CLINICAL TECHNIQUE: FEEDING HAY TO RABBITS AND RODENTS

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Abstract

The recommended diets of pet rabbits and herbivorous rodents are often based on hays (dried forages) as the staple diet item. The rationale for this recommendation is a combination of logistical factors (i.e., hays are more readily available than a constant supply of fresh forage) and health concerns (i.e., using hays rather than fruits, nonleafy vegetables, and grain products apparently circumvents several health problems). Offering a variety of hays is a feeding concept that has so far received little attention. The choice of hays should be based primarily on a hygienic evaluation. Although hays have to be of impeccable hygienic quality, they need not necessarily be of high nutritive quality. A high proportion of stems and high-fiber material may be adequate for the maintenance of herbivores, and hays of higher nutritional quality can be used as dietary supplements in animals with increased energy requirements. Educating pet owners about the use of multiple hay combinations and the appreciation of the nutritive variety of hays may represent an opportunity for channeling interest and engagement in their animal while concurrently providing a preventive health measure.

Key words: diet; feeding; hay; obesity; rabbit; rodent; tooth wear; urolithiasis

Dried forages (hays) are a recommended essential staple item of feeding regimes for pet rabbits and rodents (e.g., guinea pigs, degus, chinchillas).[1-4] The logic behind this specific dietary recommendation appears sound and includes several different lines of argument that are discussed in this article. However, it is imperative that one understands that such recommendations result from a combination of logistical and epidemiological considerations.

FEEDING RECOMMENDATIONS AND THE IDEAL DIET

Ideally, animals cared for by humans should receive the same diets as their free-ranging counterparts. In the case of rabbits, the ideal diet consists of various grasses, forbs, herbs, and leaves[5-7]; this is a similar for guinea pigs,[8] chinchillas,[9] and degus.[10] The best way to imitate such diets would be to have the animals on large pastures with a diverse variety of plant species, or to collect grasses, forbs, herbs, and tree leaves on a daily basis. No recommendation of any other feeding regime implies that it is better to feed something other than a natural diet. Such recommendations imply that it is logistically not possible to feed a natural diet, and therefore the recommended alternative should be used as a replacement. This disclaimer may seem superfluous, or self-evident, to many readers. However, the understanding that an artificial feeding regime is always only a substitute for a natural does not necessarily come naturally. There are commercial children's games in which the question "what does a rabbit eat?" is answered by "bread and carrots"; and sometimes we receive phone calls by agitated, engaged rabbit owners who think that the recommendation to use hay as the staple diet item is irresponsible-because grasses, forbs, and herbs should really be the staple diet item!

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Therefore, it is in a scenario of choice among those diet items logistically available for the common pet owner that the recommendation to use mainly hays has to be understood: it is in contrast to commercial fruit and most commercial vegetables (with the exception of green leafy produce), in contrast to grain mixes and grain-based products (e.g., grain-based pelleted feeds, bread), and even in contrast to forage-based pelleted feeds that hays are the preferable option. Fruits and seed mixes are not recommended in rabbit feeding[1,11]; nevertheless, such feeds are still often fed to pet rabbits.[12-14] It is in contrast to such diet items that feeding mainly hay can have a prophylactic health effect.

WHY HAYS ARE IMPORTANT?

Nutrient Composition

Commercial fruits and nonleafy vegetables contain very high levels of easily digestible carbohydrates ("sugars")—higher than in any food these animals eat in the wild.[15] Additionally, commercial fruits and nonleafy vegetables contain little calcium. Grains also contain high levels of easily digestible carbohydrates (starch) and have a calcium:phosphorus ratio imbalance. Fruits, nonleafy vegetables, grains, and grain products therefore contain higher levels of digestible energy than the natural diet of rabbits and herbivorous rodents. In contrast, green leafy vegetables, hays, and forage-based pellets contain high levels of complex carbohydrates ("fiber") that are not easily digestible. These diet items also contain adequate levels of calcium and a balanced calcium:phosphorus ratio.

