Basics of Alpaca Nutrition

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AOBA – Portland OR
June 2001

INTRODUCTION

Nutrition is one of the major keys to animal health. Without a sound nutrition program, an animal will be unable to produce fiber or a cria to its maximum genetic potential. Limitations in the supply of nutrients can and do compromise an animal's immune system. Therefore, having a working knowledge of the nutrients needed by the animal, and what feeds will supply those nutrients, is one of the most important steps in managing an animal. I strongly suggest that if you do not have a livestock background and are not familiar with herbivorous hoofstock, research the alpaca and what it needs BEFORE you bring it home. There are a lot of questions to be asked before you actually feed an alpaca, and I will attempt to address those is this text. There is not enough time or space to cover all the aspects of nutrition and the feeds that are used to feed these animals, but I will do my best to address some of the "basics."

Nutrition is one of the major keys to animal health.

An animal can live for long periods of time with limited nutrients. The animal body has a unique way of "borrowing" nutrients from other parts of the body to enable life to continue. But there is a price for this "borrowing," and sooner or later those borrowed nutrients need to be replaced or the animal will become ill and may even die. Until the animal "crashes," it is not obvious that there is a problem, and often the only symptoms that something is wrong may be subtle changes in production, a lower yield of fiber, or a cria of low birth weight and vigor. Records are a vital part of a production system, and an alpaca owner needs to record body weights on a regular basis.

In addition to proper feeding management, I encourage you to get to know your animals – really know them. Individuals that have worked with livestock previously – cattle, sheep, goats – are aware of subtleties to watch for. These subtleties are factors that can never be learned from a book, little things that can only be learned from actually working with animals. You might hear one of these individuals say, " That animal does not feel well," and you think the person is "bonkers." The animal is eating and moving around, adequately, in your mind. But beware, it may be the way the animal is holding its head, or perhaps it is standing off by itself. Either way, individuals working/raising alpacas have to become familiar with their animals from the beginning. Get in with your animals. Walk among them, watch them and know what is normal. All animals are creatures of habit, and if you are familiar enough to know "normal" and are watching closely, you will be aware when something is wrong. Do not be a "fenceline" manager. Combining these concepts and proper feeding management, you will be well on your way to a successful venture into the alpaca husbandry.

Know what is normal for your animal – get in and walk around with them daily.

Nutrition is not always easy – it is a puzzle. And there are many pieces to that puzzle including management, behavior of the animal, potential disease, physiological status (i.e., pregnant, lactating, growing), economics involved with forage and grains and, of course, what feedstuffs are available to feed the animal. Becoming aware of these puzzle pieces and how they fit together is a good start when feeding the alpaca. Be aware that the nutrient requirements for the alpaca are not known. Data from small ruminants like the sheep and the goat have been extrapolated for the alpaca to obtain an estimated requirement. I have incorporated those estimates in Table 1. This information was presented at the AOBA meetings last June in Louisville, Kentucky (Irlbeck 2000).

We do not know the "exact" requirements of all nutrients for alpacas – but have extrapolated from other species to incorporate with what we do know.

Table 1. Estimated Nutrient Requirements of Llamas and Alpacas.

Nutrient	Level	Source
Crude Protein, %	8-14	Johnson, 1989
ME, Kcal $BW^{.75}$	84.5	Carmean, 1992
Calcium, %	0.3-0.85	Van Saun, 1999
Phosphorus, %	0.16-0.40	Van Saun, 1999
Potassium,%	0.5-1.0	Van Saun, 1999
Magnesium,%	0.12-0.20	Van Saun, 1999
Copper, ppm	13-15	Van Saun, 1999
Iron, ppm	60-130	Van Saun, 1999
Manganese, ppm	45-55	Van Saun, 1999
Selenium, ppm	0.4-0.6	Van Saun, 1999
Zinc, ppm	40-50	Van Saun, 1999
Vitamin A, IU/kg	3000-3500	Van Saun, 1999
Vitamin D, IU/kg	3000	Extrapolated
Vitamin E, IU/kg	17-20	Van Saun, 1999

When feeding alpaca – you must always keep in mind the microbes in the stomach that are responsible for fermenting the fiber.

