DR. DETECTIVE: HOW DO I FEED THE MULTICAT HOUSEHOLD WITH DIFFERENT NUTRITIONAL NEEDS?

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MULTIPLE CATS, MULTIPLE NEEDS

The goal within a multi-cat household is to: 1) determine an appropriate base/common denominator diet available to everyone achieving a feeding strategy *that puts no one at risk* nutritionally, as well as, 2) to meet any additional individual nutritional needs of each member of the group as closely as possible twice or more times a day "behind closed doors". This requires analyzing the clowder's nutritional needs, personalities and physical abilities.

In order to determine what doesn't put anyone at risk, we need to think about what disease condition is most responsive to or, the reverse, most damaged by feeding the wrong diet. In other words, which cat is most fragile, from a nutritional point of view? Cats are obligate carnivores. This concept is central to understanding the nutritional needs of cats and planning dietary therapies for health disorders, especially when dealing with multiple cats with differing health considerations. We need to review basic nutritional needs of this species before we can decide what modifications can be made safely.

FOOD, FEEDING AND NUTRITION IN A FELINE CONTEXT

Cats diverged from dogs approximately 30 million years ago, evolving metabolically into obligate carnivores with unique strategies for the utilization of protein and amino acids, fats and vitamins. This concept must be at the centre of trying to understand the nutritional needs of cats and planning dietary therapies for health disorders. Domestic cats have not evolved from the wild cat model. They are anatomically and physiologically adapted to eating as many as 10-20 small meals, (a reflection of their hunting behaviour), throughout the day and night. This allows them to hunt and eat when their prey are active. Small rodents make up the majority of their diet, with rabbits, birds, insects, frogs and reptiles making up a smaller proportion. The average mouse provides ~8% of an average feral (i.e. active, unaltered) cat's requirements. Repeated hunting throughout a 24-hour period is needed to meet this need, resulting in the normal grazing behaviour of domestic cats.

Being obligate carnivores has affected everything about cats: their hunting behaviour; that they eat many small meals a day alone; the small size of their stomach; their lack of salivary amylase; their social structure. Cats are hunters, yet the drive to hunt is independent from the need to eat. Hence, feeding more food doesn't stop them from killing birds or mice, it merely makes them gain weight. Most cats needs 10-15 attempts to be successful at killing prey, thus the drive to "eye, stalk, pounce and kill" is permanently turned-on to avoid starvation. The average mouse provides 30-35 kcal of energy. Needing 50 kcal/kg ideal weight/day, the 5 kg cat needs 250 kcal or 8 mouse-sized portions/day. These meals are spread out throughout the day, not consumed all at once.

Feeding twice a day or having a bowl that is never empty are not "natural" ways for cats to eat. A 30 kcal meal is approximately 10 pieces of an average maintenance dry food; even eating 10 extra pieces/day results in a 10% (1 lb) weight gain/year. Our need for interaction with our cats also contributes to obesity. Cats generally interact with us frequently and at a low intensity/casually; people generally want fewer, more intense/focused periods of interaction with them. Eating is not a social activity for cats. We may feel like a bad provider or rejected if our cats don't eat their food eagerly and seek second helpings. And, because their meals are so small, we misunderstand and want them to eat more. We try different diets until we have "evidence " that they enjoy their food. We train them to ask for food and they train us to respond to their boredom or other unmet needs by feeding them.

