

# Small mammal nutrition: significance of feeding a species-specific diet

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## ABSTRACT

The past decade has seen a rapid growth in popularity of small mammals kept as companion animals. Statistics from the Pet Food Manufacturers Association (2012) estimate as many as 1,000,000 rabbits, 500,000 guinea pigs, 500,000 hamsters, 200,000 rats and 100,000 gerbils are kept as pets in the UK. As the popularity of such species increases, so do client expectations, with owners increasingly expecting the provision of high-quality veterinary knowledge and care for their choice of companion (Mancinelli and Bament, 2014; **Figure 1**).

A foundation of appropriate health and welfare for these species is adequate nutrition. Nutrition is the process of providing and assimilating food necessary for animal maintenance and growth.

**This article will outline the main characteristics of the gastrointestinal tract and nutritional requirements of commonly kept small mammals, as well as discuss problems that may arise from inappropriate nutrition.**



**Figure 1.** As the popularity of owning small mammal species such as rabbits and chinchillas as pets increases, so too does client expectation on their quality of care. IMAGE: ©Koshakas/freeimages.

## Rabbits

Rabbits belong to the order Lagomorpha and are herbivorous in nature, surviving in the wild on a high-fibre diet consisting of grasses, weeds and the occasional pieces of twig and bark of shrubs, bushes and trees. This high-fibre diet is essential for dental attrition and to stimulate gastrointestinal motility.

The main anatomical characteristics of the lagomorph's gastrointestinal tract are:

- A thin-walled stomach with a pH of approximately one to two, with a well-developed cardiac sphincter that prevents vomiting in healthy specimens (Thompson, 2013).
- A relatively short small intestine comprising the duodenum, jejunum and ileum, which digests carbohydrates, proteins and fats as in other species.
- A large hindgut comprising the caecum and colon.

The junction between the ileum, caecum and proximal colon – known as the ileocaecocolic junction – is adapted for mixing and separating large quantities of ingesta. Contractions of the musculature (haustra) in the walls of the proximal colon and caecum sort the material into indigestible and digestible fibre.

Indigestible fibre has little nutritional value to the rabbit, so is excreted rapidly as hard faecal pellets. While serving little nutritional purpose, this fibre is essential as it stimulates intestinal motility and keeps ingesta moving rapidly through the gastrointestinal tract (Prebble, 2012).

Digestible fibre provides nutritional value to the rabbit, so is moved retrogradely via reverse peristalsis to the caecum for fermentation. Fermentation by the specialised microflora (bacteria, yeasts and protozoa) contained in the caecum produces volatile fatty acids, which are absorbed

and provide an energy source for the rabbit.

However, not all nutrients are absorbed at this stage; the remaining fermenting caecal content is formed into pellets known as caecotrophs, which contain microbial proteins and vitamins B and K. These caecotrophs are encapsulated in mucus to provide protection from the acidic environment of the stomach and are ingested whole directly from the anus in a process known as caecotrophy (Prebble, 2012).

This process of redigestion facilitates the absorption of previously undigested nutrients and enables rabbits to get maximum nutrition from their high-fibre, relatively low-quality diet.



**Figure 2.** Leafy greens provide a valuable nutrient source.

As with any species kept in captivity, the diet of wild animals should be mimicked where possible (Thompson, 2014). For rabbits, this means providing a high-fibre diet based on good quality hay such as timothy hay, supplemented with leafy greens including broccoli, cabbage, kale and pak choi (**Figure 2**). Dark green vegetables such as these are generally nutrient-rich.

Cousquer (2008) suggests a minimum of three different greens are fed daily and should be rotated to discourage the development of fussy eating.

Carrots, which are frequently offered to rabbits, are actually high in sugar and should be fed only in very small quantities. In fact, it is the green carrot tops that are much more beneficial for the rabbit than the root vegetable (Thompson, 2014).

A limited amount of a commercial foodstuff should also be provided in the diet. Commercially available diets have been formulated for rabbits containing the required nutrients; however, these can sometimes fall short in providing a balanced diet – in particular, sufficient fibre.

This situation occurs most notably with multi-component cereal-type mixes as, given the opportunity, rabbits will select the items higher in protein and carbohydrate in preference to the more fibrous material – a process known as selective feeding. When such diets are fed, it is essential not to refill the bowl until everything in the daily portion has been consumed.

If the rabbit is not consuming the entire daily portion, gradual weaning on to a mono-component diet would be advisable. Mono-component foods are nutritionally complete foods that are extruded, pelleted or baked biscuits containing all the nutrients the rabbit needs in each bite. This ensures a balanced diet is fed and selective feeding is prevented.

Low-fibre diets in rabbits have been associated with reduced gastrointestinal motility, prolonged retention of digesta in the caecum, decreased formation of caecotrophs and a higher incidence of diarrhoea (Jenkins, 1999).

Without continual wear from the chewing of abrasive foodstuffs, malocclusion can develop. Incisor malocclusions may be easy to identify; however, cheek tooth malocclusions are hidden from external view, hence often become apparent only once significant pain and discomfort has been experienced by the rabbit.

It is important to note dental issues can affect other parts of the head, resulting in abscesses behind the globe of the eye or affecting the lumen of the tear duct as it runs over the cheek teeth and maxillary incisor roots, causing pus to appear at the eye or nares (Girling, 2003). A high-fibre diet and regular oral examinations are therefore advocated in all rabbits.

