horse science

4-H HORSE PROGRAM

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HORSE SCIENCE

This educational material has been prepared for 4-H use by the Cooperative Extension Services of the U.S. Department of Agriculture and State Land-Grant Universities in cooperation with the National 4-H Council and the American Quarter Horse Association.

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You probably feed your 4-H horse a supplement. You know that the supplement will make your colt grow faster and be healthier. The horse will be in "better shape" than if you just let him graze.

You know this because you know something about animal nutrition. Animals need many different kinds of nutrients. Different animals need different kinds and amounts of nutrients. This is where the science of animal nutrition comes in. Part of the animal nutritionist's job is to find out what nutrients animals need.

In feeding experiments, different feed ingredients are tried. In the laboratory, feeds are analyzed. Nutritionists search for the best combination of feeds for the kind of horse being fed. For mares nursing foals, the feed must help produce milk. For a pregnant mare, the feed is designed to help produce a healthy foal. For a young horse, feed is designed for growth and development as well as maintenance and energy.

After experiments are conducted, they are checked and rechecked. Then the results are used to make recommendations to horse owners. This means good rations for a minimum cost to horse owners. It also assures you that your horse is fed in a way to meet the needs of his body in the type of work that he is doing.

KIND OF NUTRIENTS

There are many different chemicals in feeds. Animals need some of them in large amounts - others are needed only in tiny amounts. Some have not been discovered or named yet.

These feed constituents are divided into five main types of nutrients. Each type has a different job in the animal's body. The five types are (1) energy nutrients (carbohydrates and fats), (2) proteins, (3) vitamins, (4) minerals, and (5) water.

None of these is more important than the others. All are essential. But with the exception of water, the energy nutrients usually make up the greatest bulk of feed.

Energy nutrients are the body's fuel. In fact, they are even chemically similar to fuels we use - gasoline, oil and coal.

After digestion, the energy nutrients are carried by the blood to the cells of the body. In reactions very much like burning, they are used by the cells for energy. Energy or fuel is required to power the movements of muscles - walking, a beating heart, breathing, blinking eyes and contractions of the digestive system. At the same time, heat is produced to maintain body warmth.

The main energy nutrient is carbohydrate. There are many carbohydrates. Even the relatively simple ones are complex compounds. All carbohydrates are made up of carbon, hydrogen and oxygen. Carbon is the key to carbohydrates. This element can behave in several different ways. As a result, there are thousands of possible combinations of carbon, hydrogen and oxygen.

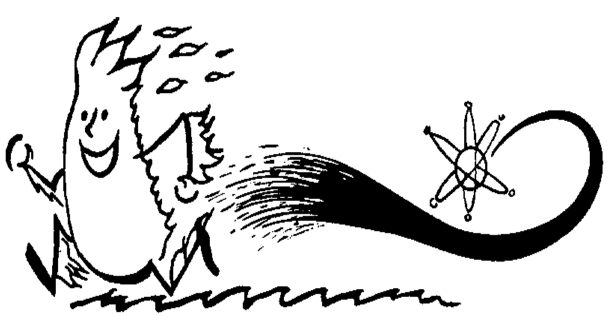
Sugars and starches are carbohydrates. They are relatively simple. Cellulose is one of the more complex carbohydrates.

The sugars and starch are easy to digest. They have a high "feeding value" because very little of them pass through the body undigested. Grains such as corn and oats contain much sugar and starch.

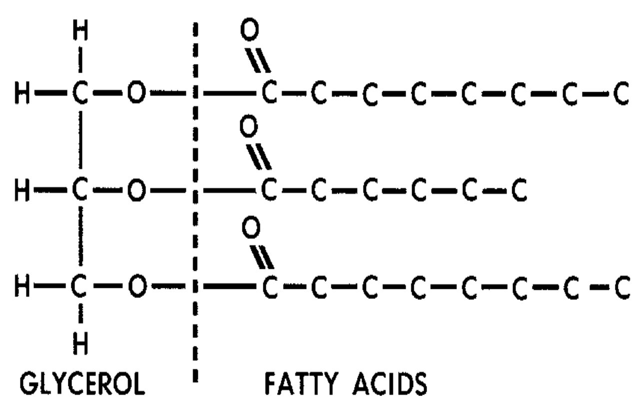
Cellulose is chemically a carbohydrate. It makes up the fiber in plants. Grass has much cellulose. Cellulose is hard to digest. For most animals it has a low feeding value; however, ruminants (cattle and sheep) can digest large amounts of cellulose with the aid of bacteria in the rumen. The caecum or large intestine of the horse functions similar to the rumen in cattle and sheep.