Opportunities to express hunting behaviour are a basic need for a cat. If a cat doesn't have the opportunity to hunt, toys meeting appropriate criteria are small (prey-sized), make high-pitched squeaks or cheeps and move in a rapid, unpredictable fashion. The Indoor Pet Initiative offers an informative piece on choosing the correct toy for an individual cat: http://indoorpet.osu.edu/cats/basicneeds/preypref/index.cfm. Allowing them to hunt for their food (bowl) or using a feeding toy are mentally stimulating activities. Examples of feeding toys include:
NoBowl Indoor Hunting Feeder (www.docandphoebe.com)
Cat Activity Fun Board (www.traininglines.co.uk/cat-activity-fun-board-3397-0.html)
FUNkitty Egg-Cersizer: (www.petsafe.net/search?q=egg-cersizer)

Aikiou Stimulo (www.aikiou.com/stimulo-cat-bowls-and-feeders/)
Catit Design Senses Food Maze (http://usa.hagen.com/Cat/Feeding/Accessories/50745)

Cats are very sensitive to the feel of a food (physical form), its odour and taste. They eat their prey head-first. This is a tactile response to the sensation from the direction of the hair/feathers. Most cats prefer foods that are solid and moist, like flesh, not powdery, sticky or greasy. They prefer their food at fresh-killed body temperature rather than room temperature, out of the refrigerator or hot.

Under stressful situations, cats will refuse a novel food; under other circumstances, the same cat may be very adventuresome and chose a new diet over their familiar food. A new diet is more likely to be accepted if it is offered at home rather than in the clinic setting.

Numerous studies have been performed all showing that spaying and neutering/castration decrease energy expenditure by 7-36%. It is, therefore, very important to counsel clients to change from a growth to an adult formulation and to restrict the caloric intake after surgical altering. In general, unaltered cats need 60-80 kcal/kg/day; after altering, they need about 40-50 kcal/kg *ideal* body weight/day.

While other species are able to rest their metabolic pathways from the efforts of glucose (energy) synthesis when they have been fed, cats must continue gluconeogenesis in both the fed and fasted states. When anorectic, they catabolize body proteins. Protein supplementation during fasting will slow hepatic lipid accumulation. Urea cycle enzymes in the liver of cats are always „turned on“. Adult cats have a much higher requirement for protein than dogs or humans. Expressed as a percentage of diet, adult cats need 29% vs. the adult canine requirement of 12% or the human need for 8%. Over the long-term, cats can adapt to lower protein diets and use carbohydrates as an alternate energy source. In a paper that is in press (J Fel Med Surg) at time of writing these notes (Feb 2013), Laflamme has shown that healthy cats need a minimum of 5.2 g protein/kg/day in order to maintain a neutral nitrogen balance.

An elegant study (Hewson-Hughes) has shown that, when cats are able to choose the constituents of their diet, they will aim for a macronutrient profile of 52% protein, 36% fat and 12% carbohydrate. This fits with the many studies of the diets of free-roaming feral cats. In a review of 27 studies, Plantinga showed that the native diet consists of 52% protein, 46% fat and only 2% carbohydrate.

QUANTITY TO FEED

50 kcal/kg/day provides a rough guide and refers to ideal body weight of a healthy adult cat. If a cat is overweight, calculate their caloric requirement for maintenance requirements of their ideal weight. For elderly, thin cats, they need about 70 kcal/kg/day with at least 5g protein/kg/day. These rough guides are adequate for calculations to determine how much a patient should be getting on a daily basis in clinic and as a starting point for the patient when they are discharged. The client should be advised of the actual amount of food to feed when sent home with canned or dry food. Make sure that you are communicating with common vocabulary as what one person thinks of as a “cup“ may not be an 8 oz/250ml measuring cup. The most accurate method for measuring food quantities is by using a kitchen scale.

Once feeding any therapeutic diet, it is very important to check and see how the individual patient is responding to the diet by reevaluating them, just as we would recheck a patient on any other medical therapy. Checking body weight and condition cannot be done over the phone. For cats outside of the 2-7kg (5-16lb) range in ideal condition, the 50 kcal/kg/day formula isn’t accurate enough. The following formula is more appropriate: 70 (BW in kg)$^{0.75}$ (raised to the 0.75 power). Alternately and more easily, a nutritional calculator is available at: http://petnutritionalliance.org.

