



American Consortium for Small Ruminant Parasite Control

Best Management Practices for Internal Parasite Control in Small Ruminants

NUTRITIONAL EFFECTS ON PARASITES

Nutrition is an important part of an integrated approach to internal parasite control, helping prevent parasitic infection (by gastrointestinal nematodes or worms) through strengthening of the immune system (resistance). Proper nutrition can also lessen the effects of reduced intake and tissue damage caused by parasitic infection (resilience).

Most research has focused on the effects of protein, but minerals and vitamins are also important for proper immune system response. In addition, energy is required for animal protein production, which can support immune function and help the body repair damage from parasites. Condensed tannins in some feedstuffs can also be useful for helping to manage worms. Refer to the fact sheet in this series on sericea lespedeza for more information.

NUTRITION FOR RESILIENCE

It is well-known that supplemental protein can both reduce the negative impacts of parasitism, as well as boost the immune system to help prevent infection. The latter is called immunonutrition. Parasitism has been documented to cause a 10 to 20 percent reduction in feed intake, with an additional reduction in nutrient digestibility, metabolism, and utilization. This essentially causes a nutritional deficiency, which usually limits animal productivity. Additionally, protein is lost, due to worm damage to the gastrointestinal lining, further increasing animal protein requirements. Protein is used to enhance immune response against worms and help repair damaged intestinal tissues. Supplemental protein has been shown to improve production of red blood cells, helping animals to recover quicker from anemia caused by the barber pole worm. These factors may more than double the protein requirements (for maintenance) of the animal.

The use of protein to repair damage by worms limits its use for other purposes, resulting in reduced weight gains. It is well-documented that animals



Goats grazing Sunn Hemp

under nutritional stress, such as thin animals, are more susceptible to worms. Therefore, it is recommended that all producers learn how to properly body condition score their animals and maintain them at optimal scores. While the optimal score may depend upon the production environment and animal's stage of production, a minimum score of 2 (on a scale of 1 to 5, where 1 is emaciated and 5 is obese) is recommended. Animals with body condition scores below 2 have proven to be the most susceptible to worm infection. Body condition scores, along with weight gains and other performance indicators, can be monitored to determine the need for supplemental feeding and/or deworming.

Young animals have a high protein and energy requirement for growth, and their intake from pasture is usually limited by their size, making them more subject to under-nutrition, especially of protein. Therefore, supplementation with extra protein may be necessary to help alleviate the loss of production (weight gain) caused by worms. In fact, studies have shown that parasitized animals will choose to eat more of a higher protein supplement



Lambs grazing cool season grasses

than a lower protein one when allowed to choose. Parasitized animals consuming a low-quality forage will also select urea-molasses (protein-energy) blocks to attempt to self-medicate. Consequently, it is beneficial to feed protein at levels higher than typical requirements when animals are challenged by parasites. It is also beneficial to manage pastures to keep them leafy and vegetative to provide a higher level of protein and energy. Vegetative plants are also more palatable, which should increase intake of nutrients.

NUTRITION FOR IMMUNITY

A properly functioning immune system is the body's first line of defense against parasites. Major factors which determine immune system function related to parasitism include genetics, nutrition (especially protein), and previous exposure to worms. Stresses such as shipping, poor nutrition, infectious disease (such as pneumonia), weather, or new peers can also detract from proper immune system function. In addition, some animals (and breeds) have greater immunity against parasites, and animals can be genetically selected for this characteristic. Refer to the fact sheet in this series on genetics for more information.

In addition to protein and adequate dietary energy, minerals and vitamins are also important to immune system function. Easily-digested carbohydrates as an energy source, such as grain or molasses, can be an important supplement under some conditions due to their support of protein synthesis in the rumen. In

general, nutrients are used first for maintenance, growth, and reproduction, and the immune system receives any not used for those functions. When scientists determine nutrient requirements, it is done without regard for the needs of immune system. Priority in use of nutrition for growth vs immunity is different in sheep and goats. Under dietary restriction, in hair sheep (Blackbelly) lambs, growth was a priority over response to internal parasite infection whereas when the level of nutrition was high, the nutrient priority was a response to internal parasites. However, in Creole kids, their nutritional priority was growth regardless of level of nutrition.

However, when the immune system is challenged (e.g. by worms), more nutrients are needed to fight the challenge, and those nutrients may not be available if only the minimum requirements are fed. In fact, the high nutrient demand for fetal growth and milk production resulting in a shortage of nutrients for the immune system may contribute to the increased worm load (periparturient egg rise) found in small ruminants around the time of giving birth. So, providing supplemental protein and energy at the last part of pregnancy and during lactation can also help the female fight parasitism.

Feeding by-pass protein to sheep and goats has resulted in enhanced immunity to worm infection shown by reduced fecal egg counts or worm burdens (number of worms in stomach and intestine). By-pass protein is protein that is not degraded in the rumen, but is digested and absorbed in the small intestines. Reduced worm numbers and fecal egg counts due to by-pass protein appear to be directly



Nutritional tub

related to the amount of protein supplied. Carryover effects on fecal egg counts have lasted up to a year in sheep fed higher protein for nine weeks. Responses have also been observed in ruminants on poor quality pastures supplemented with molasses-urea (energy-protein) blocks. There are also molasses tubs with natural protein that may provide a greater benefit in controlling worms. A greater response may be more likely with high-quality by-pass proteins such as those in fish meal or cottonseed meal. Other feedstuffs with high bypass proteins include distillers dried grains, corn gluten feed, and feather meal. It has been shown that in lambs infected with *T. colubriformis*, the small intestine was pathologically damaged which impaired digestion and absorption capacity, which can result in reduced skeletal growth and bone density.

