Alpaca Pastures in Wisconsin

by **Dan Undersander**

Centuries ago, the Inca began raising alpacas for their soft and luxurious fleece. They pastured their animals in the lowland meadows and marshlands called bofedales, at an elevation of about 4,000 feet above sea level. The alpaca's native region has a very short growing season with 75% of the rainfall between December and March. During the dry season (May to October), native forage has relatively low nutritional value. Fortunately, alpacas are well adapted to this cycle of feast and famine. In fact, the primary feeding-related problem among North American alpacas is obesity.

Digestive Physiology

Alpacas are lamoids which is a group of South American camelids including the guanaco, vicuna, alpaca and llama. Camelids are not true ruminants like cattle, sheep and goats; their unique gastrointestinal anatomy designates them as "functional ruminants." Their stomachs have three compartments, all with absorptive and secretory glandular areas which are characteristic of the camelid digestive system. Stomach motility is faster than that of true ruminants, with contractions of the first compartment occurring at three to four times every minute (even faster when eating). These factors facilitate nutrient absorption when forage quality is low. In such cases, camelids are 50% more efficient in extracting fiber than are sheep. In the first compartment (C-1), carbohydrates are converted into volatile fatty acids which are then absorbed with two to three times the efficiency of cattle and sheep. Apart from their nutritive function, these fatty acids aid in the camelid's adaptation to low-protein diets; when nitrogen is metabolized into urea, the microbes in the alpaca's digestive tract use it to synthesize protein; these microbes are then digested and the protein absorbed. Though few reports exist on the exact species microbes present in the camelid stomach, it is evident that they also digest the cellulose from plant cell walls, as well as starches, sugars, acids, lipids, and protein. Some even synthesize vitamins. These bacteria are very sensitive to environmental shifts; sudden changes in an alpaca's diet can cause stomach atony, a condition wherein the microorganisms die off and digestion is severely inhibited. Therefore, diet changes must occur gradually. Stomach microbes are also hindered by excess lignin in overly mature forage, as well as nitrogen/mineral deficiency. Slowing down their facilitating effect on cellulose digestion will reduce the amount of forage an alpaca will voluntarily consume; and in terms of contribution towards an animal's energy (84.5 kcal per kilogram$^{0.75}$ of body weight) and nutritional requirements[1], quantity is just as essential as quality.

The digestive system of lamoids has a noteworthy capability for digesting certain toxins.

Temperate Pastures

Now move the thousands of miles north to the Midwestern regions of North America, where alpaca ranching has been growing in popularity for the last few decades. Information on raising alpacas is most often obtained through the oral traditions within what might be termed a subculture of alpaca breeders, though there is very little in the literature pertaining to the actual practices involved. The ideal pasture, particularly with regards to alpaca fleece production, is nearly impossible. Studies with Australian sheep have shown that the particular amino acids of which wool is primarily composed (namely, cysteine and methionine) simply does not exist in grasses in sufficient quantities for feed-to-wool efficiency rate any greater than 0.115 ($\pm$0.018). Legumes are a necessary companion to grass. A pasture must have at least 40% legumes for adequate nitrogen fixation; otherwise nitrogen fertilization is required. Furthermore, legumes suffer less decline in digestibility and accessible protein as they mature.

As for specific types, numerous books have been written on the subject of forage. However, the question of what to include in a temperate pasture is not as daunting as all that. The myriad species can reasonably be trimmed down to a selection of a few of the more common forage crops. The University of Wisconsin Extension publishes forage variety updates and a booklet called *Pastures for Profit: a Guide to Rotational Grazing*. These list a number of grasses and legumes with the necessary information to plant a productive pasture. They are not ubiquitously appropriate, however, and only a few will succeed in southeastern Wisconsin. Timothy, for example, yields much high-quality forage and is quite compatible with legumes, but will not tolerate the heat and drought that typically occur in late July and August. Perennial ryegrass tolerates the drought, but not the winter cold. The spring rains and melt water tend to flood lower areas, and reed canarygrass is well-suited to these conditions; however, the presence of alkaloids in some varieties of this species makes it unpalatable if not toxic. It is also an invasive species which can easily displace native plants. Beyond climate concerns, there is the question of growing season and the distribution of a crop's yield. These considerations make orchardgrass a good choice. With a long growing season, it produces a high yield with greater regeneration after the late-summer drought. It is highly competitive; any companion crops must be as well. Red clover is just such a legume to compete with orchardgrass. Meadow fescue is also resistant to high traffic (an individual alpaca is easy on the pasture, but they do like to travel in groups) and has good fall yield, especially if fertilized. It must be noted that the latter is slow to establish and must be planted in early spring.

Alfalfa is a popular legume; it tolerates drought more than flooding and has a long growing season. However, it is generally inappropriate for alpacas. Alfalfa has more crude protein (18 to 20% DM) and calcium than is necessary (requirements are 12-15% DM and 0.6-0.85%, respectively); excess dietary protein can potentially have adverse renal effects, while excess calcium can bind with other nutrients and/or form stones in C-1. A vigorous clover would be a better choice. Red clover is very competitive, but does not withstand dry conditions. It must also be replanted every three to four years. White clover is thus left as the best choice; it persists well, surviving even heavily-grazed pastures. It is also easy to establish.