GASTROINTESTINAL TRACT

Understanding what kind of gastrointestinal tract (GIT) an animal has is an integral piece from the nutrition puzzle and understanding how and animal is fed. Types of GIT vary among the animal kingdom based on animal diets. The GIT is defined as the part of an animal's body from the mouth, esophagus, stomach, small and large intestine and down to the anus. For example, a carnivore has a very short GIT because its meat-based diet is very digestible and a larger tract would not be needed. An animal that consumes forages like grass and hay (herbivore) must have a much larger tract as it needs to house the

symbiotic microbe population. The microbe population is needed to break down or ferment cellulose, cellulose being a major component of plants. Mammals cannot digest cellulose. Yes, cattle, horses, sheep and even alpacas consume forages and seem to do quite well, but it is because of a resident microbe population. The microbes produce an enzyme called cellulase to ferment cellulose found in plants. Without this enzyme, forages could not be fed to the above animals. Also, because of the sensitive nature of those symbiotic microbes and how they are affected by what we feed them, great care needs to be taken. If the microbes were to be hampered in any way by what we feed the alpaca, then the animal can be compromised. Symbiotic means that the microbes and the alpaca both are dependent on each other. The alpaca provides a "home" and food supply for the microbes, and the microbes ferment that food and produce volatile fatty acids. Volatile fatty acids provide a source of energy for the alpaca.

The alpaca is a psuedoruminant having a three compartment stomach.

The alpaca is an herbivore and is classified as a pseudoruminant. Being a pseudoruminant means that the alpaca (like the llama) is similar to a ruminant animal (cattle, sheep, goats and deer), but is not exactly. Ruminants cannot all be fed the same, so care needs to be taken which ruminant model is used for comparison with an alpaca. Cattle are able to do quite well on large quantities of low quality forage, the alpaca cannot. The feeding principles for the sheep and goat are closer to what alpacas need than those for cattle. Because of its size and metabolism, the alpaca needs high quality forages. I will discuss how you can determine what a high quality forage is shortly in this text.

When evaluating GIT differences, the most important GIT difference is the stomach. The stomach of the alpaca is not the same as what we think about for people, for dogs or even the horse. The alpaca stomach has three parts – Compartment I, II and III. Compartment I is the largest and analogous to the rumen in cattle, sheep and goats. It is here in Compartment I that microbial fermentation of the fibrous portion of plants occur. Compartment II is much smaller than the first, and it is here that buffering agents and more digestive enzymes are added to the digesta (partially digested food). When the digesta leaves Compartment II, it enters Compartment III where nitrogen (urea) is recycled, and more buffers and digestive enzymes are added. The lower portion of Compartment III is analogous to the stomach of the human, horse or dog – it is here that protein digesting enzymes and hydrochloric acid are added. It is also here that microbes attached to food particles coming from Compartment I are digested, becoming what we call microbial protein – an important source of amino acids for the alpaca as they are for ruminants like cattle, sheep and goats.

SO HOW DO WE FEED THE ALPACA

Many scientists, myself included, indicate that when feeding animals we need to consider what the animal was fed in its native habitat. For example, alpacas are South American camelids, and we need to closely evaluate what the animals are being fed in South America. Yes that is true. But we also have to consider that individuals raising alpacas in South America most often do not have the available resources that we in the United

States have to feed animals. Animals in South America are quite often fed a subsistence ration and when consuming that kind of diet, they do not produce fiber and young at the same level as they do in the United States. They also do not live as long. If there is a consistent problem feeding in the United States, it is usually in our zeal to take care of these animals in the best possible way, and we over-feed them. Rarely do alpacas get underfeed in the United States, unless it is in ignorance.

The major problem with feeding alpaca is over feeding and the second is underfeeding – we need to handle our animals to monitor their body condition.

So where do we start? In Table 1, we see that the alpaca requires 12-14% CP. But what does this mean and how do you supply 12-14% crude protein (CP)? The best way to provide an explanation is to talk about the nutrients in conjunction with the feeds that provide them. The best place to start would be the most important nutrient – water.

