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Photograph: Smithsonian's
National Zoo

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The Smithsonian Zoo's lions did react to the earthquake, but went back to their routines within minutes of the shaking, while other animals were more irritated by the quake, sending out alarm calls and hiding.

Nutritional Management of Feline Hyperthyroidism: What's the Best Diet to Feed these Cats?

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Hyperthyroidism is the most common endocrine disorder of cats, and is one of the most common medical problems seen in small animal practice. Surprisingly, despite the fact that nutritional factors and cat food likely has a role in the etiopathogenesis of this disease (1), there are only limited published recommendations about what to feed these cats.

The question, "What's the best diet to feed my hyperthyroid cat?" is an extremely common one that I get from concerned cat owners. I'm certain that many of you get the same question.

With the recent introduction of the Hill's y/d diet (2), the iodine deficient diet which, according to the company website "restores thyroid health," I thought that my opinion of what diets should be fed to cats with hyperthyroidism might be of interest.

For the first section of this article, will discuss the ideal food composition and nutrients that I believe hyperthyroid cats should be fed. I will then discuss the use of y/d diet, and specifically address the pros and cons of using this diet for management of hyperthyroid cats.

THE MANY METABOLIC PROBLEMS FACING THE HYPERTHYROID CAT

When secreted in excess, thyroid hormones have profound metabolic effects on the whole body, and dysfunction of multiple organ systems (CNS, cardiac, gastrointestinal, hepatic, and renal) is common in hyperthyroid cats (3-5).

Weight Loss and Muscle Wasting

Weight loss, despite a normal to increased appetite, is the classic and most common signs seen in cats with hyperthyroidism (3-5). These cats lose weight because their hyperthyroidism accelerates their metabolic rate and body's energy expenditure; they are burning up their food calories faster than they can consume their daily meals.

It's important to realize that hyperthyroidism is a catabolic state. The progressive weight loss and muscle wasting that is so characteristic of feline disease is caused by increased protein catabolism leading to a negative nitrogen balance (6,7). When hyperthyroid cats first lose weight, the case can usually be first noticed as a loss of muscle mass in the cat's lumbar paravertebral area. Despite this loss of muscle mass, most mildly hyperthyroid cats retain their "belly" during the initial stages of their thyroid disease and may even have a higher than ideal body condition score. With time, severe muscle wasting, emaciation, cachexia, and death from starvation can occur if the cat's hyperthyroidism is left untreated (3-5). In hyperthyroidism, the cat's body consumes its own muscle tissue to get the protein it needs to sustain its carnivorous life.

Even with treatment of hyperthyroidism, recovery of muscle mass and function may be prolonged, lasting several weeks to months. This is especially true if these cats are not provided with enough protein in their diet to rebuild and maintain their lost muscle mass.

Hyperglycemia, Glucose Intolerance, Insulin Resistance, and Overt Diabetes

Hyperthyroid cats commonly develop profound changes in glucose and insulin metabolism. Mild to moderate hyperglycemia is common in hyperthyroid cats, which is generally attributed to a "stress" reaction (3,5).

However, the actual metabolic changes are actually much more complicated: hyperthyroidism frequently causes moderate to severe "endogenous" insulin resistance, as demonstrated by high resting serum insulin concentrations and an exaggerated insulin response during an IV glucose tolerance test (8,9). This insulin resistance is associated with a decreased glucose clearance (impaired glucose tolerance), which is indicative of a prediabetic state (**See Figure 1**).