Prophylactic Health Effects

The major cause of tooth wear in rabbits and rodents is the chewing action itself—repeated tooth-to-tooth contact. A food with a low energy density (i.e., hays or fresh forages, in contrast to fruits and grain products), which the animal will eat more of and chew longer,[16] will therefore have a better prophylactic effect in regards to dental health. Epidemiological data indicate that rabbits that are fed a typical grain mix are at a higher risk for dental problems than rabbits that are not fed such a mix (and which, therefore, might ingest a higher proportion of forages).[17]

Rabbits[18] and rodents (guinea pigs[19]) that do not receive hay or fresh forages are at a higher risk for fur-chewing and the subsequent formation of trichobezoars in the stomach.

When maintained on hay which is a dry food, rabbits ingest more drinking water than when kept on other dry foods such as grain mixes or grain-based pellets, and also produce higher volumes of less concentrated urine.[20] This can be expected to have a prophylactic effect against urolith formation.

On forage diets, the danger that animals ingest more energy than required seems to be reduced as compared with energy-dense diets such as fruits or grain products. In a variety of feeding trials with rabbits, animals raised on forage-only diets had less adipose tissue than those fed more concentrated diets.[21-23] This will also be important in the long-term management of foot problems.[24]

Protective effects on gut health and gastrointestinal tract–associated disease of a high dietary fiber content have been demonstrated repeatedly in research investigations that use rabbits raised for commercial production.[25] Comparatively large, indigestible fiber particles—as ingested when feeding on forages—are considered a prerequisite for proper motility of the rabbit colon,[26] and presumably this is also true for herbivorous rodents. A reduced motility of the gut is thought to make animals more susceptible to enteritis or constipation.[1]

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ARE HAY-ONLY DIETS NUTRITIONALLY ADEQUATE?

When caring for rabbits and herbivorous rodents that are not raised for intensive meat production, there should be no rationale to offer high-energy feeds. In the wild, lactating female rabbits can nurse their young without additional meals that consist of grains. Nevertheless, pet owners often express concern over whether forage-only diets can be nutritionally sufficient for their animals. Again, the only scientific studies one can use to answer this question are based on production rabbit research, which has demonstrated repeatedly that forage-only diets do not appear problematic if supplemental vitamins and minerals are provided.[21-23,27] The reason why the additional use of an artificial diet is often recommended is to avoid health problems that might arise from a lack of a specific nutrient in the forage (e.g., trace minerals). In practice it is likely (but it cannot be

guaranteed) that this could be avoided by constantly providing a large variety of forages that do not all originate from the same location. However, in reality the animals often receive a single type of forage harvested from one location for comparatively long periods of time. Hence, supplying a pelleted feed (high in fiber) that is balanced in its vitamin and mineral content (i.e., for guinea pigs this includes a stable source of vitamin C), at 1 tablespoon per kilogram of animal, is usually recommended.[1] It should be noted that for guinea pigs, vitamin C can be provided by feeding fresh forage (e.g., grass, herbs, green leafy vegetables) on a daily basis.[28] Theoretically, supplementation of calcium and vitamin D should not be necessary when feeding hay-based diets, because these nutrients are mostly present in sufficient amounts in forages.

HAY VARIETY

Although many people think of apples, carrots, pellets, and hay as 4 different food items, apples and carrots—even in their various cultivars—are of a relatively consistent nutrient composition when compared with the enormous variety of hays that exist. Feeding 2 different hays will often represent a higher degree of "nutritional diversity" for an herbivorous animal than when feeding 2 fruits or vegetables. Moreover, because rabbits and herbivorous rodents are small in body size compared with the forages provided as hays, different bites from out of the same batch of hay can represent a distinct variation in nutrient intake. Hence, offering hay allows the animals to feed selectively, and differences in the degree of selectivity have been demonstrated with rabbits avoiding the high-fiber parts of hay to a higher degree than guinea pigs.[29] Such selective feeding is a cause of concern when animals are offered dietary choices they did not face when their food selection mechanisms evolved: high-energy items such as commercial fruits, nonleafy vegetables, and grain products are usually preferred, and with seed mixes it is the high-energy components that are selected[11] because herbivores evolved to select for high-energy feeds. Rabbits, like many other herbivores, can even differentiate between hay from the same pasture that has been cut in the early morning and in the late afternoon (presumably because of the content of soluble sugars in plants, which increases constantly from sunrise to sunset).[30] These selection mechanisms can be used if the diet choices offered are within the range of their natural diets—for example, by offering a variety of fresh herbs and grasses, or by offering a variety of hays. Offering a variety of hays (Fig 1) is an option for enrichment and stimulation for herbivores that is currently heavily disregarded. When feeding hays, it is important that owners understand that it must be replaced daily. Thinking that "as long as some of the old hay is left, there is no need to remove and provide new hay" can result in suboptimal hay intake, because the animal is left with only those parts it previously did not want to eat.

