Chapter 21

Feeding Mature Adult Cats: Middle Aged and Older

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"Every life should have nine cats."
Anonymous

CLINICAL IMPORTANCE

More pet cats are getting older. Thirty-five percent of cats in the United States are at least seven years of age (Lund et al, 1999). The number of pet cats older than six years in the U.S. nearly doubled (from 24 to 47%) over a recent decade (Stratton-Phelps, 1999). Similarly, in Europe, the number of cats older than seven years increased by 100% between 1983 and 1995 (Kraft, 1998). For the purposes of this chapter, the term "mature" indicates cats that are seven to eight years old and older. It includes cats that could be considered "middle-aged," "senior" and "geriatric."

Age-related diseases begin to increase in prevalence around seven or eight years of age; this prevalence is coupled with the gradual onset of behavioral, physical and metabolic changes related to aging (Lund et al, 1999). Instituting appropriate changes in nutritional management and preventive care at this point are important to reduce risk factors for common age-associated diseases (Table 20-1), thereby helping to maintain good health and maximize longevity. Furthermore, a cat's chronologic age may not accurately reflect its physiologic age (e.g., an eight-year-old cat with kidney disease and poor nutritional status is likely to be "physiologically older" than a healthy 11-year-old cat).

This chapter builds on many of the recommendations in Chapter 20 for feeding young adult cats. The minimum nutrient requirements of mature adult cats are similar to those of young adult cats. The few studies evaluating the effects of aging on the nutritional needs of cats have shown minimal changes in nutrient requirements. Therefore, nutritional recommendations for mature adult cats are based on risk factor management, extension of learning from other species and prudence. Several key nutritional factors for mature adult cats, however, are lower than the recommended upper range for young adults. To date, the only nutritional modification proven to slow aging and increase the lifespan is caloric restriction. Reducing caloric intake by 20 to 30% of normal, while meeting essential nutrient needs, slows the aging process and decreases susceptibility to cancer, renal disease, arthritis and immune-mediated diseases in animal models studied (Sheffy and Williams, 1981; Kealy et al, 2002). This level of caloric restriction is difficult to achieve in the long term and has not been incorporated into mainstream nutritional advice.

Older mature cats become less active and have reduced lean body mass. Together, these changes reduce their basal metabol-

Table 21-1. Common physiologic changes and diseases associated with aging in cats.*

Body systems/functions	Age-related changes	Associated conditions and diseases
Metabolism	Decreased thirst sensitivity	Dehydration
	Decreased thermoregulation	Hypothermia or hyperthermia
	Decreased immunocompetence	Susceptibility to infections, disease and cancer
	Decreased rate of drug metabolism	Drug intolerance
	Increased sleep	Irritability
	Decreased activity and metabolic rate	Loss of body mass, reduced BMR and obesity
Special senses	Decreased olfaction	Reduced food intake and weight loss
	Decreased taste perception	Reduced food intake and weight loss
	Decreased hearing	
	Decreased visual acuity	
Oral cavity	Decreased salivary secretion	Increased oral disease
	Increased tooth loss, dental calculus	Painful or difficult prehension
	Increased periodontal disease	Reduced food intake and weight loss
		Susceptibility to sepsis and end-organ damage
Gastrointestinal	Decreased liver function	Reduced nutrient assimilation
	Increased cellular infiltrates	
	Decreased digestive function	Reduced nutrient digestibility
	Decreased colonic motility	Constipation
	Decreased pancreatic function	Reduced nutrient digestibility
Endocrine	Decreased pancreatic function	Glucose intolerance and diabetes mellitus
	Decreased adrenal function	Reduced ability to respond to stress
	Alterations in thyroid structure and function	Hyperthyroidism
Integumentary	Loss of elasticity, dry, thin coat, hyperplasia of sebaceous glands with decreased sebum and increased waxy secretions	Dermatitis Intradermal cysts Dry, flaky coat
Urinary	Decreased total renal function	Chronic renal failure Hypokalemia
	Alterations in acid excretion	Decreased acid-base regulation Metabolic acidosis
Reproductive	Testicular tumors and atrophy, mammary gland nodules	Reproductive gland neoplasia
	Irregular estrous cycles	Reproductive failure
	Decreased conception rates	Pyometra
	Cystic endometrial hyperplasia	
Musculoskeletal	Decreased lean mass and tone	Decreased BMR, weakness, decreased activity
	Decreased bone mass	Osteoarthritis, spondylosis
	Degenerative joint changes	
Cardiovascular	Decreased cardiac output, increased peripheral resistance, hypertension	Cardiomyopathy, valvular regurgitation Hypertension and end-organ damage
	Valvular thickening	
Respiratory	Reduced vital capacity and compliance	Chronic respiratory disease
	Increased respiratory rate and residual air capacity	
Nervous	Alterations in neurotransmitter levels	Senility
	Progressive decline in cellularity of nervous tissues	Decline in special senses
	Decreased reactivity to stimuli and cognition decline	Behavioral changes