WATER

Water is the first nutrient of importance. Good quality water is becoming more difficult to acquire with the increase in human population. Regardless of the challenges of finding a good water source, we must keep in mind that an animal can only survive a brief time without water – the amount depending on environmental conditions. To determine if you are providing good quality water, have it tested. Test your water, even if it is city water, and definitely if it is well water. Many owners, many veterinarians and even nutritionists forget water when problems occur with an animal. But what do you test water for? In Table 2 I have listed a few "good" water standards. There are many other measures (i.e., individual minerals) of "good" water, but this is a start. If your water source meets these requirements and is low in bacteria, herbicides, and other chemicals, at least you know that it is probably safe for the animals to drink. But, you also need to be aware of the mineral content of your water. For example, if it is high in iron, that iron may tie up other nutrients like zinc and copper. If zinc or copper is tied up and is no longer available to the animal, the immune system is compromised, as is fleece quality.

Get your water source analyzed – it can solve many mysteries regarding alpaca health! This includes minerals, nitrates and potential contaminants.

Table 2. Good Water Standards for Livestock Use

Total Solids	Less than 1000 ppm[1]
Hardness	Less than 1000 ppm
Sulphates	500 ppm or less
Nitrates	Less than 45 ppm
Sodium	500 ppm or less

Source unknown.

[1] ppm = parts per million

FORAGES AND GRAINS – THE CARBOHYDRATES

As indicated earlier, the alpaca is an herbivore – it eats plants. Plants are carbohydrates. Carbohydrates are divided into two categories: 1) complex carbohydrates like cellulose and hemicellulose; and 2) readily available carbohydrates like sugars and starches. So what does that mean, and how do I apply it to feeding the alpaca? Complex carbohydrates are forages such as grass and alfalfa hay (Table 3), grass that is grazed by the animals and any shrubs and tree material that the animals may consume. Readily available carbohydrates are grains – barley, corn, oats, and wheat (Table 4).

FORAGES

Lets talk about the complex carbohydrates - forages - first! So what kind of hay should you feed to your alpaca? I can tell you idealistically; however, actual economics often play a major role in determining exactly what an animal is being fed. I will provide you with the basic principles of what to use when evaluating forages like grass and alfalfa hays, but what you actually feed depends on where you live. Hays are not all the same, as a multitude of factors affect the potential nutrient variability. Factors include the maturity of the forage when it is cut for hay, what was the weather when the hay was harvested, as well as losses due to harvesting and storage techniques. All producers know that if you want it to rain, cut down the hay!

All hays and not all pastures are the same – be aware of the plant idiosyncrasies and their effect on the animal. Be aware of maturity issues.

Get your forages analyzed – proximate analyses and fiber analyses – NDF and ADF.

In general there are two types of forages – legumes and grass. The most common legume fed in the United States is alfalfa, called lucerne in most other parts of the world. Clover, another legume, is occasionally fed in the US, but predominantly in other countries. Nutritionally, legumes are higher in protein and calcium than are grasses. There are in general three types of grasses: 1) cool season grass; 2) warm season grass; and 3) southern grasses. Examples of common cool season grasses include brome, timothy, and orchard grass. Cool season grasses do better in a temperate climate when it is cooler and there is ample moisture. Examples of warm season grasses are big and little bluestem, Indian grass and switchgrass. Warm season grasses do better when the temperature is higher and under drought-like conditions. Rotations of cool and warm season grasses are common to allow for seasonal changes. Southern grasses such as Bermuda grass are much lower quality than cool or warm seasons grasses - partially because they are grown in a much hotter climate. It is important for you to become familiar with the type of forages (and their idiosyncrasies) commonly fed/grown in your part of the country - before you feed alpacas!

Now let me discuss the simplistic components that make up a plant (Figure 1). A plant can be divided into cell solubles and cell walls. Cell solubles are starches, sugars – readily available carbohydrates that are digestible by all animals. Cell walls are the important part that we will use to determine forage quality. They are made up of lignin, cellulose and hemicellulose. For this discussion, lets say that lignin is not digestible by

animal or microbial enzymes. Thus the more lignin in a forage, the more indigestible it is, as the lignin ties up the rest of the plant components. The more mature forages are, the greater the lignin content. In general, the hotter the environment when a forage is grown, the higher the lignin content of that forage. Thus management (and luck) of the forage crop is critical when producing high quality forages.