FEEDING FOR LIFE-STAGE OR USING THERAPEUTIC DIETS AS PART OF DISEASE MANAGEMENT

Let’s apply this overview of very basic nutrition and feline feeding facts to a multi-cat home with multiple nutritional needs to a household consisting of the following twelve individuals:

1. A 14 year old cat with International Renal Interest Society (IRIS) Stage 2 renal insufficiency
2. A 13 year old thin, arthritic cat
3. A 4 month old healthy kitten
4. A 2 year old healthy adult cat
5. A 7 year old obese cat (BCS 8/9, high morphometric measurement)
6. A 10 year old cat with diabetes
7. A 15 year old hyperthyroid cat
8. A 6 year old cat with "IBD" who vomits and gets diarrhea readily
9. An 8 year old cat with pancreatitis
10. A 4 year old cat with diet-responsive skin allergy
11. An 8 year old chronically constipated cat
12. A 9 year old cat with CaOx history
13. A 2 year old cat with struvite crystalluria
14. A cat with hepatic lipidosis

What dietary strategy can accommodate what appears to be completely disparate nutritional needs?

1. FEEDING CATS WITH RENAL DISEASE

We would like to feed first cat, an elderly individual with Stage 3 renal disease, a protein-restricted diet suitable for renal insufficiency. Do all cats with renal disease have the same etiologic cause for their decline in renal function? Are they all at the same stage? Do they have identical nutritional requirements? Could this cat, perhaps, benefit from being fed a protein enhanced diet, a recuperative diet, a growth diet, a senior diet or a maintenance diet?

Protein: calorie malnutrition occurs when a cat is getting enough calories but not enough of them come from protein. As a result, there may or may not be weight loss, but there will be muscle wasting as well as a deterioration in the hair coat quality. Because protein is component in antibodies, immune function may be compromised; anemia may be exacerbated due to the lack of building components for hemoglobin; albumin levels may decrease and tissue healing may be affected. Protein is a preferred flavour, so if a cat is already inappetant, restricting protein may result in inadequate intake of all nutrients, and the protein intake may fall below that required for normal function.

As an *obligate* carnivore, if a cat doesn't get enough dietary protein to meet metabolic requirements, he must draw on endogenous, stored protein sources to meet those needs. Over months, cats can down- regulate their protein needs and switch to use other pathways, but in the short and intermediate term, muscle will be catabolized. The resulting muscle wasting and decreased mass reduces the serum level of creatinine (Cr) measured. This makes it difficult to know how much of a Cr decrease seen in a cat fed a restricted protein diet is from improvement in renal function and how much is because there is less functional muscle producing Cr.

Despite numerous experimental studies and clinical trials, questions about feeding protein to the cat with renal disease still remain, including:

1. What is optimal amount of protein for a cat with CKD? How much restriction is necessary?
2. Do different types of kidney disease require different dietary therapies?
3. At what point in disease progression should protein restriction be implemented?
4. Does the type of protein fed make a difference?
5. Does every meal have to be restricted?
6. Is phosphorus restriction as, or more, beneficial than protein restriction in Stages 2 and 3?
7. Might some cats with advanced disease benefit from increased protein levels?
8. Should the diets of cats with proteinuria be protein restricted or enhanced?

Protein levels in "restricted" and "high" protein diets fall within the nutritional guidelines, merely at the low or at the high end of the range. Protein-restricted therapeutic diets are not all the same; there are some marked differences in their composition, not just in protein sources and quantities, but also in the calorie source, in phosphorus, potassium, and sodium content. (**Table 1**)

Dietary protein is not, in and unto itself, toxic to kidneys. Because of inherent progression of chronic renal insufficiency, IRIS staging focuses on factors which, when managed, are known to slow progression. These are: azotemia, metabolic acidosis, hyperphosphatemia, proteinuria and hypertension.