Pasture Rotation and Management

Alpacas will often find a favorite spot (usually near the water bucket) and proceed to nibble the grass to within $^1/_8$ of an inch from the soil while leaving the rest of the pasture to become overgrown and unpalatable. This uneven grazing pattern can result in soil erosion and/or the establishment of undesired plant species due to lack of competition. More than that, it is also unpleasant to look at. Rotational grazing offers a number of benefits when compared with continuous grazing. Moving animals through a circuit of smaller paddocks leaves time for the other paddocks to rejuvenate. This can increase pasture productivity by as much as 2 tons per acre. It also enables more even distribution of manure and therefore nutrients. Increasing herd density in this way discourages the spot grazing just described.

Timing is very important in rotational grazing. Nutrient bioavailability decreases as a plant matures while the yield increases with plant size. Since the quantity consumed is just as important as the quality of the forage, there must be a balance between the factors. Nutritional value and yield generally reach this balance just before the stems begin to elongate. The time this actually occurs is different among species, but it can be observed as the stems become more prominent compared to the leaves. Alpacas present a small dilemma when considering the timing of rotation. The general recommendation for ruminants is moving a herd into a pasture when the forage is 8-10 inches high for the cool-season grasses mentioned earlier and 12-14 inches high for the warm-season grasses. Observation of alpaca grazing behavior suggests they will not even go near grass this high. Hypotheses differ as to why, but whatever the reason, the recommended balance between quality and yield will not work for alpacas. They do not need so much forage as cattle, requiring only the equivalent of half a bale of hay a day. Therefore, the sacrifice in yield from grazing shorter forage is acceptable.

The longer season alpacas can graze, the better for them. The forage is allowed to grow until the killing frost; the growing season is over, but the alpacas may continue to graze. Stockpiling forage is also a wise pasture management practice. One simply takes a paddock out of rotation in early fall and fertilizes it in early August (at about 50 N lb./acre) to encourage late-season growth. The natural yield distribution of orchardgrass makes it well-suited to this practice. Paddocks with stockpiled forage should preferably be near the alpacas' shelter, as they may not be willing to brave the eventual winter cold if grazing stockpiled forage into December or January.

Manure Management

Alpacas tend to defecate in a concentrated area, forming communal dung piles. While this allows for easier collection if one intends to recycle it, it also has some implications for the vegetation immediately surrounding the pile. Alpaca manure is quite valuable as fertilizer; it supplies plants with crucial nitrogen, but not in such amounts as will "burn" seedlings. It is also rich in potassium, but potassium is highly water soluble, which means that precipitation will leach out the potassium and it will be lost to the soil underneath dung piles. Frequent collection and storage will preserve its value as fertilizer. One could also simply cover the pile when it rains.

Parasite Control

Gastrointestinal nematodes cause millions of dollars of production loss annually in the livestock industry. Overdependence on anthelmintic drugs (drugs that expel parasitic worms (helminths) from the body) over the years has selected for drug-resistant strains in all major helminth species. Therefore, these drugs must be used according to label restrictions and in a good rotational grazing program to minimize their use.

Certain plant secondary metabolites with anthelmintic properties have been identified. The active phytochemicals are so complex and target so many sites within a cell that gastro-intestinal parasites cannot develop a resistance to them. The primary compound studied is condensed tannin. As with all medicinal substances, condensed tannins are toxic in sufficient amounts. However, herbivores have been shown to select plants with medicinal value. Given the choice, alpacas will self-medicate when they sense a physiological need; the implication of this is that a given pasture must provide species of such value in addition to their conventional forage. Plants with therapeutic levels of condensed tannins include chestnut and willow leaves; chicory; and heather. Sericea lespedeza and sainfoin have also shown promise in the research, but they will not grow in Wisconsin; they may be administered as hay when infection is first detected.

Other plants have more preventative value. Gastrointestinal nematode eggs pass out of a host with the feces, and then grow through several free-living larval stages in the manure pile. Upon reaching their third stage, the larvae crawl out of the pile and up the stems and leaves of the surrounding herbage on films of moisture, where they are ingested by the next host. Some common pasture species have been shown to thwart the larvae in this process and thus reduce the number of eggs taken up. The most effective is, in fact, white clover. Beyond plants, earthworms may also be employed to break up the manure pellets, exposing the eggs and larvae to desiccation.

These methods are not 100% effective but incorporating them into a parasite control system with drenches of products, such as ivermectin and fenbendazole, reduces the need for the standard anthelmintics, thereby minimizes selection for drug-resistant strains.

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[1] The exact energy and nutritional requirements of lamoids are unknown; the information provided in this paper is extrapolated from studies on sheep, goats, and cattle.