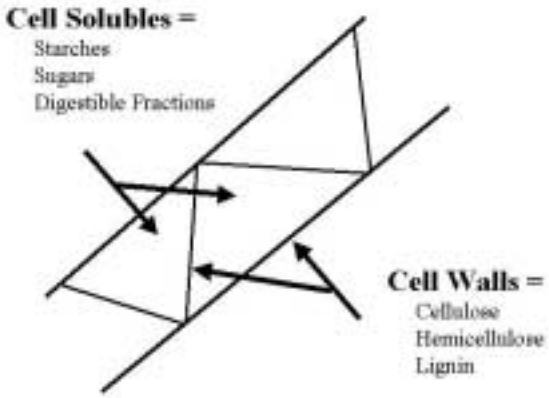

Figure 1. Schematic of Plant Components

In Compartment I of the alpaca GIT, the cellulose from forages is fermented by microbes. When the forage is more mature, there is more lignin, and the cellulose fermenting capability of the microbes is diminished. The hemicellulose found in forages is very digestible by animals and microbes' enzymes, but again if there are high amounts of lignin, the capability to digest hemicellulose will too be decreased.

The more mature the plant, the more lignin. The more lignin in a plant, the less digestible it is to the animal, the less the animal can eat, and the lower the nutritive value.

Again - get your forages analyzed – proximate analyses and fiber analyses – NDF and ADF.

Often alpaca producers do not produce their own forages but purchase it from various sources. Thus, when purchased, a producer needs to sample that forage and have it analyzed. But what does that mean? What do you ask for when having forages analyzed, and then how do you interpret the information that you get back from the laboratory? My recommendation is to ask for **proximate analyses** (includes CP and others), **fiber analyses** (to be defined shortly) and if possible the **calcium** and **phosphorus** levels. There are other measures that can be done, but at least this will provide enough information to determine forage quality.

Fiber analyses will be the focus of the next few paragraphs as these will help in determining the quality of your forage. Fibers are based on the principles of a scientist, Dr. Peter Van Soest, who developed the detergent fiber technique in the 1960's. Thus the techniques are also called the Van Soest fiber analyses. There are two of Dr. Van Soest's

measures that we are going to use in this discussion and what you will need to ask for in the analyses request. They include: 1) acid detergent fiber (ADF); and 2) neutral detergent fiber (NDF). The ADF content of a plant includes lignin and cellulose concentration, while the NDF content of the plant includes the lignin, cellulose and hemicellulose concentrations. So what does an ADF or NDF level mean, and how can you apply it to feeding the alpaca and determining quality of the forage being fed to your alpacas?

First lets look at the ADF concentration of the plant. The level of ADF can be used to determine how digestible forages are – digestible dry matter (DDM). If a feed is more digestible, then an animal can eat more and get greater energy and nutrient content from it, thus it is of higher quality. In Table 3, I have listed feeds of varying maturities with corresponding ADF and NDF values. In general, the more immature a forage when harvested, the higher the quality and the lower the ADF value. Likewise, the more mature the forage, the lower the quality, and the higher the ADF value. The %NDF can be used to determine the dry matter intake (DMI) of forages. Like the %ADF, %NDF can be used to determine forage quality. The higher the forage quality, the lower the %NDF and the higher the DMI. Conversely, the lower the forage quality is, the higher the %NDF and the lower the resulting DMI for the feed. An alpaca consumes less than a ruminant. On average a ruminant consumes 2 to 2.2% of its body weight, while an alpaca consumes on average 1.8 to 2.0% of body weight. The animal may consume more than that, but then they are often prone to obesity. Listed below are the equations that can be used to calculate DDM and DMI, and thus assist in making a decision on forage quality.

Digestible Dry Matter (DDM)

% DDM = 88.9 – (0.779 X %ADF).
For example - if the %ADF = 31, then
%DDM = 88.9 – (0.779 X 31) = 64.75%

This means that the forage is 64.75% digestible. Compare this to the values given in Table 3.

Dry Matter Intake (DMI)

%DMI = 120/%NDF
For example – if the %NDF = 40, then
%DMI = 3% of the animal's body weight

A %DMI value of 3.0% means that the forage is high enough in quality that an animal could eat 3% of its body weight! That is very high quality forage when you are looking for 1.8 to 2.0% for animal maintenance. This quality of forage would be excellent for females in late gestation and early lactation.