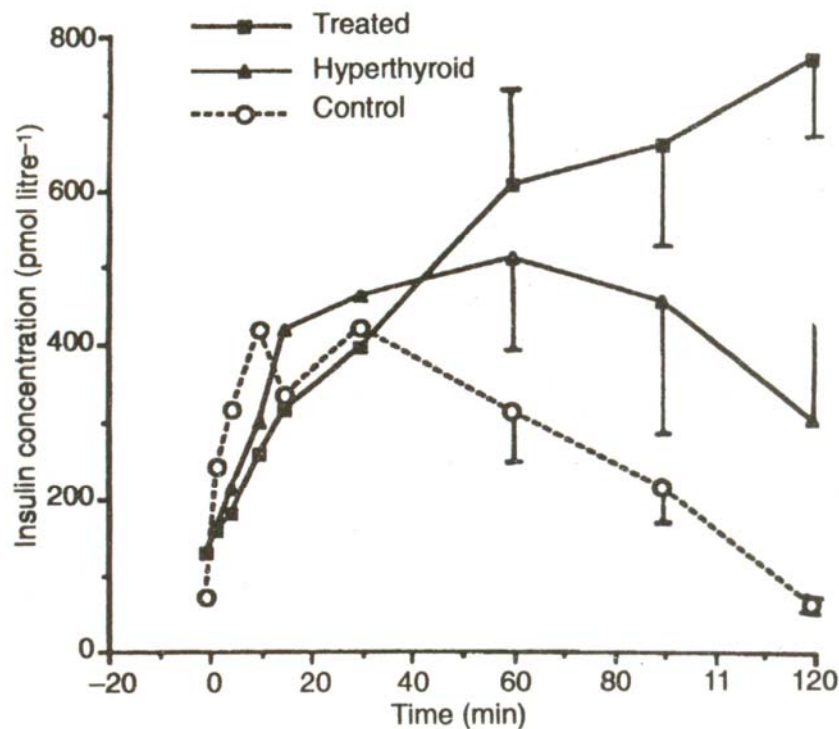


Figure 1: Serum insulin concentrations in response to intravenous glucose tolerance test in 11 healthy cats, 15 cats with untreated hyperthyroidism, and 6 hyperthyroid cats after treatment (9). Notice the exaggerated insulin secretion in the untreated hyperthyroidism cats, which becomes even worse after treatment. The finding of such high insulin concentrations is diagnostic for "endogenous" insulin resistance.

Occasionally, an untreated hyperthyroid cat will develop overt diabetes mellitus. Many of these diabetic cats will develop moderate resistance to the injected insulin, with poor diabetic control.

Surprisingly, the insulin resistance and prediabetic state so common in hyperthyroid cats does not always improve and may even worsen despite successful treatment of hyperthyroidism (9).

Sarcopenia of Aging

In addition to loss of muscle mass from the catabolic effects of thyroid hormone excess, cats also tend to lose muscle mass they age, independent of their thyroid status. This phenomenon, referred to as sarcopenia of aging, is also common in elderly human beings (10-12). The term age-related sarcopenia is derived from Greek (meaning "poverty of flesh") and is characterized by a degenerative loss of skeletal muscle mass and strength, as well as increased muscle fatigability.

In adult cats, maintenance energy requirements decrease by about 3% per year up until the age of 11 years, and then actually start to increase again (13). This contributes to a tendency of senior cats to lose muscle mass if their energy needs are not met. Lean body mass of aging cats drops dramatically after 12 years of age, and by age 15, cats may have a mean lean tissue mass that is a third less than cats aged 7 years or less (13, 14). Body fat also tends to progressively decrease in cats after the age of 12 years; this combination of reduced lean mass and body fat contributes to weight loss experienced by many elderly cats.

The ability to digest protein is also compromised in many geriatric cats. After the age of 14 years, one-fifth of geriatric cats have reduced ability to digest protein (13-15). Reduced protein digestibility in geriatric cats seems to occur in parallel with reduction of lean tissue and it might predispose them to negative nitrogen balance. (16).

Although moderation of calorie intake might be suitable for some mature cats, it does not appear to match the needs of most geriatric cats. In contrast, it seems more logical to use highly digestible, energy-dense food for geriatric cats in order to prevent or slow their decline in body weight and lean body tissue (13,16,17). Reducing protein intake in geriatric cats, at a time when lean tissue has been lost, is contraindicated. Geriatric cats seem to have nutritional requirements closer to kittens than to mature adult cat.

DIET RECOMMENDATIONS FOR HYPERTHYROID CATS

High Dietary Protein

Obligate carnivores, such as the cat, are unique in their need for large amounts of dietary protein (specifically, dispensable nitrogen) that separates them from omnivores and herbivore species (18-20). This absolute requirement for dietary protein intake in cats is critically important when formulating a diet for hyperthyroid cats, in which protein catabolism and muscle wasting is universally present.

Protein is the primary macronutrient responsible for maintenance of muscle mass. Restoring and preserving any remaining muscle tissue in cats treated for hyperthyroidism depends upon the cat consuming a diet with sufficient amounts of high-quality protein. This recommendation for higher amounts of dietary protein does not change once euthyroidism has been restored. The dogma that all older cats should be fed reduced energy “senior” diets must be questioned based on what is now known about the increasing energy requirements and nutritional needs of older cats (12,13).

