Self Medicating Livestock

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A recent study by Dr. Juan Villalba (Villalba, et al., 2010) and his colleagues at Utah State University shows that lambs can be trained to prefer a food with plant secondary compounds (PSC) to help alleviate internal parasites.

First, a little more information about secondary compounds and how they differ from primary compounds in plants. Primary compounds are for maintenance, growth, and reproduction in plants. All plants contain PSC and for a long time scientists didn't know what the purpose of PSC were in plants. Now, it is believed they are used by plants for self defense (limit consumption by herbivores), attracting insects for reproductive purposes, stress resistance, and protection from UV radiation. Human interest in PSC now centers on their potential for positive medicinal purposes. PSC are often advertised as having antioxidant properties in foods such as blueberries (flavonoids) or coca (alkaloids).

The truth is that PSC occur in all plants, but at this point we are not sure of all of their properties, nor do we know exactly how all PSC interact in a human's stomach, an herbivore's rumen, or how they interact with each other, nutrients, or other compounds in plants. As with any compound, it depends on the dose to decide if it is beneficial or toxic. Just as if you eat too many blueberries the potential antioxidant effect may be outweighed by the negative gastrointestinal feedback (aka make you feel sick or worse or be lethal in an extremely large dose). You may have already suspected an ability of livestock to select foods for medical purposes, but what the studies in Dr. Villalba's paper show that sheep with parasites can be trained to prefer a food with PSC that does not normally contain PSC.

There are many types of PSC, but here are just a few: tannins, saponins, alkaloids, and terpenes. These PSC are found in the following forages, tannins in birdsfoot trefoil (Lotus corniculatus), saponins in some varieties of alfalfa (Medicago sativa), alkaloids in entophyte-infected tall fescue (Lolium arundinacea), terpenes in sagebrush (Artemisa tridentate), and juniper (Juniperus osteosperma).

What Dr. Villalba and his colleagues at Utah State University did was expose lambs that had internal parasites (IP) and lambs that did not have IP to alfalfa with tannins (AT). They randomly selected 26 lambs from a group of 40 and tested all 26 lambs for parasites. Of the lambs that were positive for parasites, 20 were randomly selected for the study. Of those 20 lambs, 10 were given Ivermectin to eliminate their parasite loads. The other 10 lambs were not given medication to reduce their parasite loads. All 20 lambs were fed plain alfalfa (negligible amount of tannins)

for 10 days from 8 a.m. to 11 a.m. To calculate how much the lambs ate the lambs were fed a specific amount and their refusals were weighed, making it easy to calculate what they had consumed. Then lambs were given a preference test between alfalfa and AT for days 11-13. At this point, all lambs preferred alfalfa. On days 14-15 all lambs were only offered AT and refusals were weighed. During days 16-21 all lambs were offered both alfalfa and AT, testing their preference. This is when things got exciting. Lambs with parasites preferred the AT over alfalfa, while lambs without parasite loads preferred alfalfa. This pattern of conditioning lambs to AT continued on days 22 and 23 and preference tests were given on days 24 and 25. Then lambs were offered alfalfa on days 26 and 27, and tested for their preference of alfalfa verses AT on days 28 and 29. On day 29 lambs that had not been treated with Ivermectin were given a dose of Ivermectin on day 29 and day 34. Between day 29 and 34 lambs were only offered alfalfa. On days 35 to 39 lambs' preference between alfalfa and AT was tested for the last time. Fecal tests were performed on days 1, 10, 17, 24, and 37 to test for internal parasites.

During the first and last two days of testing, the lambs initially not treated with Ivermectin did not differ in their consumption of AT, but on the rest of the testing days the lambs with parasites consumed more AT than the lambs without parasites. It was found that preference for AT had a direct relationship with the lambs' parasite load. While the lambs had to learn the effect of alfalfa with tannins, they soon were able to benefit from the anthelmintic properties, thus reaffirming their preference for AT compared to the food offered that did not contain anthelmintic properties (alfalfa). These benefits and preferences have been shown before in other studies with lambs (Lisonbee et al., 2009). In Lisonbee's study, lambs with parasites consumed more of a tannin containing supplement than lambs without internal parasites.

Other studies show that it takes 50g of quebracho tannin (a type of tannin isolated from plants) to reduce parasitic loads in sheep. (Butter et al., 2000.) So, what plants do tannins occur in naturally? Birdsfoot trefoil is one plant species that has been found to reduce parasitic loads as well as have other health benefits for cattle and sheep (MacAdam, et al., 2006) (www.plantmanagementnetwork.org). Keep in mind, birdsfoot trefoil requires 18" of precipitation so using birdsfoot trefoil may only work well on an irrigated pasture in parts of Colorado. Also, keep in mind that PSC levels vary in different plant varieties and they may also differ as a result of soil type and water availability.

If you would like to know more about studies done at USU on livestock foraging behavior, check out the BEHAVE website.

Villalba, J.J, Provenza, F.D., Hall, J.O. and Lisonbee, L.D. 2010. Selection of tannins by sheep in response to gastrointestinal nematode infection. J. Anim. Sci. 88:2189-2198.