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CHOOSING HAY

The choice of hays should be based on 2 different evaluations that must not be confused with each other—the hygienic quality and the nutritional quality. It often makes sense to use hay of a moderate to low *nutritional* quality, but this does not imply that a moderate to low *hygienic* quality forage is acceptable.

Hygienic Evaluation

The hygienic quality of hay can be evaluated by judging its feel, smell, and appearance. Laboratory methods such as a microbiologic analysis in which the presence of certain bacteria and fungi are quantified and compared with standard values are available[31]; however, such analyses are often reserved for litigation cases. In practice, a sensory evaluation of the hay will be performed by the person responsible for buying and feeding that product. A schematic representation of this process is outlined in Table 1. Only hays that are judged "acceptable" should be used to feed the animals. When caring for pet rabbits and herbivorous rodents, the hygienic quality of the hay may not be a logistical challenge to owners because of the small amounts of hay usually purchased. Discarding a small batch of hay is not a major financial problem for the single pet owner as it would be for a farmer who has to discard a barn filled with hay stored for his dairy stock.

Nutritional Evaluation

The nutritional quality of hay can also be evaluated by judging its feel, smell, and appearance.

Again, laboratory methods such as a nutrient analysis are available but are rarely used by pet owners. A schematic representation of this process is outlined in Table 2. Note that only those hays that passed the hygienic evaluation outlined in Table 1 should be submitted for nutritional evaluation. A low nutritional evaluation score does not represent a hygienic hazard.

Although the use of such schemes should be regularly practiced, they can serve as a guide for the evaluation of hays even for the lay rabbit owner. Differences in the nutritive value of hays from the same pasture will depend on the period of harvest, with an increasing proportion of stems and inflorescences (hence fiber content) over time. Second cuts will mostly be performed when the hay is in comparatively early growth stages and contains less fibrous material. Differences between hays from different pastures will depend additionally on plant species composition; a higher proportion of dicot material (e.g., lucerne, clover, herbs) will increase the protein and calcium content of the product. An example of 2 different grass hays is given in Figure 2. The hay on the left consists of a higher proportion of stems (course to the touch); its nutritive value is therefore lower than that of the hay product on the right.

In the literature that describes rabbit nutrition, the most common differentiation found between hays is that between grass and lucerne/alfalfa hays. Like most dicot material, lucerne/alfalfa hay is high in protein and

Feeding 2 different hays will often represent a higher degree of "nutritional diversity" for an herbivorous animal than is achieved when feeding 2 fruits or vegetables.

FIGURE 1. Different types of hay commonly offered to pet herbivores: (A) Timothy. (B) Orchard. (C) Alfalfa. (D) Oat. (E) Organic. (F) Meadow hay. Photos courtesy of Oxbow Animal Health, Murdock, NE USA.

