

Behavior Facts

The BEHAVE program began about 25 years ago. When the project began, we didn't know how or even if ruminants learned about foods. Since that time we and others have discovered that learning is crucial to the survival and productivity of ruminants. Listed below are facts about how experience, social interactions, feedback, variety and learning affect diet and habitat selection of ruminants. Most of the facts were derived from research experiments with livestock. The number(s) listed at the end of each fact corresponds to a reference found at the end of this document, simply click on a number to display a reference. This list is not all encompassing and is a work in progress. If you have references that need to be added to our list or you find errors in this document please e-mail me, Beth Burritt, at bethb@cc.usu.edu

Exposure to foods early in life

1. Ruminants exposed to nutritious foods at six-weeks of age with their mothers remember those foods for at least three years. (4)
2. Ruminants exposed to poor-quality foods with their mothers during the first three months of life remember those foods for at least five years. (5)
3. Exposure to foods early in life can alter rumen size, rumen morphology and liver function. (1, 3, 112)
4. Ruminants reared in different environments have different food preferences. (14)
5. Young ruminants (less than six months of age) readily acquire preferences for unpalatable foods. (73)
6. Flavors in milk fed to nursing ruminants influence their food preferences later in life. (69)
7. Early exposure to flavors or foods early in life increase preferences for those foods or flavors later in life. (81, 82)
8. Lambs exposed to barley early in life reached slaughter condition more quickly than lambs not exposed to barley. (1, 2)
9. Ruminants must acquire foraging skills to forage efficiently. (7, 8, 9)
10. Foraging skills are specific to plant form. (10, 11)
11. Young naive ruminants spend more time foraging than mature experienced ruminants presumably because young ruminants have higher nutritional requirements and must acquire foraging skills. (109)

12. Ruminants are less likely to try new foods if experiences with new foods have been unpleasant in the past. (29, 59, 61)
13. Ruminants reared on low nitrogen diets early in life recycle nitrogen more efficiently than ruminants reared on nitrogen adequate diets. (12)
14. Ruminants exposed to poor-quality foods (straw, woody plants, etc.) early in life readily consume those foods later in life even when other foods are available. (3, 16)
15. Ruminants with positive experiences with nutritious high-toxin foods early in life will readily consume foods high in toxins even when nutritious low-toxin foods are available. (15)
16. Excessive exposure to toxins early in life may damage detoxification systems which in turn may cause ruminants to reduce consumption of plants containing that toxin later in life. (112)

Palatability - Preference

1. Ruminants prefer familiar to novel foods. (17, 26, 28, 29, 30)
2. Ruminants form preferences for flavors paired with glucose rather than saccharin. (18)
3. Ruminants form preferences for flavors and foods paired with glucose rather than water. (74, 120)
4. Ruminants form preferences for flavors paired with starch rather than water. (19)
5. Ruminants form preferences for flavors paired with volatile fatty acids rather than water. (20, 21)
6. Ruminants form preferences for flavors paired with protein or nitrogen rather than water. (22)
7. Ruminants prefer hay cut in the afternoon rather than the morning, presumably due to higher sugar content of plant in the evening. (86)
8. Ruminants form stronger preferences for foods when feedback occurs soon after eating. (23)
9. Ruminants eating a meal of several familiar foods and one novel food associate changes in positive feedback with the novel food. (24, 99)
10. When odors are paired with positive feedback (nutrients), ruminants will increase intake of foods with these odors. (83)

11. Ruminants avoid foods paired with sodium when their sodium levels are adequate. (21)
12. Ruminants prefer to eat foods with similar rates of protein and energy degradation. (6, 46)
13. Ruminants are more likely to eat new foods if they contain familiar flavors. (27, 28, 99)
14. Ruminants are more likely to eat novel foods if they have positive experiences with novel foods. (27)
15. Ruminants are more likely to eat a new food in a familiar rather than an unfamiliar location. (26)
16. Ruminants reared on bland foods prefer foods with weak rather than strong flavors. (70, 80, 100)
17. Ruminants prefer either weak or strong flavors depending on their past experience (post-ingestive feedback) with the flavors. (100)
18. In most cases, ruminants select foods based on nutritional composition rather than intake rate. (106)
19. Ruminants will increase intake rates on highly fibrous, poor quality foods, like straw, if they receive a boost of nutrients when first exposed those foods. (58)
20. Preferences for foods change based on the nutrient status of the animal. (25, 87, 88)
21. Preferences for foods depend on the toxin status of the animal. (85)
22. The phosphorus status of an animal affects its diet selection. (108)
23. Hydrolyzed casein applied to plants reduces preference of those plants by deer. (89)
24. Ruminants can learn to consume medicines to alleviate illness. (55, 56, 57, 64, 104)
25. Feeding novel foods in familiar troughs increases acceptance of new foods. (123)
26. Familiarizing animals with any grain will increase the likelihood they will eat another grain. (125)