In most geriatric cats, logic dictates the use highly digestible, energy-dense food mitigates the decline in body weight and lean body tissue and to avoid protein:calorie malnutrition (12,16,17). Protein reduction for this geriatric life stage, at a time when lean tissue is being lost, is contraindicated. Geriatric cats seem to have nutritional requirements closer to kittens than to mature adult cats.

Low Dietary Carbohydrates

Since most of these cats also have subclinical diabetes —as evidenced by their mild hyperglycemia, glucose intolerance, and insulin resistance (see Figure 1)— feeding a low carbohydrate diet (<10% of total calories) also is strongly recommended (21).

Feeding a low carbohydrate diet will improve insulin sensitivity, reduce the need for exogenous insulin, and help stabilize glucose metabolism in these cats (21-23). This may prevent the development of overt diabetes and control long-term obesity in these cats after successful control of the hyperthyroidism.

Selecting a Cat Food Based on Diet Composition and Ingredients

Like normal and diabetic cats, I believe that it makes sense to feed most hyperthyroid cats a diet composition close to what they would be getting in the wild. That would be a diet composed of approximately 50-70% protein, 5-10% carbohydrates, and 30-40% fat.

Because older cats also lose lean muscle mass in association with the “sarcopenia of aging,” this diet composition needs to be continued after one treats the cat’s hyperthyroidism to restore euthyroidism.

Composition: Check out this website (<http://binkyspage.tripod.com/foodfaq.html>), which gives you a breakdown of the composition of the various prescription and over-the-counter diets. This website uses metabolizable energy (ME) values to evaluate food composition— in other words, it gives you the percent calories that comes from the protein, fat, and carbohydrate fractions of the diet, and allows us to compare various diets without worrying about their differ

ent water levels. It turns out that many of the over-the-counter diets have a better composition of protein and carbohydrates than you might have thought — even better than many of the more expensive prescription diets. Very few of my hyperthyroid cat patients require a prescription diet to fulfill their nutritional needs.

The composition of almost all dry food cat diets are much too high in carbohydrates and most are too low in protein content. In addition, all dry foods are obviously water depleted; given that cats normally have a low thirst drive, feeding dry food (especially to an elderly hyperthyroid cat) predisposes them to a state of chronic dehydration. That is why I believe it's best to limit the amount of dry food that is fed to cats, or even better, not feed dry food at all.

Ingredients: Once we have selected a few diets with the required composition breakdown of carbohydrates, protein, and fat, we next have to look at the ingredient list. Not all of the proteins in cat foods are equal in quality. Remember that quality meat is the best ingredient in a food and that meat by-products are a close second. Some vegetable and grains are fine, but they supply a less bioavailable form of protein for cats and should not be the primary source of dietary protein.

Remember that when deprived of protein, carnivores will continue to break down muscle tissue to create the energy they need (18-20). By feeding only high-quality protein diets, we will help restore the cat's muscle mass and improve strength and agility.

Hyperthyroidism and Concurrent Renal Disease

Concurrent chronic kidney disease is common in hyperthyroid cat, occurring in up to 30% of cases. Cats with advanced renal disease (IRIS Stage 3 or 4) may need lower amounts of dietary protein to lessen uremic episodes (24). However, at least in early to mid-stage renal disease, lowering of the serum phosphate concentration is much more important in management than dietary protein restriction, and this can be easily accomplished with phosphate binders without lowering the protein content of the diet (25,26).

It may seem impossible, but no studies have conclusively demonstrated that severe restriction of protein alone will prevent further deterioration of kidney function in cats (27). In all of the reported studies, the diets were restricted in phosphorous and salt, as well as protein; in addition the kidney diets all were supplemented with potassium, B-vitamins, and omega-3 fatty acids, all of which may be more important than protein restriction alone.

The major problem that I have with the prescription kidney diets is that they restrict protein to the point that some cats — especially those with concurrent hyperthyroidism — will continue to catabolize their own muscle mass (and become protein malnourished) despite adequate control of the thyroid condition. Most nephrologists nowadays (and I agree) would NOT use restricted protein for cats during the earlier stages of CKD, but rather, they start protein restriction when needed to keep the serum urea nitrogen in the 60 mg/dl range. By doing this, we would help prevent or delay the development of signs associated with uremic syndrome.