Key: BMR = basal metabolic rate.
*As in any biologic system there is much individual variation. An individual aging animal may have few to many of these changes. Also, the age at which changes occur, and their severity, is quite variable.

ic rate. Additionally, changes occur in virtually all body systems. Age-associated changes in physiologic function include reduced digestive function, immune response, glucose tolerance, renal function, smell, taste perception and numerous other changes (**Table 21-1**) (Harper, 1996; Markham and Hodgkins, 1989; Cowan et al, 1998). Not all cats develop all age-associated changes nor will the changes that develop necessarily occur in any predictable sequence. Aging cats become less adaptable and have reduced physiologic reserve to withstand perturbations in their health and environment, including changes in their food. Older cats age at different rates; thus, greater diversity exists in individual needs than at any other lifestage. Individualization of nutritional management becomes even more important because of the reduced adaptability of older mature adult cats. The goals for nutritional management of mature adult cats are:

- Maintenance of optimal nutrition (i.e., maintenance of ideal body condition and weight, adequate intake of a nutritious food and good hydration).
- Risk factor management (i.e., minimization of associated disease risks [Table 20-1]).
- Disease management (i.e., amelioration of clinical signs of common diseases, slowing progression of certain chronic diseases).

• Improvement in the quality and length of life.

This chapter describes how to assess mature adult cats and how to determine and meet their nutritional needs.

PATIENT ASSESSMENT

History and Physical Examination

A complete history should be taken and physical examination performed as described for young adult cats (Chapter 20). Physiologic changes associated with aging and age-related diseases are of particular interest. Note any changes in appetite, food or water intake, activity, oral health and body condition. Abnormalities in these parameters are often early indicators of underlying disease. Oral disease is the most prevalent disease in adult cats; however, weight loss, cancer, renal disease, cardiac disorders, diabetes mellitus and hyperthyroidism are frequently diagnosed in this age category. Kidney disease may affect nearly 30% of older mature adult cats and is a major cause of death (MAF, 1998; Lulich et al, 1992). Physical evaluation of renal size, shape and firmness may uncover kidney abnormalities, whereas thoracic auscultation may expose cardiac disease. Hyperthyroidism may be detected by palpating enlarged thyroid glands or may be suspected based on the history and other physical findings. A fundic examination may help detect hypertension, which is often secondary to renal, cardiac or thyroid disease in older mature adult cats. Retinal hemorrhage was a common finding in a group of older hypertensive cats (Littman, 1994).

Laboratory and Other Clinical Information

Specific abnormalities in the physical and historical examination should be pursued further using appropriate diagnostic procedures. A geriatric-type blood panel to screen for common age-associated diseases should be performed at least annually. The minimum database should include a complete blood count, urine specific gravity and sediment examination and a serum biochemistry profile. The biochemistry panel should include measurements of albumin, globulin, urea nitrogen, creatinine, glucose, alkaline phosphatase, alanine aminotransferase, calcium, potassium, phosphorus, sodium, chloride and bicarbonate. Serum total thyroxine (T_4) concentrations should be assessed if clinical or biochemical abnormalities suggest hyperthyroidism. Feline leukemia and feline immunodeficiency virus testing should be current and repeated if potential exposure has occurred or suspicious clinical signs are present. Specialized diagnostics may be indicated by physical and/or biochemical findings (e.g., electrocardiography, ultrasonography, radiography, blood pressure monitoring).

Key Nutritional Factors

The recommended range of nutrient allowances can be optimized to support changes in physiologic function and reduce risk factors for common age-related diseases. **Table 21-2** summarizes key nutritional factors for mature adult cats.

