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A Simple Basic Explanation of Cow
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INTRODUCTION

Cattle producers in many ways have expertise in nutrition. Each day when cattle are fed or when grazing, they are taking in nutrients (protein, energy, minerals, etc.) that are vital for their life and production. Cattlemen are responsible for providing the feeds that supply the nutrients for the beef animal. If provided in the proper balance and portions at an economical level then the desired results should be obtained. If shortages occur with any required nutrient or if the nutrients are fed in excess or the sources are extremely costly then economic losses will be experienced. Because the largest cost in maintaining a beef cow and producing a calf is feed expenses, it is logical to concentrate on this high ticket item. Cattlemen often want direct answers concerning their feeding program such as "how much and what type of supplement should I feed to grazing cows in early winter." Unfortunately, there is not an accurate answer to this question until more is known about the type of cattle and the base forage the cattle are consuming. Perhaps if ranchers would couple their excellent experience in feeding cattle with some basic facts on the nutrition of the cow, then the feeding program could be fine tuned and more profit gained.

The title of this paper indicates both simple and basic nutrition. Sometimes a basic concept appears to be anything but simple to a person that is attempting to use the concept and apply it in a practical feeding situation. The challenge and objective of this brief discussion is to try to keep the basic concepts simple to understand and yet show why it is important to further understand cow nutrition. This brief discussion will not be complete enough for many readers. Many textbooks and other publications go into great detail and allow further pursuit of a more thorough understanding of basic nutrition.

FEEDS AND THEIR NUTRIENTS

Nutrients are those compounds or components of feeds that provide the total nutrition (life and production) for the cow. Energy is the nutrient that comprises the largest portion of the cow's diet and is usually the most expensive part of the cow's feed costs. It may not be the largest out of pocket expense because many ranchers raise the sources of energy in our forage based operations. We characterize energy as TDN (total digestible nutrients) as in the case of feedlot diets and in a few cow rations the energy used to maintain the cattle (NEm - Net Energy for maintenance) and then the energy left over after maintenance is used for gain or production (NEg - Net Energy for gain) is used in ration balancing. When the amount and quality of feed consumed is known the Net Energy values allow for fine tuning of rations. Because in many ranch situations it is impractical to accurately determine the quantity and quality of forages fed, then TDN is used to evaluate energy in the cow's diet.

Protein is another nutrient that is consumed in large quantities and in many operations comprises the largest out of pocket expense which affects cash flow. Usually protein is referred to as crude protein, however in the future we will be considering where and how the protein will be digested and utilized. Terms such as by pass protein, metabolizable protein, net protein, etc., will be used. Non-protein nitrogen such as urea shows up as crude protein in analysis and can be potentially combined by the rumen microorganism into high quality, utilizable protein. This is called microbial protein. A more complete and applied discussion on protein utilization can be found in the accompanying paper in this proceeding entitled "Effects of Supplementation on Intake and Utilization of Harvested Forage".

Neither protein or energy is the most important. They are both important and they both must be supplied in adequate quantities to acquire satisfactory performance. Some have felt that energy is the nutrient needed for reproduction and protein is needed for growth. The facts are they are both needed for maintenance, growth and reproduction.

Minerals are usually classified into the macro and micro minerals. Calcium, phosphorus and potassium are the macro minerals that usually concern us in beef nutrition with phosphorus being the one that is most often deficient in high forage diets. Trace or micro mineral nutrition involves very low quantities and their supplement needs will vary from one region to another. This perhaps is one of the most difficult nutrition problems to solve because good basic and applied research data are difficult to obtain in any given area or region. Other than vitamin A which is easy and cheap to supplement, most vitamins are not of concern to supplement when fed to healthy cattle.

THE DIGESTION PROCESS

Digestion simply refers to the breakdown of feedstuffs. In order for it to be utilized by the cow it must be broken down to a level so it is absorbed through the gut lining.

