Learning What to Eat and What to Avoid

Young herbivores learn which foods are harmful and which are safe through interactions with their mothers. Throughout life, they learn about the consequences of eating through postingestive feedback they experience after eating foods. But how can they do this in a world where toxin and nutrient levels of forages change daily and seasonally? How can they possibly learn and remember all the plants that grow in pastures and on rangelands? How can they survive when we move them to new pastures with unfamiliar foods?

Several factors that enable herbivores to determine which foods to eat (palatable, nutritious, safe) and which to avoid (unpalatable, toxic, low in nutrients). By understanding these factors, livestock producers can preserve weight gain and productivity even when moving their animals to new locations, or introducing them to new feeds.

Herbivores don't eat that many foods. When we look at a rangeland or pasture we often see tens or hundreds of plant species but in reality only a few plants make up the bulk of an animal's diet in a meal. In one study a pasture contained 100 plant species but 5 species made up 65% of the diet. The remainder of the diet was made up of 7 species or more depending on the animal but each of these plants made up less than 10% of the diet. In general, 3 to 5 species make up the bulk of the diet and the remainder of the diet is made up of plants eaten in small quantities.

Mom provides a framework. A young animal first learns about which foods to eat and which to avoid by foraging with its mother. By the time the animal has to forage on its own, it is already familiar with a number of plants that are nutritious and safe to eat. Thus, an animal divides its foraging world into two food groups, familiar and novel. Animals learn through trial and error about novel foods based on the postingestive consequences of the novel foods they eat.

Novelty. Herbivores sample novel foods cautiously. If the consequences of eating the food are positive—feedback from needed nutrients—the animal will increase intake of the new food. If consequences are negative—illness from toxins or lack of feedback because the food is low in nutrients—the animal will decrease intake of the food.

When eating a meal of several foods, novelty is the key to figuring out which foods are harmful and which are nutritious. When animals eat a meal of several familiar foods and a novel food and then experience illness, they subsequently avoid the toxic novel food. Conversely, when animals suffering from a nutritional deficiency recover after eating a meal of several familiar foods and a novel food, they learn to prefer the nutritious novel food.

Herbivores also reduce intake of familiar foods when the flavor of the food changes. Changes in flavor may occur when forages grow on different sites or as the plant matures. If the change in flavor results in illness, the animal avoids the food in the future. If, however, the change in flavor results in positive consequences then the animal will continue to eat the food.

Prior illness. Herbivores continuously sample foods, even foods that made them ill. If an animal gets

sick after eating a meal of several familiar safe foods and food that caused illness in the past, subsequently it will avoid the food that caused illness. Animals are able to remember which foods previously made them sick for a long time. For example, ewes given lithium chloride, a compound that causes food aversions, after eating a meal of caragena and Russian olive, subsequently avoided caragena but not Russian olive because they had been made sick on caragena two years earlier.

Generalization. Animals use past experiences with familiar foods to make foraging decisions about new foods. If new foods have flavors similar to foods that made the animal ill in the past, it is less likely to eat these foods. Conversely, if new foods have flavors similar to familiar nutritious foods animals ingest those foods more readily. Adding familiar flavors coupled with nutrients, such as molasses, can also increase intake of novel foods. For example, cattle increased intake of novel, weedy plants such as Canada thistle, spotted knapweed and leafy spurge after the plants were sprayed with molasses. Cattle continued to eat the plants even when they were no longer sprayed with molasses.

Amount and timing. If the foods an animal eats during a meal are equally unfamiliar and the animal experiences illness, how does the body determine which food to avoid? Animals pair feedback—positive or negative—with the food they ate in the greatest amount provided both foods are equally new. Animals also form aversions to or preferences for foods when food ingestion is quickly followed by either illness or positive postingestive signals provided the foods are equally familiar to the animal. For example, when lambs were fed two foods that were both somewhat familiar, lambs formed an aversion to the food they ate just before getting sick.

Research suggests sheep must eat a threshold amount of a novel food in order to discriminate among foods. For example, when lambs fed a maintenance diet adequate in nutrients were offered two novel foods for only 20 minutes per day, they preferred the less nutritious of two foods, presumably because it was most familiar. However, the lambs quickly learned to prefer the most nutritious novel food when the two novel foods were the only foods offered. Thus, lambs discriminated between the two foods based on the amount of food eaten and their nutritional state. Collectively, factors such as these influence palatability as food abundance, nutritional quality, and toxicity change daily and seasonally.

Salience. At one time researchers thought animals formed aversions to certain strong flavors more readily that others. They referred to these flavors as salient. Bitter, for example, was thought to be a salient flavor because many toxic compounds are bitter. Further study indicated that the response the scientists observed was simply due to novelty. When animals are reared on bland foods and get sick after eating a meal of several foods, one of which has a strong novel flavor, they form an aversion to the food with the strongest flavor. If, however, they are reared on foods with strong flavors and get sick after eating a meal of foods with strong familiar flavors and a novel bland food, they form an aversion to the bland food. Thus animals associate illness with novelty not necessarily with strong flavors.

Conclusions. A few simple rules can make a complex process like foraging relatively simple. Animals depend on the availability of familiar foods to make correct foraging decisions. When animals are moved to new foraging locations that contain only novel foods, it is more difficult for them to select safe nutritious foods and to avoid toxic foods. Understanding how animals discern safe from harmful foods is important information managers can use to help animals make transitions to new locations or train animals to eat new foods.

Additional Reading

Provenza, F.D., 2004. Foraging Behavior: Managing to Survive in a World of Change. USDA-NRCS. To view or order: www.behave.net.

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