Table 21-2. Key nutritional factors for foods for older cats.

Factors	Recommended food levels*	
	Normal and underweight	Inactive/ obese prone
Energy density (kcal ME/g)	4.0-4.5	3.5-4.0
Energy density (kJ ME/g)	16.7-18.8	14.6-16.7
Fat (%)	18-25	10-18
Fiber (%)	≤5	5-15
Protein (%)	30-45	30-45
Calcium (%)	0.6-1.0	0.6-1.0
Phosphorus (%)	0.5-0.7	0.5-0.7
Sodium (%)	0.2-0.4	0.2-0.4
Potassium (%)	≥0.6	≥0.6
Magnesium (%)	0.05-0.1	0.05-0.1
Average urinary pH	6.4-6.6	6.4-6.6
Antioxidants		
Vitamin E (IU/kg)	≥500	≥500
Vitamin C (mg/kg)	100-200	100-200
Selenium (mg/kg)	0.5-1.3	0.5-1.3
VOHC Seal of Acceptance	Plaque control	Plaque control

Key: ME = metabolizable energy, VOHC = Veterinary Oral Health Council (Chapter 47).
*Dry matter basis. Concentrations presume an energy density of 4.0 kcal/g. Levels should be corrected for foods with higher energy densities. Adjustment is unnecessary for foods with lower energy densities.

Water

Water is an often overlooked but critical nutrient in the health of mature adult cats. Aging impairs thirst sensitivity, which is already low in cats compared with other species (MacDonald et al, 1984; Markham and Hodgkins, 1989). Additionally, the decline in renal function observed in many mature adult cats may increase water losses due to impaired urine concentrating ability. Together, these characteristics predispose older cats to dehydration. Chronic dehydration can impair normal metabolic processes and exacerbate subclinical disease. Dehydration also reduces a cat's ability to thermoregulate. Water intake in healthy cats without increased losses is 200 to 250 ml per day (Burger and Smith, 1987). This intake comes from a combination of free water, metabolic water and water contained in food. Changing to a moist food or adding water to the food (moist or dry) can increase water intake. Offering low-salt broth, meat juices and "pet drinks" have been advocated to enhance water consumption; however, the long-term effectiveness of these strategies is unknown. Clean fresh water should be available at all times and readily accessible to further encourage water intake.

Energy

Reductions in lean body mass, basal metabolic rate and physical activity decrease energy requirements as animals age (Sheffy and Williams, 1981; Taylor et al, 1995). In many species, the decrease in lean body mass is counterbalanced by an increase in total body fat such that obesity becomes more prevalent with age (Armstrong and Lund, 1996; Sheffy and Williams, 1981). However, studies reveal the prevalence of obesity plateaus and then declines in cats after seven years of age, whereas the preva-

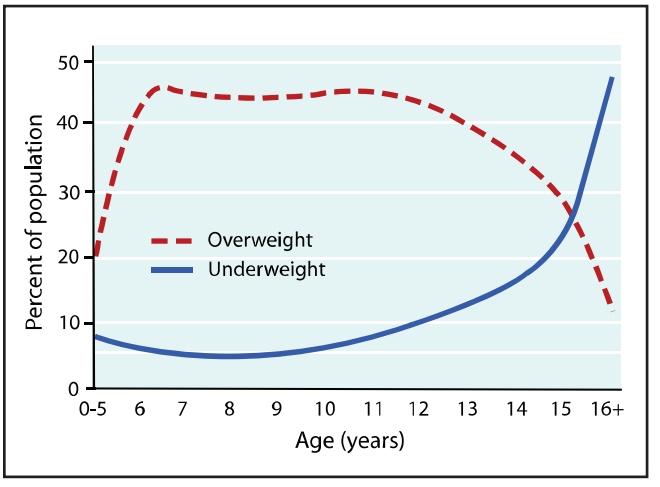

Figure 21-1. Proportion of overweight (body condition score [BCS] 4/5 or 5/5) and underweight (BCS 1/5 or 2/5) cats. Note that six- to 12-year-old cats are commonly overweight, whereas cats over 12 years old are at greater risk of being underweight. (Adapted from Armstrong PJ, Lund EM. Changes in body composition and energy balance with aging. Veterinary Clinical Nutrition 1996; 3: 83-96.)