Azotemia, metabolic acidosis and, to some degree, hyperphosphatemia are affected by hydration, thus optimizing hydration through the use of canned diets, adding water to food, encouraging drinking by use of flavoured liquids or a fountain along with the use of daily subcutaneous fluids are beneficial to the well-being of the patient. The patient should enjoy the diet offered, regardless of what illness he/she has. *It is always more important that they eat, rather than what they eat.* And the *amount consumed must be monitored*. This requires calculating the caloric requirements for each individual. 50 kcal/kg/day is a reasonable goal. By being made aware of how much food this is equivalent to, they can notify the veterinarian should the cat be eating less than that amount. This helps prevent confusion regarding weight loss associated with progressing disease vs. that associated with inadequate nutrient intake.

Returning to the cat in question, we do not know from the description (Stage 3 chronic kidney disease) whether the cat is proteinuric or not, nor what the phosphorus or potassium levels are. A protein-restricted diet (which one?) may be appropriate, but one of the other aforementioned diet types (protein enhanced, recuperative, growth, senior or maintenance) might be the correct diet for this individual. Just because someone has a specific illness does not automatically mean that the diet designed for that ***condition*** is the best diet for that ***individual***.

Every time we send home a therapeutic diet, we are performing a feeding trial with one subject in it (n=1). We have to get the cat back into the clinic and see how he/she is doing on that food. How is his weight? Increased? Decreased? How is his coat? Does he eat with enjoyment or vigour? What are his stools like (moist logs or dry pellets, cow patties or coloured water)? How energetic is he since he has been on this diet? Has there been a change in his PCV and proteins? In this case, have the BUN and Cr, the phosphorus and calcium or usg changed? Is he proteinuric and potentially protein deficient? What about his blood pressure? Have these parameters increased or decreased?

2. FEEDING FOR ARTHRITIS

What are the nutritional requirements for cat #2 who is thin and arthritic? Options include a mobility/joint die or, for weight gain, a kitten diet, a recuperative diet, or possibly a senior diet. Assuming that the physical examination and diagnostics do not reveal a cause for her weight loss, it is reasonable to try a variety of diets including all of above in case she has become bored with her food. The addition of omega-3 fatty acids appears to be beneficial as does supplementation with green-lipped mussel extract and glucosamine/chondroitin sulfate.

3. & 4. FEEDING GROWING CATS AND ELDERLY CATS

Young cats have growth requirements, which include an increased proportion of animal based protein and more calcium and phosphorus. The 4-month old kitten (#3) and the 2-year old healthy adult (#4) would ideally be fed a kitten diet and a maintenance diet respectively. Elderly cats over 12 years of age have been shown to have an increased need for protein, relative to adult cats. They also need more calories from fat than during their adult stage. In part this is because of a decreased ability to digest and absorb fat and protein.

5. FEEDING OBESE CATS

For the fifth cat, the 7-year old obese kitty with body condition score (BCS) 8/9 (or 4.5/5) the therapeutic strategies may include a high fiber diet, a high protein, low carbohydrate balanced diet, or a low fat diet.
Exceeding a cat's protein needs beyond maintenance requirements helps induce satiety. In a study by Laflamme et al, when cats were fed a diet with 45% of calories from protein, cats lost more fat and less lean mass compared with cats fed a diet with 35% of calories from protein, despite similar total weight loss and rate of weight loss.

Traditional belief holds that it is the calories ingested versus expended that is required for weight loss and that it doesn't matter which approach we choose, (making this cat very flexible) as long as the caloric intake is reduced, the diet is balanced, the cat isn't feeling deprived and pestering the client and the diet is balanced. Given the

benefits of achieving lean body mass by feeding a high protein diet, a goal of at least 40% protein, dry basis, in a low-fat diet (6% to 10% fat) is a healthy approach to take. Feeding closer a native, paleolithic high protein, lower carbohydrate diet may have hormonal benefits that favour lean, however this idea has not been proven.
The KEY is in determining how much the cat *should* weigh. The nutrition calculator at: http://petnutritionalliance.org is very helpful and is a simple way to calculate current intake and desired intake based on body condition score.