USE OF AN IODINE DEFICIENT DIET (Y/D) FOR TREATMENT OF CATS WITH HYPERTHYROIDISM

Does Diet Management with Hill's Prescription Diet y/d Work?

Recent studies have indicated that use of a diet with severely restricted iodine levels (Hill's Prescription Diet y/d Feline —Thyroid Health) can result in normalization of T₄ levels in hyperthyroid cats and provide a further option for medical management of this disease (28,20). The basis for using this diet is that iodine is an essential component of both T₄ and T₃; without any iodine, the thyroid cannot produce thyroid hormones. This is clearly an iodine diet, containing levels (<0.32 ppm or <0.32 mg/kg) well below the minimum daily requirement for adult cats (0.46 ppm or 0.46 mg/kg) of food (30).

By 4 weeks, about 75% of hyperthyroid cat exclusively eating y/d will have normal serum total T₄ concentrations. By 8 weeks, 90% of cats have a serum T₄ level; by 12 weeks, almost all cats should have normal values (2). This therapy appears to be more effective in cats with only moderate elevations of T₄ than cats with severe hyperthyroidism.

Based on the data so far, however, the serum T4 concentrations in many cats fed this diet remain in the high-normal range, rather than the lower half of the T4 reference range. Since most older, clinically normal cats have serum T4 values in the lower end of the reference range (e.g., 1.0-2.5 mg/dl), that is considered the ideal target range for success in treating cats with hyperthyroidism no matter what therapy is used.

Main Indications for y/d Diet for Management of Hyperthyroid Cats

In my opinion, the main indication for the use of y/d diet would be in cats that are not candidates for definitive treatment of the underlying thyroid tumor(s) with radioiodine, which remains the treatment of choice. In addition, nutritional management with y/d food (canned rather than the dry y/d) could be considered in cats whose owners are not able to give oral medication or in cats that develop side effects from oral or transdermal methimazole.

This represents a new “alternative” medical treatment for hyperthyroidism that certainly will have advantages over other alternative medical therapies such as ipodate, herbal extracts, or homeopathic drugs. In my opinion, y/d is not the treatment of choice but does represent a viable option for those hyperthyroid cats where no other option is effective or acceptable.

Disadvantages of y/d Diet for Management of Hyperthyroid Cats

All of the recent hype and widespread promotion of this diet could imply that y/d is now the treatment of choice for hyperthyroid cats. Although this diet does appear to be effective in lowering serum T4 concentrations in most cats, its use is not without disadvantages.

1. First of all, this diet cannot cure hyperthyroidism. Rather, feeding y/d just offers control (withholding fuel for thyroid tumor). The thyroid tumor remains and will continue to grow larger. As now documented in cats with long-standing hyperthyroidism, transformation of adenoma to thyroid carcinoma can occur unless definitive treatment (surgery or radioiodine treatment) is used to cure the disease.
2. The cats fed this diet must not eat any other cat diet, table food, or treats because even tiny amounts of iodine may lead to failure of this diet to effectively control hyperthyroidism (2).
3. If the diet is stopped, relapse will develop; the cat must eat only this diet for rest of his/her lifetime. If a cat develops other age-related disease (diabetes, cardiac, or GI disease), a disease-specific diet cannot be fed or relapse of hyperthyroidism will occur.
4. The long-term consequences of this iodine deficient diet in cats are not known, especially in normal cats in household that are also fed this diet. Without adequate iodine to make thyroid hormone, circulating T4 and T3 fall, which will give rise to high serum levels of thyroid stimulating hormone (TSH) The high TSH acts on the thyroid gland to stimulate cellular growth and proliferation and induce thyroid hyperplasia and goiter (31). For this reason, y/d should not be the only diet fed to euthyroid cats, which can be an issue for owners with multiple cats in the same household.
5. Active iodide uptake and accumulation also occurs in a variety of nonthyroidal tissues, in addition to the thyroid gland (32). The other tissues that actively accumulate iodine include the salivary glands, gastric mucosa, lactating mammary gland, choroid plexus, and the ciliary body of the eye. Although the complete physiological significance of such nonthyroidal iodine accumulation is not clear, iodine appears to play an important role as an antioxidant and in immune function. In addition, iodine deficiency has been reported as a risk factor for both gastric and breast cancer in human patients (33,34).
6. The composition (protein/fat/carbohydrate breakdown) of y/d reveals that it is a high carbohydrate, low protein diet (Table 1). Compared to a cat's natural diet in the wild, y/d is 2.5 to 5 times higher in carbohydrates and contains only half of the amount of protein normally ingested. Feeding y/d for long periods is less than an “ideal” diet for an obligate carnivore, especially in hyperthyroid cats with severe muscle wasting or sarcopenia of aging (12, 13, 17).