For maximum quality and quantity, alfalfa is harvested at what we call 1/10 bloom. That means that approximately 1/10 of all blossoms on a plant or plants in the field are in bloom and the rest have not yet blossomed out. This is called early bloom in reference texts. In general, the more blossoms open on a plant the greater the maturity. In Colorado, it is usually possible to have three harvests or cuttings of alfalfa. At higher

altitudes this may be reduced to a single cutting (if alfalfa can be grown at all), while in other parts of the country, six or more cuttings can be harvested. Emphasizing Colorado management in this dialogue, the first cutting of alfalfa in the season is usually of lower quality than later cuttings as it has larger stems, fewer leaves and more weeds. Later cuttings (second, third and fourth) have smaller stems and more leaves. Since the majority of the nutrients are in the leaves, the more leaves, the higher the quality of the forage. Later cuttings are usually of highest value and, if managed correctly, may bring a premium to the producer. The first cutting is usually classified as beef cow hay. The second and third cuttings of a forage are targeted by horse people. The third and fourth are considered dairy quality (if cut at an immature stage), as the highest quality forage is essential for maximum milk production. Therefore the later cuttings of a season are of higher quality in a perfect scenario. A perfect scenario is not realistic in most situations, as rainfall and other "situations" will affect the potential quality, even if you have harvested it at the perfect time.

Table 3. Nutrient content[1] of forages commonly fed to alpaca.

Forage	%CP	%ADF	%NDF
Alfalfa, pre-bud	23	28	38
Alfalfa, early bloom	20	30	40
Alfalfa, mid-bloom	17	35	46
Alfalfa, mature	15	41	53
Alfalfa-grass, midbloom	15	38	55
Alfalfa-grass, mature	12	42	52
Brome, late vegetative	14	35	63
Brome, late bloom	8	49	81
Orchardgrass, late vegetative	18	31	55
Orchardgrass, early bloom	15	34	61
Wheat straw	4	54	85

Pioneer (1995)
[1] Dry Matter Basis.

Grass is normally harvested only twice in Colorado - thus, there are only two cuttings. At higher altitudes, there will only be one cutting. When harvesting grass for hay, the more immature the grass is when cut, the higher the quality of forage. As the plant matures, seed heads develop, and as they begin to emerge, the quality of the hay goes down. If all of the plants have seed heads, the hay is now called mature hay and is of lower quality. Generally the first grass hay cutting of the season is of higher quality. As the season advances and temperatures increase, the amount of lignin in the plant increases, lowering the digestibility. Therefore, the earlier, more immature cuttings are of higher quality than later cuttings. Therefore, it is possible to break open a bale of hay and look for the number of blossoms and seed heads. The more blossoms and seed heads found, the more mature the hay and the lower the quality.

Once the forage has been harvested or purchased, it needs to be stored correctly to protect nutrients in the feed. The best form of storage is to put the hay in an enclosed barn or shed. If that is not possible, a tarp can be draped over the stack of hay and secured. Either

way serves to protect the forage from losing nutrients to bleaching from the sun or leaching of nutrients by rain or snow. After one year's storage there is a decline in the nutrient content, so it is best to appropriate that amount of forage that can be fed in one year's time.

GRAINS

Readily available carbohydrates like grain are an energy source. They are not a protein or mineral source (Table 4), and are to be used only in moderation for the alpaca if the animal needs more energy. Times of higher energy (and nutrient) requirements for the alpaca include late gestation (last one third), early lactation, growth, in extremely cold weather and at times for the geriatric animal. Grain is commonly used as a carrier for a mineral supplement, and daily small amounts (quarter of a 8 ounce cup) are not a problem. The problem with overfeeding grain to alpaca primarily deals with the microbe population. Remember that the microbes in Compartment I digest/ferment the cellulose from forages. They also ferment the starch in grains. Starch is much easier to ferment than cellulose, and if too much grain is fed, then the microbes ferment it very fast, producing a large proportion of lactic acid rather than the traditional fatty acids we talked about earlier. The pH of lactic acid is very low and can actually burn the inside of Compartment I. In ruminants this is called acidosis, in camelids it is called "grain-overload." The problem with grain overload in the camelids is that by the time you see any symptoms, it is probably too late to save the animal even with drastic surgical measures. For example, just recently a local producer had 9 alpacas consume a 55-gallon barrel of grain. The producer called a vet who did not have alpaca experience and who asked if the animals were showing any symptoms – in ruminants symptoms are apparent in only a few short hours. Animals become lethargic with their heads hanging down and have labored breathing. Symptoms of a grain overload are often not apparent in alpacas for 24-48 hours. In the above scenario, the animals had not exhibited symptoms and thus were not treated. The next day when the first alpaca began to exhibit the symptoms of grain overload, it was rushed to the veterinary hospital where the grain was immediately surgically removed from the animal. The animal died even with surgery, as did 7 of the other 9 animals. Thus, if your alpaca consumes a large amount of grain, immediately contact a veterinarian who has had camelid experience and take the precautionary measures. Further information about the nutritive value of grains is characterized for camelids in another article written by Fowler in 1989.