The thermic effect of food (TEF) refers to the energy cost of digesting and absorbing food. TEF is higher when meals are small and frequent, so feeding multiple small meals is preferable to feeding one or two large meals. One way to incorporate this into the diet—and give the cat a little challenge (and exercise)—is to divide the day's food into six or seven small portions, using feeding balls or placing it on saucers throughout the home as if the cat were on a "treasure hunt". This feeding strategy makes the cat less likely to gorge and entices him or her to look for more, all of which has a higher TEF cost.

Include the calories in the treats and supplements, people food and pill pockets that the kitty is being given when you figure out the quantity of food to recommend. As with the protein-restricted diets, the composition of therapeutic diets designed for weight loss are very different from each other.

6. FEEDING CATS WITH DIABETES
Cat #6 is the 10-year old diabetic. Feeding strategies include a high protein, low carbohydrate diet or a high fiber diet. However, a diabetic cat can be controlled with insulin as long as the diet and treats fed remain consistent from day to day.

Neither carbohydrates nor dry extruded diets are cause of diabetes or obesity. However, exchanging dietary carbohydrate for protein appears to be useful for weight loss treatment and management of non-insulin dependent diabetes in cats.

In a prospective, randomized, double blinded 10-week study (Hall et al), 12 cats (7/12 obese) of whom six were newly diagnosed and six were poorly controlled diabetics evaluated standard maintenance diet vs. lower carbohydrate, higher protein (LCHP) diets. The cats ate dry or canned based on their preference. All were treated with glargine and assessed at weeks 1, 2, 4, 6, and 10 with fructosamine, BG curve and clinical signs. One cat from each diet group achieved remission by week 10. All cats improved clinically, increased weight and achieved good glycemic control. Those fed the LCHP had a significantly greater decrease in fructosamine. The conclusion, based on this small study was that using insulin, "frequent monitoring is key to achieving glycemic control in diabetic cats; potential benefits of dietary modification require further evaluation". The author summarizes all of the preceding studies and approaches: high fiber & low fat, high insoluble fiber vs. low fiber, LCHP canned, low carbohydrate diet vs. low carbohydrate diet plus acarbose, low carbohydrate & low fiber diet vs. moderate carbohydrate & high fiber diet. None of these approaches appears to make a meaningful difference in the small numbers of cats in each study.

7. FEEDING FOR HYPERTHYROIDISM
Use of the effective but extremely low iodine-containing diet in a multi-cat household such as this is inappropriate.

8. FEEDING CATS WITH INTESTINAL SENSITIVITY
Our dietary choices for cat #8, the adult with the sensitive gastrointestinal tract and a diagnosis of "IBD" are either a limited antigen, a "hypoallergenic" or a hydrolyzed protein diet. Some cats may tolerate a highly digestible, low residue intestinal diet.

9.FEEDING CATS WITH PANCREATITIS
What diet is optimal for cats with pancreatitis is unclear. However, unlike dogs, there is no benefit to restricting protein. In some cases, feeding an intestinal diet, a limited antigen diet, or hypoallergenic diet similar as is indicated in cats with chronic enteropathies, is one reasonable approach. Another would be to feed a higher protein, lower carbohydrate, in other words, a paleolithic diet.

10. FEEDING CATS WITH DIET- RESPONSIVE SKIN ALLERGY
If diet is believed to be a component of allergic dermatitis, offering exclusively a hypoallergenic diet (or a limited antigen diet) is warranted.

11. FEEDING THE CONSTIPATED CAT
Constipation is, first and foremost, treated through rehydration. As long as cellular dehydration is present, the need will exist to resorb water from renal and gastrointestinal systems. Addition of fiber to the diet should be avoided until the patient is adequately hydrated. Use of enemas, promotility agents and laxatives prior to addressing this underlying problem is ineffective at best and has the potential for exacerbating the problem. Once that has been accomplished (or simultaneously to rehydration), once can focus on assisting the passage of the feces by mechanical or pharmacologic means.