TABLE 1. Sensory evaluation of the hygienic status of hay[31]

Parameter	Finding	Score*
Feel	Dry	0
	Slightly damp	−2
	Damp-moist	−5
Smell	Without untypical odors	0
	Moldy nuances	−5
	Moldy-rotten	−10
Color	Typical (greenish)	0
	With gray/white nests	−2
	Diffuse grayish discoloration	−5
Contamination†	Mold, beetles, mites	
	None present	0
	Moderate amounts	−5
	High amounts	−10
Score:		
0	Acceptable	
−1 to −5	Moderately defective	
−6 to −10	Significantly defective	
−11 to −40	Not considered food anymore	

*Scores intermediate to the ones provided here are possible.
†Shake out fine parts for inspection; check with magnifying glass.

calcium and may on average contain more energy than a grass hay. However, generalized statements on the energy density/fiber content of hays are problematic, because these can vary drastically according to harvest time. Instead, owners should consider estimating these parameters using the information found in Table 2. Because of the higher protein and calcium content, lucerne/alfalfa hay appears suitable for growing animals; conversely, the lower protein and calcium levels of grass hays appear more adequate for the maintenance of adults.[1] In particular, a diet based on lucerne hay can lead to more urinary calcium sludge.[32] Although urinary calcium sludge is a natural condition in rabbits, it may predispose susceptible animals to calcium urolithiasis. On the other hand, alfalfa hay is a good choice in situations in which calcium supplementation is warranted.

Apart from the lucerne/alfalfa–grass hay dichotomy, other reasons for choosing a particular hay type, to the author's knowledge, have not been reported in the scientific literature. It is the experience of various pet owners that a hay with a "moderate/satisfactory" nutritive value may be an adequate dietary offering, especially for guinea pigs and degus. Maintaining animals on hays with such a nutritive value offers the possibility that when an increased energy provision is considered necessary, it can be done in a way that particularly mimics free-ranging conditions by either increasing the amounts of fresh forage (e.g., grass, herbs, green leafy vegetables) and/or by offering an additional hay of high nutritive value.

CONCLUSION

As long as hays and/or fresh grass, herbs, and green leafy vegetables consist of the staple diet items for pet rabbits and herbivorous rodents, with a very limited amount of a pelleted feed for mineral and vitamin supplementation (if, in other words, a diet based on grain products and fruit is shunned), many diet-related health problems may be avoided. To date, the author is not aware of any scientific investigations that determine if supplementation of fresh grass, herbs, and green leafy vegetables to a hay-based diet

TABLE 2. Sensory evaluation of the nutritional status of hay[31]

Parameter	Finding	Score*
Feel	Soft, leafy (hardly any inflorescences)	10
	Moderately leafy	5
	Very few leaves, mostly stems, many inflorescences	2
	Straw-like, tough	0
Smell	Enjoyable, aromatic	3
	Mild hay smell	1
	Flat smell	0
Color	Bright green	5
	Slightly bleached out	3
	Distinctively bleached out	1
Contamination†	No macroscopic contamination	2
	Moderate soil/grit contamination	1
	Distinctive soil/grit contamination (including roots)	0
Score:		
16 to 20	Good to very good	
10 to 15	Satisfactory	
5 to 9	Moderate	
0 to 4	Low nutritive value (like straw)	

*Scores intermediate to the ones provided here are possible.
†Shake out fine parts for inspection.

FIGURE 2. Comparison of a late-cut hay with a high proportion of stems from tall-growing grasses (left) and a second-cut hay of low-growing grasses (right). Photo courtesy of Priska Küng.

actually confers a health benefit. Similarly, there are no scientific studies on the health benefits of offering a combination of hay varieties as opposed to only one. There is also no scientific basis to determine whether increasing the energy density of a hay-based diet with a limited pelleted feed supplement by increasing the amount of that pelleted supplement is less adequate than by providing an additional hay of higher nutritive value. In the end such decisions remain choices of the pet owner and are based on different philosophical approaches, and will often be determined according to logistical implications. For the veterinarian who gives advice to her/his clients, the suggestion to increase the variety of hay, or to regulate energy density of the diet by choosing between different hays, may be particularly suitable for clients who want to actively care for their animals. Offering these solutions may prevent owners from expressing their care by offering a variety of other less suitable feeds (e.g., complicated grain mixes, large varieties of commercial fruits). Whatever dietary approach one uses, a proper monitoring of the animal's condition (by regular weighing and body condition scoring) should be a matter of course.

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