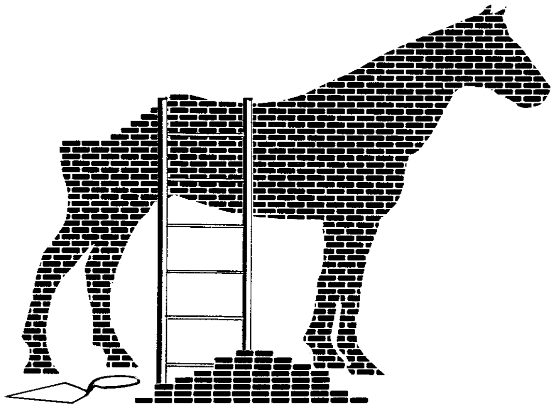
Another group of energy nutrients is the fats and oils. Fats and oils are chemically alike. Their main difference is that fats are solid at body temperature; oils are liquid. Both are usually called fats.

Like carbohydrates, fats are made up of carbon, hydrogen and oxygen. They are also used to provide energy for movement and heat. Fats contain a higher percentage of carbon and hydrogen atoms than carbohydrates do. Thus, the energy in fats is more concentrated. Fat has 2.25 times more energy per gram than carbohydrate.



THE ENERGY NUTRIENTS





THE PROTEINS

While carbohydrates and fats supply energy, proteins supply the material from which body tissue is made. They are the bricks and mortar from which bodies are built.

Proteins are highly complex. In addition to carbon, hydrogen and oxygen, they contain nitrogen. Some proteins also contain sulfur. A few contain phosphorus or iron.

Like carbon, nitrogen can be combined with other chemical elements in different ways. The various combinations result in many different proteins. Each protein is made up of several nitrogen compounds called amino acids. These amino acids are the “building blocks” from which proteins are made. The chemical arrangement of the amino acids determine the quality of the protein.

During digestion, proteins are broken down into amino acids. These are absorbed from the intestine into the blood stream and carried to all parts of the body. Then they are recombined to form body tissue.

Proteins that are eaten eventually become muscle, internal organs, bone and blood. Skin, hair, hooves, and many other parts of the body are also made of protein. If an excess of protein is fed, the nitrogen portion of the protein can be separated from the rest of the nutrient and be discarded in the urine. The remaining materials can then be converted into energy by the animal.

TWO PROTEINS ARE NOT ALWAYS ALIKE IF MADE OF THE SAME AMINO ACIDS!

AMINO ACIDS	1	2	3

PROTEIN #1	1	2	3
PROTEIN #2	1	3	2
PROTEIN #3	2	1	3
PROTEIN #4	3	2	1
PROTEIN #5	3	1	2
PROTEIN #6	2	3	1

THE VITAMINS

Although animals need large amounts of both energy and proteins, other nutrients are just as vital, but are needed in much smaller amounts. The vitamins are such a group.

For a long time, people noticed that certain diseases were caused by the lack of certain foods. Then modern science began analyzing the foods. They were found to contain small amounts of certain complex chemicals. Other foods did not contain them.

These nutrients were called vitamins, or “vital amines”. They are essential to normal body functioning.

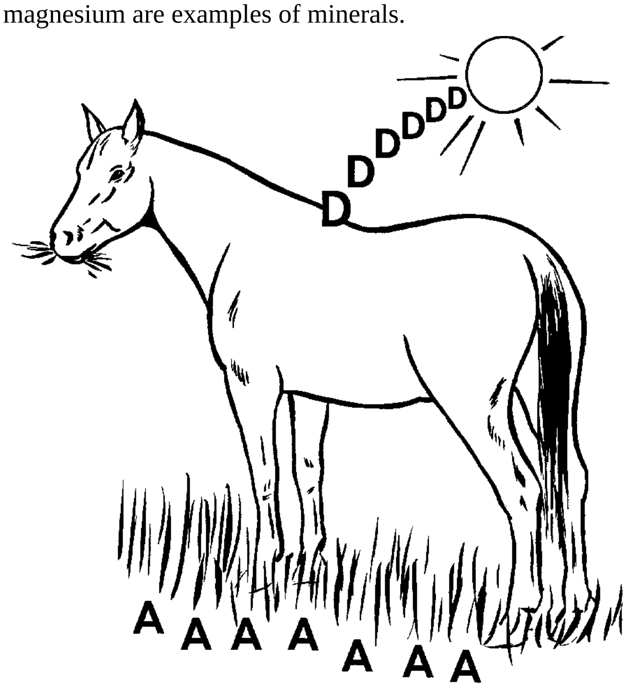
The vitamins are not chemically alike. Each one also has a different job in the body. Still, they are all classed together under the term vitamins. This is because they are all organic compounds. (They contain carbon). Also, all of them are needed only in very small amounts.

Vitamin A is responsible for the health of the eye and the tissue of nasal passages, lungs and digestive system. Vitamin D is responsible for the strength and proper development of bones and the mineral balance in the blood. Other vitamins have just as important functions.

Some animals require only certain vitamins in their feed, whereas others can manufacture some of their own. Feeds are a good source of certain vitamins. Carotene in green grass is a good source of vitamin A. Sunshine and sun-cured hay are good sources of vitamin D.