lence of underweight cats increases dramatically after 11 years of age (**Figure 21-1**) (Scarlett et al, 1994; Armstrong and Lund, 1996). This observation may be explained by the high occurrence of disease in this age group, reduced food intake due to impaired appetite or sensory function, an age-related decline in food digestion or assimilation or a combination of these factors. Although the prevalence of obesity declines after seven years, a significant proportion of mature adult cats remain overweight (**Figure 21-1**). Both obesity and cachexia significantly increase the risk of mortality in cats over eight years of age, with obese cats nearly three times as likely to die as cats of optimal weight (Scarlett and Donoghue, 1997). Therefore, it is critical to recommend foods and feeding methods that will achieve optimal weight and body condition in individual mature cats.

In a study of healthy cats, energy intake declined slightly until approximately 10 years of age. However, a sharp increase in food intake was observed in cats 12 years and older (Taylor et al, 1995). In another study, the energy requirement of cats also decreased with age through approximately 11 years; likewise, the energy needs of these cats increased at approximately 12 years onward (Laflamme and Ballam, 2002). A 10% reduction in fat digestibility was responsible for a similar reduction in total food digestibility in the cats 12 years and older mentioned in the first study (Taylor et al, 1995). The digestibility of dietary fat declined significantly with age, whereas protein and carbohydrate digestibility remained unchanged. Thus, reduced fat digestibility in these mature cats was offset by increased food intake; as a result, digestible energy intake was not different between age groups (Harper, 1996). A later study also found an age-related decrease in ability to digest fat that involved about one-third of cats over 12 years of age (Perez-Camargo, 2004). From these studies, it is unclear if changes in the metabolic rate of older cats are compensated for by a reduction in fat digestion, or if older cats simply compensate for impaired digestion by consuming more food. The latter seems more likely based on observations that weight loss is more prevalent than obesity in very old cats. A decline in pancreatic enzyme secretion is a common physiologic change associated with aging in many species and could be expected to reduce digestibility of dietary fat. In addition, hepatic changes seen in older mature cats may influence nutrient assimilation (Armstrong and Lund, 1996). Based on these studies, the energy density of foods formulated for mature cats should be between 3.5 to 4.5 kcal/g (14.6 to 18.8 kJ/g) dry matter (DM), depending on their predisposition to be overweight and caloric intake may have to be restricted. Inactive/obese-prone cats should be fed foods with lower energy density (3.5 to 4.0 kcal/g [14.6 to 16.7 kJ/g] DM). Normal and underweight cats should be fed energy-dense foods (4.0 to 4.5 kcal/g [16.7 to 18.8 kJ/g] DM) and caloric intake should not be restricted, except to prevent or treat obesity.

Reasonable estimates of caloric needs in mature adult cats are 1.1 to 1.4 x resting energy requirement (RER) (55 to 70 kcal/kg body weight [230 to 293 kJ/kg body weight]), with more active or underweight cats needing up to 1.6 x RER (80 kcal/kg body weight [344 kJ/kg body weight]) (Taylor et al, 1995). Obese cats can be managed with standard weight-control programs appropriate for adult maintenance (Chapter 27).

Fat

Although weight loss is prevalent in very old cats, obesity still affects a large portion of the mature adult cat population (**Figure 21-1**) (Armstrong and Lund, 1996; Lund et al, 2005). Certain diseases associated with obesity are also common in these cats (e.g., diabetes mellitus, hypertension and heart disease). Additionally, the risk of death increases nearly threefold in older obese cats (i.e., eight to 12 years) (Scarlett and Donoghue, 1997; Markham and Hodgkins, 1989; Kirk and Toll, 1996). Moderate to low levels of fat are indicated to reduce the risk of obesity (Scarlett et al, 1994; Hand et al, 1989). However, very old cats need energy-dense foods and ample levels of essential fatty acids. Essential fatty acids (i.e., linoleic, arachidonic and possibly linolenic) help maintain normal skin and coat condition. As animals age, they tend to lose skin elasticity, develop epidermal and follicular atrophy and have reduced sebum secretion (Markham and Hodgkins, 1989). Markedly reducing dietary fat (i.e., calorie-restricted or "light" foods) is not recommended for older mature adult cats unless they are obese prone. Fat should be highly digestible in foods intended for older cats. As discussed above, fat digestion declines with age, which may account for the weight decline noted in very old cats (Taylor et al, 1995). Dietary fat improves food palatability and contributes significantly to energy density. Therefore, maintaining moderate fat concentrations improves food and caloric intake in older mature adult cats and enhances absorption of fat-soluble vitamins (Kane et al, 1981). The recommended range for fat content in foods for mature adult cats is 10 to 25% DM, depending on whether or not they are prone to obesity. Foods for cats that are inactive or prone to obesity should contain 10 to 18% DM fat and foods for cats that are normal or underweight should contain 18 to 25% DM