Soluble fibers are helpful in diarrhea; insoluble fibers are beneficial for constipation. Dietary fiber is a combination of soluble and insoluble fibers. Recently a dry diet enhanced with psyllium has been marketed for the treatment of constipation. Along with rehydration, feeding this diet alleviated obstipation in cats with megacolon allowed them to cease medication, avoid surgery or euthanasia. Another approach is to reduce fiber feeding a low residue diet.

12. & 13. FEEDING CATS WITH LOWER URINARY TRACT DISEASE
Ensuring that urine is in a neutral pH and stays dilute enough so that mineral components don't come out of solution (i.e., urine remains undersaturated) will help reduce the chance of either CaOx or struvite crystals from forming.

14. FEEDING FOR HEPATIC LIPIDOSIS
The most important thing is that the cat gets adequate calories without restricting protein. Lipidosis is a disorder of lipoprotein metabolism. Additionally, L-carnitine, S-adenosylmethionine, B vitamins and taurine may be supplemented. If the cat has an esophagostomy tube in place, ensuring nutrition is easy if kitty isn't eating enough on his/her own.

NOTE: For **all** cats in the household:
Make sure that **water**, the most important nutrient, is readily accessible. Have lots of water stations around the home. They should be in places other than the "kitchen" as well, so that cats don't have to compete and because cats like to eat and drink in different places.

BASELINE DIET
The first of the two goals for feeding a multi-cat household is to achieve a feeding strategy that puts no one at risk nutritionally having the base/common ground diet available to everyone. Of these twelve cats, the one at greatest risk if fed the wrong diet is the cat with "IBD". If the cat with renal disease were in IRIS stage 4, he may well be the most delicate, but just getting adequate calories into a uremic cat becomes the main concern at that point and placing a feeding tube would allow us to deliver an appropriate diet. We would also have to think about a different strategy for restricting access to other diets if he were feeling well enough to be roaming the house. If he is hyperphosphatemic as well as being in stage 3, using intestinal phosphate binders is a viable and necessary alternative to using a restricted protein diet as the baseline, everyone eats, diet. (He can still get the restricted protein diet twice a day.)

SUPPLEMENTING REQUIREMENTS
The second goal is to meet the individual nutritional needs of each member of the household as closely as possible twice a day "behind closed doors". Certainly the "IBD"-safe diet can be left out during the day for all cats to eat. Twice daily all cats other than the cat with gastrointestinal disease, can be placed in separate rooms to be supplemented with their different or additional needs. This requires analysis of the clowder's needs as well as their personalities and physical abilities. The elderly cat who is less able to jump can be prevented from eating the food of an agile youngster if the growth diet is placed high up. An overweight cat can be prevented from getting to any food other than that designed for weight loss (the base diet) by putting a latch on a door, building a creep feeder or using a "keyed" cat flap (such as one that responds to the cats' pre-existing microchips: www.sureflap.ca) so

only the thinner cats can get through the narrower space. Treasure hunts using small quantities of food as well as feeding balls (which some cats won't want to us) will also help. Figuring out creative strategies to use based on the strengths and weaknesses of the individuals is an intriguing challenge and needs to take the cats' physical, personality and nutritional profiles into consideration.

Reducing stress in the multi-cat household must always be a focus. Cats are social but with strict social rules and restrictions to keep distance in order to avoid confrontation. Recognizing the environmental needs is extremely important. Ellis writes eloquently about this. http://www.catvets.com/guidelines/practice-guidelines/environmental-needs-guidelines.

KEY POINTS

1) Don't assume that a diet designed for a particular clinical condition is necessarily the best diet for every cat with that condition.
2) The quantities to be fed listed in product guidelines are a starting point. Each cat is different.
3) Monitor the clinical response of the individual patient to the dietary *prescription*.

SUGGESTED READING:

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- WSAVA Global Nutrition Guidelines https://www.wsava.org/Guidelines/Global-Nutrition-Guidelines (accessed October 11, 2018) for Body and Muscle Condition Scoring and for Nutrition Assessment.