THE MINERALS

Like vitamins, minerals are usually needed only in small amounts. Unlike vitamins, they are inorganic - they do not contain carbon. Iron, copper, phosphorus, calcium, and magnesium are examples of minerals.



Minerals are important in the chemical reactions of the body. Without them, many life processes could not take place. Without iron in the blood, for instance, oxygen could not be carried to the body's cells. For animals such as horses that are very active, the oxygen carrying capacity of the blood is a very vital factor in their daily life. A race horse uses tremendous quantities of oxygen during a race.

Without calcium and phosphorus proper bone and tooth formation would not take place. These are examples of the need for minerals.

WATER AS A NUTRIENT

The last item on our list of nutrients is so common that we seldom think of it as a nutrient. But water is the largest single part of nearly all living things. The body of a colt is three-fourths water, while an adult is approximately 50 percent water.

Water performs many tasks in the body. It makes up most of the blood, which carries nutrients to the cells and carries waste products away. Water is necessary in most of the body's chemical reactions. In addition, water is the body's built-in cooling system. It regulates body heat. It acts as a lubricant.

Life on earth would not be possible without water. An animal can live longer without food than without water.

FINDING OUT WHAT'S IN FEEDS

Research has provided the information that is available about the different kinds of nutrients. The scientist has developed methods by which the amount of each nutrient in a feed can be accurately determined. Knowing the nutrient content of a feed is very important to livestock raisers.

Water is one of the nutrients that is fairly easy to determine. Simply take a sample of a feed and weigh it. Then heat the feed sample slightly above the boiling point of water. Hold it at this temperature until the feed stops losing weight. Then weigh the feed. This weight is subtracted from the weight before heating. The difference between the two weights represents the amount of water driven off by the heat. To find the percentage of water, divide the dry weight by the original weight.

Another fairly simple analysis is to find out how much mineral is in the feed. Recall that minerals are inorganic chemicals. As such they will not burn. When feed is completely burned, a whitish-gray ash is left. If the weight of this ash is divided by the original weight of the feed before burning, the percent mineral, or ash, is obtained.

The chemical analysis gets more complicated when you are determining how much protein is in a feed. Recall that protein is made up of carbon, hydrogen and oxygen plus nitrogen. Scientists have learned that protein is about 16 percent nitrogen. Using certain chemical tests, the amount of nitrogen in a feed can be determined. Multiplying this amount by 6.25 (16 percent nitrogen divided into 100=6.25) gives the amount of crude protein in a feed. It is called crude protein because it includes all nitrogen compounds. There may be some nitrogen compounds in the feed which are not true proteins.

Another test is for the amount of fat in a feed. Since fat dissolves in ether, a sample of the feed is heated in ether for several hours. Then the feed is removed, and the ether is evaporated. The residue that is left is the fat, or ether extract.

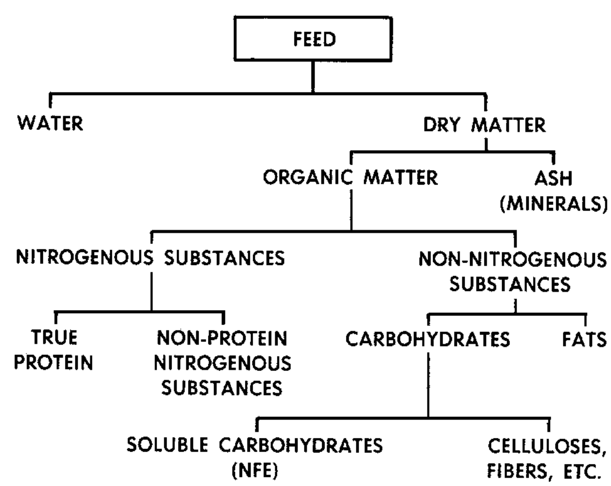
It is important to know the fiber content of feeds. This is because fiber is hard to digest. Therefore, feeds with a high fiber content are less nutritious.

To find the fiber content, some of the feed is dissolved in a weak acid or alkali. Fiber (very complex carbohydrates) will not dissolve; it is left over. Any material that the weak acids or alkali will not dissolve is considered to be indigestible by animals. Keep in mind that the cells in the lining of the stomach secrete a weak solution of hydrochloric acid.

If the percentage of water, minerals, fat, fiber and protein are added together, the total will be something less than 100 percent. This difference is referred to as the nitrogen-free extract. This extract includes the more soluble carbohydrates, sugars, starch and some cellulose. All of these are readily digested in the digestive tract.

When the amounts of different nutrients in a feed are known, the quality or feeding value of the feed can be easily determined. By adding the digestible organic nutrients (protein, nitrogen-free extract and fat x 2.25), we can tell the “energy value” of a feed TDN - total digestible nutrients - is the term used.

FEED COMPONENTS



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