Planting legumes in pastures to provide additional protein in the forage may help improve the protein status of animals, improving their resilience to worms. Animals grazing lush high-protein pastures, such as those containing alfalfa or clover, usually have an additional response to supplemental by-pass protein because of the high rumen degradability of forage protein. Grazing forages which contain condensed tannins is another way to increase by-pass proteins in the diet. Examples of tannin-containing forages include sericea lespedeza, birdsfoot trefoil, chicory, and sainfoin.

Cost of supplementation should be considered. For example, supplementation with 0.25 lb. of fish meal (per head per day) or cottonseed meal should reduce

fecal egg counts and increase growth rates. However, it could be very expensive over a long grazing season, likely more expensive than several doses of dewormer. However, the improved animal performance, especially if a high level of dewormer resistance is present, coupled with strong market prices, could possibly make it economically viable. This is especially true in animals with high production potential such as heavy-lactating dairy animals or young animals with high growth potential.

VITAMINS AND MINERALS

Supplementation with the proper vitamins and minerals is a nutritional recommendation that can also help manage parasites. It is recommended that small ruminants be given minerals that are in a loose or granular form. Consumption is less with blocks, and blocks can be hard on the teeth.

Phosphorus (P) supplementation has been shown to effectively reduce fecal egg counts as well as worm burdens in sheep. Protein meals often have higher P than forages, another benefit of protein supplementation. Diarrhea is associated with some worm infections and can cause loss of mineral electrolytes (potassium, sodium and chloride) which must be replaced to restore the animal to health. These minerals are present in many mineral supplements.

Copper, zinc, and selenium are critical for immune system function, as are manganese, iron and iodine. The use of copper oxide wire particles has been shown in several studies to reduce worm burdens and fecal egg counts of the barber pole worm (*Haemonchus contortus*) in sheep and goats. Sheep are sensitive to copper, and copper can accumulate in the liver over time, so it is advised to read the related fact sheet on copper oxide wire particles before administering them.

Iron is often mentioned in reference to parasitism since the barber pole worm sucks blood, which must be replaced. The hemoglobin in blood contains iron, which is necessary for its formation. Although most grazing animals acquire sufficient iron for maintenance needs from soil contamination on the plants they consume for maintenance, it is



apparently not sufficient, as serum iron has been shown to decline in the latter stages of barber pole worm infection. Iron supplementation could therefore help with resilience and perhaps as a supportive therapy with treatment for worms. Supplementation with copper, iron, and zinc can enhance resistance to worm infection as evidenced by reduced fecal egg count and worm burdens.

Selenium deficiency has been shown to impair the function of certain components of the immune system (neutrophils) and there have been observations of heavy parasite burdens in selenium-deficient cattle and sheep. Vitamin E is important due to its interaction with selenium. Vitamin D has also been shown to be important in immune response, but is unlikely to be a limiting factor in animals raised on pasture. Vitamin A has been documented to be involved in immune response. Vitamin C and several B vitamins are involved in the immune process, but adequate amounts are usually synthesized in a healthy rumen, so do not generally need supplementation.

VITAMINS AND MINERALS

Minerals and vitamins are usually provided in a free choice loose mineral supplement. Prices and quality of minerals vary greatly. Don't just choose a mineral based on its level of some minerals. You must also consider consumption of the mineral. For example: one with 0.5 oz/day consumption should have higher levels of the mineral than the one with an ounce per day consumption. You can monitor mineral intake by putting a set amount of mineral out, e.g. a week's supply, and seeing how long it takes for so many animals to consume it.

If a mineral has a suggested consumption of 1 oz per head per day and the animals are only consuming 0.5 oz per day, you'll need to do something to increase consumption. Conversely, if they are consuming too much mineral, you'll need to do something to limit consumption. When intake is inadequate, a palatable feedstuff such as soybean meal or ground grains can be added to the mix. When mineral is over-consumed, the addition of salt to the mix will reduce intake. When you first introduce a mineral, consumption may appear excessive, but after 10 to 14 days, consumption should level off.

It is important to make sure that the mineral supplement has high levels of minerals that are deficient in your area for cattle, sheep, or goats. This information can usually be obtained from your county extension educator or a animal nutritionist. If the mineral levels in forages are deficient for cattle, they are likely deficient for sheep and goats. For sheep, make sure the mineral supplement contains little or no copper. It is cheap to supply minerals free choice, with a good quality mineral costing less than fifty cents per pound or around \$6 per year for an animal. Hydrolyzed yeast, a common feed additive, has been shown to inhibit the exsheathment of the barber pole worm in the rumen, preventing their establishment and resulted in a 60 percent reduction in fecal egg counts.

SUMMARY

In summary, nutrition is important for immune response to worms and repairing tissue damage done by worms. Animals need to be supplied with



adequate levels of energy, protein, minerals, and vitamins. Thin, underfed animals are more susceptible to parasitism. Animals need more protein in late gestation and lactation due to the greatly increased protein requirement for fetal growth and milk production. Animals are likely to respond to supplemental protein, especially those supplements containing a high levels of by-pass protein. Mineral supplementation is also an important component of the animal's nutrition and needs to be provided at adequate levels to meet the requirement.

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Supplementation with soyhulls



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