fat. Foods with lower fat levels are recommended for obese-prone cats, and foods with higher fat levels should be fed to thin cats (body condition score <2.5/5) and cats with poor appetites. Essential fatty acids should be provided at levels at or above those recommended for young adult cats (Chapter 20).

Fiber

Fiber facilitates gastrointestinal health by a variety of mechanisms. Dietary fiber promotes normal intestinal motility and provides nutrition (i.e., volatile fatty acids) for colonocytes due to fermentation by colonic microbes. Feeding small amounts (i.e., <5%) of soluble and insoluble fiber can attain these desirable effects. Promoting intestinal motility may benefit cats with constipation (Markham and Hodgkins, 1989). Constipation is common in older cats due to reduced water intake, limited activity and reduced colonic motility. Although fiber should not be the sole factor for managing constipation, it is beneficial when provided regularly. Dietary fiber also benefits the management of obesity, diabetes mellitus and hyperlipidemia (Hand et al, 1989; Nelson and Lewis, 1990; Nelson et al, 1994; Bauer, 1992) (Chapters 27 through 29).

Increased levels of dietary fiber (5 to 15%, DM) reduce food DM digestibility and dilute caloric density; such levels are recommended for foods for inactive cats and cats that are prone to obesity. Normal and underweight cats should receive foods with increased energy density; thus, lower levels (≤5% DM) of dietary fiber are recommended.

Protein

Dietary protein should not be restricted in apparently healthy mature adult cats. Adequate protein and energy intake are needed to sustain lean body mass, protein synthesis and immune function. Besides increasing protein intake, another approach to influencing body composition (i.e., preventing loss of lean body mass in older cats), is increasing the dietary lysine-calorie ratio (**Box 21-1**). Although controversial, the protein needs of older patients may be somewhat greater than those of young adults (Wannemacher and McCoy, 1966; Carter, 1991). The recommended daily protein allowance for elderly people is increased by 25% above that for adult maintenance. The minimum recommended allowance for DM protein for adult cats is 20% (NRC, 2006). The equivalent increase in the minimum protein allowance for cats results in 25% DM protein. The minimum recommended protein allowance for healthy older cats fed commercial foods is further increased to 30% of the food DM to allow for variable digestibility and protein quality of food ingredients. An additional benefit to maintaining this moderate protein concentration in foods for older mature adult cats is the palatability-enhancing effect of animal protein, which may conceivably improve food intake and weight maintenance in very old cats. However, the long-term effects of feeding foods with high dietary protein levels to healthy cats are still largely unknown. High-protein foods have been associated with increased bone loss and increased formation of urinary calcium oxalate crystals in people (Barzel and Massey, 1998; Reddy et al, 2002). In cats, high-protein foods have been implicated in the progression of renal failure (Polzin et al, 1996). Protein restriction in foods for older cats has been advocated because of the high prevalence of renal disease in this age group (Taylor et al, 1995; Lulich et al, 1992) and the knowledge that renal failure is rarely diagnosed until at least three-fourths of renal function is lost. The potential benefits of this restriction include a delay in age-related renal impairment and slowed progression of subclinical renal disease. In one study, investigators examining the effect of protein-calorie restriction in cats following five-sixths nephrectomy observed a reduction in proteinuria and glomerular injury in cats fed reduced-protein foods (27.6% DM) compared with high-protein foods (51.7% DM) (Adams et al, 1993). A secondary finding was an increased occurrence of hypokalemia in cats fed the high-protein food (Adams et al, 1993). However, a subsequent study demonstrated no change in renal pathology following protein restriction and a slight benefit (i.e., reduced cellular infiltrates and tubular lesions) to caloric restriction (i.e., 56 kcal/kg body weight [low-calorie group] vs. 75 kcal/kg body weight [high-calorie group]) (Finco et al, 1998). Unfortunately, these studies may not be directly comparable because the dietary protein sources were markedly different. Thus, there is no clear consensus about the role of protein reduction in slowing progression of clinical or subclinical feline renal disease (Polzin et al, 2005). Healthy older cats should receive sufficient protein to adequately meet protein needs and avoid protein-calorie malnutrition. Improving protein quality without increasing protein intake can fulfill any additional protein needs of older cats. Until further research defines an optimal range of dietary protein for older cats, moderate levels of dietary protein (30 to 45% DM) are recommended.