Alpacas do not need grain except in during physiological stages when nutrient requirements are high including: late gestation, early lactation, in very cold weather and perhaps for a geriatric animal. Always use with care to prevent grain overload.

Table 4. Nutrient content[1] of common grains fed to alpaca

Grain	%TDN	%CP	%Ca	%P
Barley	84	13.5	0.04	0.34

Corn	87	10.9	0.03	0.29
Oats	77	13.3	0.07	0.38
Wheat	88	16.0	0.04	0.42

NRC, 1982
[1] Dry Matter Basis

If grain is supplemented to crias, they must be vaccinated for enterotoxemia as are lambs – actually I prefer good quality alfalfa hay as a creep feed. Just be careful of the animal consuming too many leaves, as this may create a bloat situation. Without the enterotoxemia vaccination, microbes in the cria's gut digest the starch from grains, changing the gut pH. A change in gut pH favors the *Clostridium* microbe population normally inherent in the gut. This organism then releases an endotoxin that will be absorbed and ultimately result in death.

One more note about grains. Notice the nutrient composition of the 4 grains presented in Table 4. Again - grains are an **energy** source (%TDN) and not a protein or calcium source. There are other feedstuffs that can supply more protein and definitely more calcium than grains. Do not use grains as a calcium source, there is none there, and besides there is more phosphorus than calcium which you do not want! Remember too that alpacas are extremely efficient, and, if too much energy (grain) is supplied, they can become obese. Animals should be weighed on a regular basis, monitored and records kept.

PROTEINS

When evaluating the protein requirement of animal, one needs to be aware that a protein requirement is in reality an amino acid requirement. The animal's requirements are for amino acids, not protein. The use of CP is part of an older system, but is still adequate in the alpaca scenario as we are not even sure about the CP requirement, much less the amino acids. Camelids, like ruminants, have an advantage because of the microbial protein supply from Compartment I that we discussed earlier in the text. Microbial protein aids in balancing out the amino acid requirements – as long as the animal is fed appropriately. The alpaca's estimated CP requirement is 12-14% CP (Table 1). If alfalfa is fed, the CP requirement will be more than met, as the CP is higher in a legume forage than grass. Alpaca producers have heard that alfalfa is bad and that it should not be fed, and that is not exactly true. Alfalfa is high in protein and calcium – higher than what the animal requires. Too much protein will be excreted as urea in the urine. You smell it as ammonia near the dung heaps. Too much calcium may tie up other nutrients and be deposited as monoliths in the gastric pits of Compartment I. Whether these monoliths are of concern is not known. However, some alfalfa is not bad, and, in fact, I use it to my advantage because of the higher nutrient value. I often blend a little alfalfa hay in with grass hay for animals having those physiological stages with higher nutrient requirements. The alfalfa is of benefit particularly in late gestation or early lactation when CP and calcium requirements of the animal are higher.

The economics of the feeding situation also needs to be considered. There are several areas of the country where it is impossible to acquire good quality grass hay. Thus, if a

producer does not have access to grass hay, alfalfa may be the only choice. Or if the only available grass hay is of low quality, then blending alfalfa with it works well. If a good source of immature grass hay is found, it will usually meets the CP requirements, but you will not know till you test it. If low quality grass hay is fed and alfalfa is not available, then supplementation with a protein source such as either soybean meal (50% CP) or corn gluten meal (65% CP), will be advised. I caution you not to feed an animal protein like meat and bone meal or tankage for several reasons. One of those reasons is palatability, meaning the animals will probably not eat it; but the greatest concern is the potential transmission of Bovine Spongiform Encephalopathy (BSE) also known as Mad Cow Disease. There have been no cases of BSE in the United States, but this is a safety measure by the feed industry to see that it does not occur.