Palatability - Aversion

1. Ruminants avoid foods because they cause food aversions not because they taste bad. (52, 71, 113)
2. Ruminants form aversions to foods that effect the emetic center in the brain and cause nausea. (39)
3. Lithium chloride is an effective agent to create aversions to foods in ruminants. (29, 60, 62)
4. Ruminants can be trained to avoid a palatable, nutritious, novel food (34, 60, 62)
5. Ruminants can form aversion to foods even when illness occurs up to 12 hours after eating the food. (30)
6. The strength of an aversion depends on the dose of the toxin. (59, 80)
7. Ruminants averted to a food avoid that food regardless of where the food is located. (110)
8. Ruminants exposed to an odor followed by a dose of lithium chloride avoid foods with that odor. (83, 84)
9. Ruminants that get sick on one new food are less likely to eat another new food. (29, 59, 61)
10. Ruminants form more persistent aversions to novel foods than to familiar foods. (31)
11. Ruminants averse to a food avoid other foods with similar flavors. (80, 84)
12. Food aversions breakdown when ruminants averse to a plant and ruminants that readily eat the plant forage together. (32)
13. Food aversions are more likely to breakdown when ruminants are foraging in unfamiliar environments where most of the available foods are novel. (26)
14. Food aversions breakdown more quickly when access to alternative foods is limited. (33, 67)
15. Ruminants often sample small amounts of foods that have made them sick in the past. (29)
16. Food aversions last can for years. (34, 61, 62)
17. Food aversions are more persistent in mature versus young ruminants. (67)

18. Food aversions can form even if animals are under anesthesia when illness occurs. (35)

19. Ruminants associate illness with:

- a. novel foods. (30)
- b. the food last eaten. (38)
- c. the food eaten in greatest quantity within a meal. (37)
- d. foods that made them ill in the past. (31)

20. Condensed tannins can cause food aversions. (52, 79)

21. Excessive nutrients, such as sodium propionate or acetate, can cause food aversions in ruminants. (20, 74)

Eating foods high in toxins

1. Ruminants can regulate intake of most toxins to avoid poisoning. (36, 71, 72, 73, 85)

2. The nutritional composition of the diets influences ingestion of different toxins. (95, 105)

3. When alternative foods are unavailable, hungry ruminants are more likely to try a new food high in toxins than ruminants that are well-fed. (73, 95)

4. As the nutritional quality of a diet declines, ruminants that are nutrient deprived are less able to detoxify toxins in foods and are less likely to eat foods high in toxins when alternative foods are available. (95)

5. Starving animals are more likely to choose to eat foods low toxins even if high energy foods that contain toxins are available. (76)

6. Ruminants in low body condition have higher levels of toxins in their blood after eating a poisonous plant compare with ruminants in average body condition. (114)

7. Ruminants are more likely to eat toxins in nutritious foods than in less nutritious foods. (95)

8. When ruminants are first exposed to a food containing a toxin, they form a stronger preference for toxins paired with a high-quality foods versus low-quality foods. (77, 103)

9. Toxins infused into the blood of a ruminant cause it to stop eating (satiety). (78)

10. Ruminants fed a high-protein supplement or a choice between a high protein and high energy supplement ate more high tannin food than ruminants offered a high-energy supplement or no supplement. (105)
11. Polyethylene glycol (PEG) increases consumption of high tannin foods. (64, 79, 96, 97, 98, 104,105)
12. Stock density and therefore availability of alternative forages affects acceptance and intake of new foods high in toxins (terpenes). (94)
13. Supplemental energy can help ruminants ingest more of a toxin. (85)
14. Supplemental energy and protein increases the palatability of forages with terpenes such as sagebrush. (53, 54, 107)
15. The energy and protein content of the diet affects intake of foods high in toxins (terpenes). (101, 107)
16. When eating diets high in sagebrush (terpenes), ruminants prefer to eat foods with carbohydrates that digest slowly (beet pulp) to those with rapidly digestible carbohydrates (barley). (102)
17. Ingestion of toxin-containing plants by ruminants influences their selection of other plant species. (102)
18. Ruminants on a high or moderate plane of energy will voluntarily ingest more lithium chloride than ruminants on a poor plane of nutrition. (76)