The stomach of the cow has four compartments, namely the rumen, reticulum, omasum and abomasum. The rumen is the largest and plays the greatest role in forage utilization. The rumen contains billions of microorganisms, both protozoa and bacteria, that are involved in forage breakdown. This is done by secreting enzymes that aids in the fermentation of the feeds in the rumen. Much of the fermentation products are volatile fatty acids (VFA) which are absorbed through the rumen wall and then travel via the portal blood vein to the liver. They are then converted to glycogen or blood sugar or energy. The reticulum is used to form boluses and serves as a "pump" to push the cows "cud" up the esophagus so it can be chewed and mechanically broken down further. While the cow is chewing her cud she is adding a large quantity of saliva (approximately 5 gallons/day) which is rich in buffering minerals that aid in controlling the proper level of acidity in the rumen. Saliva also contains considerable urea which is being recycled. Because of the cow's ability to recycle urea, many feel this is the reason that a protein supplement can be fed successfully every 3 days. She can maintain the nitrogen (from protein) in the system for a long period of time by recycling. Perhaps the cow should be given credit for being one of the first recyclers. The function of the omasum is not well known. It appears to be partially responsible for absorbing moisture from the feed in the stomach. The

abomasum is often referred to as the true stomach that is very similar to the stomach in the monogastric or simple stomach animals such as the pig or human. Because the abomasum is relatively high in acid content very few live microbes are present and digestion is via breakdown by enzymes.

After the feed and microbial particles pass through the abomasum it travels to the small intestine where many of the small nutrients are absorbed. The unutilized or unabsorbed feed particles pass on to the large intestine where some water is absorbed before passing on out of the cow.

On the average, feed particles are in the digestion tract (front to end) 24-36 hours, however this is very variable. Finely ground and high quality feeds will pass quicker. Finely ground forage will pass faster than long unground forage and consequently the digestibility of the ground forage will be lower. Poorly digestible forages will pass at a much slower rate. Reports would indicate that some particles stay in the digestive tract for over 7 days.

It is important that we understand that we are actually feeding two different parts of the cow's digestive tract. The rumen microorganisms have their own ecosystem and requirements, and are extremely important in energy and protein utilization. Digestion and absorption in the small intestine are considered as a second part of the cow's digestive tract. It is important that the rumen microorganisms' requirements are met so the level of microbial activity remains high so forage digestibility, which basically occurs in the rumen, will be at a high level. Most of the microorganisms are specialists. A group of the organisms are forage digesters or specifically breakdown cellulose and some other fiber particles in the forage. Others "specialize" in starch utilization which is found in grain. When a combination of forages and grains are fed there are some antagonisms or negative associative effects. Small amounts of grain (2 lb or less) or starch does not appear to create negative effects on the forage digesters. When the level of grain in the forage diets is increased then a shift will occur away from forage digestion in the rumen and forage digestibility will decrease, consequently less energy will be gained from the forage. This is especially true when the rumen microorganisms are short of protein. Protein is used as a "body building" nutrient for the organisms, thus protein must always be adequate so the level of the rumen microbial activity can remain high and digestion high. Some protein in feeds, especially the protein in supplements that have been heated in processing will not be broken down in the rumen and passes on through the rumen and is digested and absorbed in the small intestine just as in the pig. This is a very efficient process and once the rumen microorganisms' needs are met, then it would be desirable to meet the remainder of the cow's protein needs by feeding high by pass protein sources such as blood meal, meat meal, corn gluten meal, feather meal plus others. As more is learned of the cow's actual protein requirement and the actual by pass value of protein sources are determined, the more the by pass protein concept will be used in balancing cow rations. The life of the rumen microorganisms is variable but in all cases is short (measured in hours). Thus, the population is in constant turn over. As the rumen microorganisms, which are single cell "animals", build their bodies or cell walls they synthesize protein from nutrients available in the rumen. As they die of old age (a few hours after they are formed) they pass on down to the small intestine where they are digested and absorbed. This is referred to as microbial protein. At this point the microbial protein is utilized in the same manner as the protein that by

passed the rumen, which origin may have been from soybean or cottonseed meal. Again, it is important to understand how starch sources, such as grains, are utilized by the rumen organisms and when and why they can be beneficial or detrimental. The same is true with protein and understanding the protein and energy relationship and interdependence. With this basic understanding, then hopefully comments such as "I hear energy sources are bad" or "I understand the only way I can be assured of a high rate of reproduction is to feed energy supplements" will not be made without considering the entire situation.

In summary, this brief discussion is only a brief overview and perhaps is too simple for some and perhaps too complex for others. More can be gained and understood by reading nutrition texts, extension or other publications, taking a course at the community college or attending a special workshop. The more understanding you gain in the basic nutrition facts the better and more economically you can design your feeding program. If a well designed and economical feeding program is utilized then this should add dollars to your profitability.