## **Rodents**

Commonly observed rodents seen in veterinary practice can be divided into three main groups:

- Myomorpha;
- Hystricomorpha; and
- Sciuromorpha.

### **Myomorpha**

Rodents belonging to the suborder Myomorpha include rats, mice, hamsters and gerbils. These are omnivorous species surviving in the wild on a diet consisting of roots, leaves, grains and even small invertebrates.

The rodent digestive tract comprises a simple stomach, caecum and elongated colon. Omnivorous species have a smaller caecum compared with herbivores as there is much less need for fermentation of high-fibre food (Benato, 2010). Hamsters have two parts to their stomachs – a non-glandular forestomach and a glandular region separated by muscular folds.

Myomorph rodents are unable to vomit due to the presence of a muscular ridge between the lower oesophagus and the stomach (Keeble and Heggie, 2012). Coprophagy is a normal behaviour among rodents; unlike rabbits, however, that ingest caecal pellets directly from their anus, rodents consume faecal pellets from the floor of their caging.

Small rodents are often grouped into the same nutritional category; however, studies have demonstrated each of the individual species, despite all being omnivorous, have different nutritional requirements. A number of commercially prepared species-specific diets are available, which should be offered daily and supplemented with small amounts of vegetables and fruit. Once a week, a small portion of a protein source should be provided, such as hard-boiled egg or a piece of cheese (Benato, 2010).

Species fed only commercial cereal mixes without the addition of vegetables, fruits and an additional protein source will probably develop nutritional deficiencies over time.

It is important to remember, however, as well as not receiving sufficient nutrition, malnutrition also refers to consuming an excessive amount of food – a situation often observed among rodents. This is because owners often provide an excess of food comparative to the rodent's size, combined with limited opportunities to exercise.

Over time this can lead to obesity and other subsequent conditions including hepatic lipidosis, cardiac disease and renal dysfunction. Scatter feeding will encourage natural foraging behaviour, promote exercise and provide valuable environmental enrichment.

## **Hystricomorpha**

Commonly kept rodents belonging to the suborder Hystricomorpha include guinea pigs and chinchillas. These are herbivorous species surviving in the wild on a high-fibre diet consisting of grass and plants.



**Figure 3.** Cereal-type mixes may lead to selective feeding in some species.

The main features of Hystricomorpha gastrointestinal anatomy include a single-chambered glandular stomach, a large caecum (necessary for the fermentation of fibrous material) and a long intestinal tract. As with rabbits, guinea pigs and chinchillas produce two types of faecal pellets and exhibit coprophagia. For species kept as companion animals, the diet should consist of good-quality hay, grass and leafy green plants and vegetables such as dandelion and broccoli, plus a small amount of species-specific mono-component pellet mix, to avoid selective feeding, which is often observed among these species (**Figure 3**).

A variety of fruits is often fed to these animals in captivity; however, it is important to note fruit is high in simple sugars and as it does not feature significantly in the natural diet of these species, should be offered only in small amounts as an occasional treat.

Hypovitaminosis C – or scurvy – is observed among guinea pigs that do not receive sufficient vitamin C (ascorbic acid) in their diet. This is because guinea pigs have an absolute minimum dietary requirement for vitamin C of 10mg/kg per day, rising to three times this amount during pregnancy (Keeble and Heggie, 2012).

Clinical symptoms of scurvy include a staring coat, anorexia, slobbers, diarrhoea and stiff, painful joints.



**Figure 4.** Vegetables such as broccoli and red pepper are rich in ascorbic acid.

Commercial guinea pig diets are usually supplemented with vitamin C; however, the shelf life of the vitamin is short and easily affected by inappropriate storage conditions such as warmth and light. The condition may, therefore, be better avoided via the provision of fresh vegetables rich in ascorbic acid such as kale, spinach, broccoli and red pepper (**Figure 4**).

Sugar-rich treats should be avoided in both guinea pigs and chinchillas as these can lead to dental caries.

## **Sciuromorpha**

A commonly kept species belonging to the Sciuromorpha suborder is the chipmunk. Chipmunks are an omnivorous species that survive in the wild on nuts, grains, plant material, fruits, small invertebrates, small frogs and bird eggs. They have a single glandular stomach, a small caecum that reflects their omnivorous diet and they are coprophagic.

In captivity, their diet should comprise a commercially prepared muesli-style mix combined with fresh fruit, vegetables and a source of protein in the form of hard-boiled egg or small insects such as mealworms. Incisor malocclusion is common in chipmunks. Giving nuts in their shells will encourage dental attrition, as well as providing valuable enrichment.

## **Water**

Water must, of course, be included within the diet of all small mammals. Maintaining good water quality is important as many species will dunk their food into their water supply or, if the water is provided in bowls rather than sip feeders, some species will defaecate in their water supply (Girling, 2003). Sip feeder-style water bottles are therefore a better option as contamination by food, faeces and bedding is prevented. However water is offered, it should be changed daily and

the amount consumed should be closely monitored.

## Conclusion

An understanding of the gastrointestinal anatomy and physiology, combined with an awareness of the nutritional requirements of commonly kept small mammals, will reduce the risk of disease among these species and equip veterinary nurses with the knowledge to educate pet owners regarding the nutritional management of these increasingly popular companion animals.

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