Variety

1. Ruminants may eat a variety of foods to meet nutritional needs. (49)
2. Ruminants may eat a variety of foods to avoid toxins. (44)
3. Ruminants prefer to eat a variety of foods even when nutritional needs are met and toxins don't limit intake. (48, 87)
4. In many instances when consuming foods high in toxins, ruminants can eat more if they eat a variety of foods that contain different toxins. (44, 90, 92)
5. Ruminants eating a diet high in energy prefer foods high in protein and vice versa. (75, 88)

6. Ruminants are more likely to eat novel food that complements their basal ration. In other words, ruminants fed a diet high in energy are more likely to eat a novel food high in protein and vice versa. (75)
7. Ruminants forced to eat a flavored diet for a day prefer a diet with an alternate flavor the following day. (45, 46, 75)
8. Ruminants eating diets excessive or low in energy have a stronger preference for the alternate flavor than ruminants eating a balanced diet. (46)
9. Cost per pound of gain is lower in ruminants given an appropriate choice of foods than ruminants fed a nutritionally balanced total mixed ration. (47, 93)
10. Ruminants of similar age, sex, breed and background prefer different levels of energy and protein. (49)
11. Activated charcoal increased consumption of shrubs by sheep and goats when they were offered a limited number of shrubs (one to three species) but not when they were offered six shrub species. (90)
12. Tannins and saponins may be complementary toxins. (92)

Social

1. Young ruminants learn about foods efficiently from their mothers. (40, 41, 66, 121, 122)
2. Lambs exposed to grain for five days with their mothers ate seven times more grain than lambs exposed to grain alone for eight weeks. (124)
3. Food preferences formed in the presence of the mother lasted longer than those formed alone. (82)
4. Young ruminants can learn about foods from other members of the group. (40)
5. Six to eight-week-old lambs learn about foods more efficiently from their mothers than eleven to twelve-week-old lambs. (42, 66)
6. Ruminants refuse to eat foods that makes them sick even if their mother eats the foods. (50)
7. Young ruminants avoid foods their mothers avoid because of food novelty not because their mothers avoid the foods. (68)
8. Ruminants prefer to forage with companions rather than strangers. (43)

9. Herd mates tend to stay together but maintain their food preferences when foraging in familiar environments but food preferences tend to breakdown when herd mates forage together unfamiliar environments. (91)

10. Younger ruminants are more likely to try new foods than older ruminants.

Habitat

1. Cattle and sheep have home ranges. (51, 63)

2. Ruminants prefer the same habitats as their mothers. (13, 63, 117)

3. Ruminants prefer to forage in locations that contain needed nutrients or supplements. (87, 88, 98)

4. Ruminants prefer to forage in areas with foods in a variety of flavors provided nutritional needs are met. (87)

5. Ruminants can be trained using proper herding techniques to minimize grazing in riparian areas and increase grazing in the uplands. (111)

6. Supplements, like low moisture block, can change animal distribution and increase consumption of poor-quality forage. (65)

7. Ruminants avoid locations that resulted in electric shock but shock does not condition a food aversion. Likewise, ruminants will avoid foods that made them ill in the past but not the location of those foods. (110)

8. Ruminants use both visual cues and spatial memory (no visual cues) to track food locations, but they foraged more efficiently when visual cues were present. (115)

9. Ruminants generalize positive feeding consequences associated with a visual cue from the pen to the field. (116)

10. Ruminants trained to associate visual cues with positive feeding experiences were lured to new foraging locations using those cues but whether animals chose to remain at the new location depended on other behavioral influences. (116)

11. Ruminants can remember foraging locations that contain nutritious foods. (118)

12. Breed of sire affected foraging location of offspring. (117)

13. Ruminants select forage patches based on nutritional quality of the patch. (119)

14. In gentle terrain, ruminants preferred to graze near water during the heat of the day but further from water in the morning and evening. (119)

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