal factors that stimulate hunger in the animal. How the appetite is regulated is very complex and poorly understood. Animals have a physiological method of controlling or regulating their food intake. The hunger and satiety, or satisfaction, centers are found in the hypothalamus of the brain. It is the acids that are produced in the rumen during fermentation which affect the appetite of the ruminant animal. If the rumen is active, it will produce more acids, and this will cause the hunger centers in the brain to send messages that the animal is no longer hungry.

Generally, animals eat to meet their energy needs. The animal has some built in mechanism that adjusts energy intake to meet the needs the animal has for energy. This is true as long as no other problems, such as disease or nutrient deficiencies, exist.

Body Weight

The energy requirements of animals are closely related to their body weights. If your animal increases from 400 kg to 440 kg, the energy requirements do not increase by 10%, but actually by a lesser amount, 7.4%. This is because body weight to the 0.75 power gives a close estimate of the surface area of the animal. Remember that the heat loss and heat production are directly related to the surface area.

Individuality

The individuality of the animal affects the intake differences from one animal to the next. However, because most producers are attempting to deal with large numbers of animals and still be economically efficient, it becomes difficult to pay individual attention to animals. Thus, the most advantageous management system is to feed animals in similar categories according to age, sex and purpose.

Type and Level of Production

Young animals need their nutrients for growth. Pregnancy and lactation require nutrients for reproduction. Bulls need nutrients for production, and dry cows require their nutrients only for maintenance. Therefore, the type and level of production directly affects the nutrient requirements of the animal.

Once bison reach 18 months of age, they begin a lifetime cycle of winter weight loss followed by spring/summer weight gain. Figure 2 shows a typical weight cycle and estimated dry matter intake for bison cows throughout the course of a year. From December to April, it is not uncommon for mature bison to lose 10 – 15% of pre-winter body weight. For example, a 1000 lb. cow in December will weigh 900 lb. in April, a loss of 10% of body weight. If this loss is greater than 20% of the pre-winter body weight, there may be an increased risk of abortions, stillborns, or just generally smaller and weaker calves.

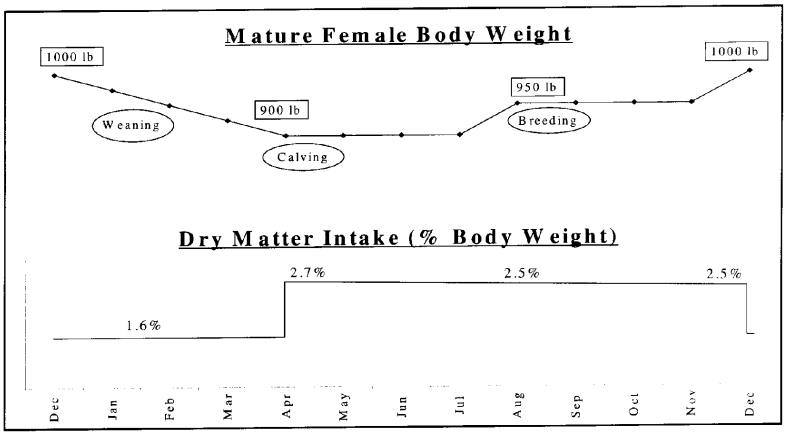


Figure 2. Seasonal weight changes of mature female bison.

Miscellaneous factors

Temperature extremes, general health of the animal and stress conditions will affect feed intake. Cleanliness of feed and water, availability of water and feeder design will also affect feed intake.

Activity:

Take one factor that can affect the feed intake of the bison and find out more about it. Talk to local bison producers, and your veterinarian. How seriously can this factor actually affect feed intake? Share your findings with others in your club. Compare and contrast the metabolism of beef cattle and bison. Explain the cold weather advantage of the bison.

Activity:

1 . Summarize the key points about bison nutrition. Make these points into a list which you would be able to use as a bison producer.

Consult with your leader to see how you can most benefit the club to present this information.

You might want to recreate a game show setting where the information in the first and second level manuals is used as an information base for trivia questions.


NOTES