Nutrients Influence Palatability

Greg Baer, a cattle producer in Missouri, planted a pasture of clovers and alfalfa that was high in protein. He believed his cattle would really gain weight on this pasture from heaven. But to Greg's dismay his cattle gained poorly and at times preferred to eat moldy hay and mature endophyte-infected tall fescue growing on the ditch banks rather than the nutritious pasture. Why did Greg's cattle behave this way?

Release of energy and protein. Animals form preferences for foods with high levels of energy and protein especially if they release quickly during digestion. For example, lambs showed a stronger preference for a flavor when eating the flavor was immediately followed by a dose of energy compared with lambs that consumed the flavor and received the dose of energy an hour later. Likewise, herbivores may prefer immature orchard grass to more mature orchard grass even though both grasses contain similar amounts of digestible energy because the nutrients in immature orchard grass are released more quickly than in more mature orchard grass.

Ruminants also form strong preferences for foods that contain energy and protein that are released at similar rates during digestion. An excess of protein relative to energy can result in ammonia toxicity, whereas an excess of energy relative to protein can cause acidosis. Both states can cause food aversions. For example, in one study lambs preferred a diet of beet pulp and alfalfa to a diet of barley and alfalfa because energy in beet pulp and protein in alfalfa are released at similar rates whereas energy in barley is released more rapidly than protein in alfalfa.

Interaction of energy and protein. The concentration of energy and protein in foods are important in diet selection but their interaction is also important. Given a choice, sheep and cattle maintain constant ratios of energy to protein in their diets to meet their needs for maintenance, growth, pregnancy, and internal parasite infestations. They avoid diets too high or too low in protein relative to available energy.

Preferences for protein and energy are influenced by what was just eaten. For example, people given flavored, medium- and low-calorie snacks prefer the flavor paired with low-calorie snacks right after eating but not when they are hungry. Likewise, lambs prefer foods high in energy after eating food high in protein and vice versa. For instance, given a choice of alfalfa pellets (high protein) and barley (high energy), lambs prefer alfalfa pellets after eating barley and they prefer barley after eating alfalfa pellets.

Minerals. Minerals also influence food preferences. Diets deficient in minerals cause food aversions. For example, a phosphorus deficiency in cattle, sheep, and goats depresses intake by 10 to 50%. The degree to which food intake is affected depends on the severity of the deficiency. Excess minerals also cause animals to avoid foods. A primary symptom of excessive minerals in the diet is a depression in food intake. Thus, the amount of minerals in foods —excess, adequate, deficient—influences food intake and preference.

Nutrients can be aversive. Normally, animals form preferences for foods high in nutrients but diets too high in nutrients or diets that are not nutritionally balanced can cause ruminants to limit intake. Ruminants suffer from acidosis when they eat too much grain or when they are not given time to adapt to diets high in grain. Likewise, forages too high in readily digestible protein can lead to ammonia toxicity and those too high in energy can also cause acidosis.

A dietary imbalance likely caused Greg Baer's cattle to perform poorly. As Greg came to realize, when it comes to nutrients, ruminants can get too much of a good thing. His pasture likely provided cattle with a diet with too much protein relative to energy. When he planted strips of grass in the pasture, cattle performance increased and their strange feeding behaviors stopped.

Correcting deficits. There is no evidence animals eat to prevent deficiencies. However, animals form aversions to diets deficient in nutrients, and that causes them to begin sampling new foods. If they find a food that corrects the deficiency, they form a preference for that food. For example, in the Netherlands, cattle grazing phosphorus-deficient forage ate dead rabbits—bones, fur and all, whereas cattle on phosphorus-adequate forage refused to eat dead rabbits. Likewise, goats browsing nitrogen-poor blackbrush acquired a preference for woodrat houses because chambers inside the houses contain urine-soaked (nitrogen-rich) vegetation that helped them correct their nitrogen deficiency. Goats that ate woodrat houses lost an average of 12% of body weight, whereas goats that did not eat woodrat houses lost 20% of body weight while browsing blackbrush for 90 days during winter.

Implications. Understanding that ruminants can balance their diets enables managers to improve efficiency by allowing animals to select their own diets. For example, a producer in Louisiana plants turnips in his ryegrass pasture to help his cattle meet their needs. Turnips are a good source of energy that complements the ryegrass which is high in protein. Cattle don't just eat the tops, they learn to pull turnips out of the ground and eat them. Planting pastures with several plant species that vary in energy and protein content, rather than a single species, allows individual animals to meet their unique needs for nutrients and improves animal performance.

Maintaining plant diversity, grasses, forbs and shrubs, on rangelands can help both domestic and wild animals meet their nutritional needs throughout the year. For example, in fall and winter, shrubs provide needed protein that complements the energy in standing dead grasses and forbs. In addition, animals that have access to a variety of plants eat more and can avoid over-ingestion of toxins compared with animals forced to eat a monoculture or a limited number of plant species.

References:

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Funding provided by Utah Agricultural Experiment Station and USDA-IFAFS. Produced by Utah State University in collaboration with University of Idaho, University of Arizona, Montana State University and the National Wildlife Research Center with research conducted at Utah State University.

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