Table 1: Caloric Distribution for Hill's y/d vs. Natural Cat Diet

Food	Protein (%)	Carbohydrate (%)	Fat (%)
Dry y/d	28	23	49
Canned y/d	27	24	49
Natural diet (35-37)	50-70	5-10	30-40

7. The ingredients present in y/d are also less than ideal for cats. In addition to the fact that y/d is a low-protein diet (Table 1), most of the diet's protein is derived from plant sources. This is especially true for the dry formulation, in which the only listed animal protein on the label is "dried egg product," and this is the fifth ingredient (Table 2). In other words, this diet does not contain any meat. The primary protein source in dry y/d is corn gluten meal, used in pet foods because of its lower cost. Prescription Diet y/d dry also contains "soybean mill run," which is considered a by-product filler. Soy may also contain enzyme inhibitors that impede normal protein digestion. Most importantly, soy is a known thyroid goitrogen and is considered to be one factor that may contribute to hyperthyroidism in cats.

Table 2: Label Ingredients for Dry y/d Feline Thyroid Diet

Corn Gluten Meal, Animal Fat (preserved with mixed tocopherols and citric acid), Whole Grain Corn, Soybean Mill Run, Dried Egg Product, L-Lysine, Chicken Liver Flavor, Potassium Citrate, Lactic Acid, Dicalcium Phosphate, vitamins (L-Ascorbyl-2-Polyphosphate (source of vitamin C), Vitamin E Supplement, Niacin, Thiamine Mononitrate, Vitamin A Supplement, Calcium Pantothenate, Riboflavin, Biotin, Vitamin B12 Supplement, Pyridoxine Hydrochloride, Folic Acid, Vitamin D3 Supplement), Fish Oil, Choline Chloride, Calcium Carbonate, Calcium Sulfate, DL-Methionine, Taurine, Vitamin E Supplement, L-Tryptophan, Natural Flavor, minerals (Ferrous Sulfate, Zinc Oxide, Copper Sulfate, Manganous Sulfate), L-Carnitine, preserved with Mixed Tocopherols and Citric Acid, Phosphoric Acid, Beta-Carotene, Rosemary Extract.

8. For the canned formulation, the ingredients list is more ideal in that the first 3 listed ingredients— liver, meat by-products, and chicken—all contain animal protein (Table 3). Liver is a very nutritious organ meat and a good source of animal protein, but the daily feeding of a pet food containing liver as the first ingredient might be questioned.

It is very unclear why there is such a discrepancy in protein sources between the dry and canned formulations of the y/d diet. If Hill's can provide animal-based proteins for the canned version, why can't it be done for the dry y/d?

Table 3: Label Ingredients for Canned y/d Feline Thyroid Diet

Water, Liver, Meat by-products, Chicken, Whole Grain Corn, Rice Flour, Chicken Fat (preserved with mixed tocopherols and citric acid), Chicken Liver Flavor, Powdered Cellulose, Calcium Carbonate, Fish Oil, Dried Yeast, Potassium Chloride, L-Lysine, DL-Methionine, Guar Gum, Vitamin E Supplement, Taurine, Choline Chloride, Salt, L-Cysteine, Thiamine Mononitrate, L-Carnitine, Dicalcium Phosphate, Ferrous Sulfate, Zinc Oxide, Ascorbic Acid (source of vitamin C), Niacin, Copper Sulfate, Manganous Sulfate, Pyridoxine Hydrochloride, Beta-Carotene, Calcium Pantothenate, Vitamin B12 Supplement, Riboflavin, Biotin, Vitamin D3 Supplement, Folic Acid.

Could Iodine Deficiency Contribute to Hyperthyroidism?

Ironically, recent studies suggest that iodine deficiency may be one of the causes for hyperthyroidism in cats, and that the development of the disease can be reduced by providing diets that are adequately supplemented with iodine (38). If this is true and iodine deficiency does contribute to the development of autonomous thyroid gland pathology, feeding y/d diet and other restricted dietary iodine diets could enhance the development of the thyroid disease in euthyroid cats fed the diet.

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