MINERALS

Most alpacas need some type of mineral supplementation. What type of mineral is dependent on the area of the country where the animals are grazed or where the forage was harvested. In general, the soil mineral content will be characterized in the feeds grown on the land. The local county extension agent can help you find out what type of soil you have. You still may have to have soil tests done in addition to your forage analyses to characterize what is needed. It is to your advantage to know the land and whether a mineral is deficient or found in excess. A local feed dealer often supplies nutritional advice if you were to buy the mineral supplement from them. Never haphazardly add a mineral mix without doing your research about what should be fed. Addition of a mineral to a diet that is already high in that mineral – whether it is from the feed or water – can create secondary mineral deficiencies or toxicities. Selenium is one mineral with which caution needs to be taken, as selenium is cumulative in the body. A secondary deficiency is a deficiency in an individual mineral created when another mineral is too high or low in comparison – remember a balanced diet is the key.

Anecdotally it is said that camelids do not utilize salt blocks, but even that is controversial depending on the person you talk to. The best advice is to provide loose mineral salt mix in a dispenser that will facilitate protection from the environment. If possible do not utilize the red salt trace mineral blocks. The blocks are red due to iron oxide, and it is thought that iron oxide will tie up other minerals. There is much more that could be discussed on minerals, but that is for a later discussion. Other references such as Pugh (1996) or Van Saun (1999) are also good sources of information.

VITAMINS

There are references on camelid vitamin requirements (Van Saun 1999), and little time will be spent on them in this text. I would like to caution alpaca breeders, though, to take care when supplementing vitamins, particularly vitamin A, as it too is cumulative in the body. Good quality forages that have been properly stored will supply all vitamins needed by healthy animals in most situations.

The only other vitamin of discussion in this text will be vitamin D. In most cases, animals can acquire this vitamin from sun-cured hay (less than one year old and if stored correctly) or from direct sunlight. Ultraviolet light (290-320 nm) from direct sunlight

converts a precursor found in the animal's skin to active vitamin D. However, in some parts of the country like Colorado, the orientation of the sun, particularly from November to March does not allow for this to take place. In such a situation, a female that is in late pregnancy (last 3 to 4 months) will need an injectable vitamin D supplement or the developing cria could potentialy develop rickets. The females should be supplemented with 150,000 IU vitamin D. The cria born during that time period should too be given a vitamin D injection (based on body weight), fed a mineral mix having a 2:1 (calcium: phosphorus) ratio and provided alfalfa hay as a creep feed.

PHYSIOLOGICAL STATUS

Briefly the physiological status of an animal determines its nutrient requirements. The stages of highest nutrient requirements are: the third trimester of pregnancy, early lactation, growth, work (individual animal, altitude, humidity and temperature), extreme cold and geriatric animals. Geriatric animals will suffer from stiffness (arthritis), have compromised immune systems and less ability to heat or cool their body. One of the key management tips is to watch their mouths. With age, they will lose teeth or the teeth will become in poor condition making it difficult for them to chew without pain. If they are unable to chew, they will eat less and will lose body condition. Provide geriatric animals with warmed water (just above freezing) to allow adequate water consumption. If the animals stop drinking water, they will not consume food. One other comment, gelded males have lower energy requirements than intact males.

ENVIRONMENTAL

Care needs to be taken in very cold or hot weather. In both extremes, animal health can be compromised particularly in geriatric animals. Geriatric animals are less able to cool or heat their bodies. In this situation, shelter from the wind in the winter and a supply of heated water (just above freezing) will aid the animal significantly. In hot weather, the animals will need some type of shade and other cooling measures to prevent them from overheating. In the AOBA proceedings (Irlbeck, 2000), environmental issues are discussed in greater depth.

SUMMARY

I have tried to discuss several basic concepts in a brief amount of space. More research is needed to quantify alpaca nutrient requirements, and yet the requirements mean little if an alpaca owner is not familiar with the feeds to provide those nutrients. Determining the nutrient content of feed, water and soil is one management tool that cannot be ignored when feeding alpaca.

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