Calcium and Phosphorus

After skeletal growth is complete, the nutritional requirement for calcium and phosphorus declines to levels needed by adult

Box 21-1. The Dietary Lysine-Calorie Ratio and Lean Body Mass of Geriatric Cats.

Besides increasing protein intake, another approach to influencing body composition (i.e., preventing loss of lean body mass) in older cats is the dietary lysine-calorie ratio. The lysine-calorie ratio affects body composition in swine and appears to do so in older cats. In a study involving older mature adult cats (>12 years old), increasing the dietary lysine-calorie ratio was correlated with variation in lean body mass. As the lysine-calorie ratio increased, loss of lean body mass was reduced. Cats fed a food with 36% dry matter (DM) protein and a lysine-calorie ratio of 6.30:1 maintained body weight and lean mass similar to that seen with a higher protein food (45% DM) that had a lower lysine-calorie ratio (4.38:1). Such nutritional technologies might hold promise for foods for older mature adult cats.

The Bibliography for **Box 21-1** can be found at www.markmorris.org.

Table 21-3. Most common causes of mortality in cats.*

Cause of death	Proportion of deaths (%)
Cancer	35
Kidney disease	24.9
Heart disease	10.7
Diabetes mellitus	7.6

*MAF (Morris Animal Foundation). Animal health survey: Top four causes of death as reported by owners. Denver, CO. 1998.

cats and is thought to remain relatively constant for life. Unlike the situation in people, osteoporosis is not commonly diagnosed in old cats. Nevertheless, the bone mass of adult cats remains stable until seven years of age and then declines (Jewell et al, 1996). The reason for the decline has not been elucidated but is presumably related to the loss of lean and total body mass that occurs with aging. With loss of body mass, less bone mass is required for structural support. Alternatively, bone loss resulting from buffering chronic elevations of metabolic acids cannot be ruled out. Older cats have been reported to maintain a greater metabolic acid load and a significantly lower urinary pH compared with young adult cats (Lawler and Ballam, 1996; Smith et al, 1997). Interestingly, a lower urinary pH (i.e., higher metabolic acid load) is also a risk factor for development of calcium oxalate urolithiasis, which is most prevalent in older cats (Thumchai et al, 1996; Kirk et al, 1995). Mature adult cats should receive foods with moderate levels of available dietary calcium (0.6 to 1.0%, DM) to help maintain bone mass and possibly reduce the risk of calcium oxalate urolithiasis.

In contrast to the moderate calcium needs during aging, reduction of dietary phosphorus is commonly recommended in foods designed for mature adult cats. The recommendation is predicated on the fact that nearly 30% of older cats may have kidney disease (Lulich et al, 1992). Furthermore, in a survey of pet owners, kidney disease was the second leading cause of nonaccidental death in cats (**Table 21-3**) (MAF, 1998). Renal insufficiency is rarely diagnosed until significant loss of renal function has occurred. Thus, large proportions of older cats have subclinical renal damage and may benefit from reduced dietary phosphorus. It is commonly accepted that phosphorus restriction slows the progression of renal disease in cats (Chapter 37). Phosphorus reduction helps decrease: 1) the renal excretory workload, 2) phosphorus retention, 3) renal secondary hyperparathyroidism and 4) the subsequent renal mineralization in cats with chronic renal insufficiency (Ross et al, 1982; Polzin et al, 1996). Therefore, in the early nutritional management of renal disease in cats, phosphorus levels should be reduced from those typically found in commercial foods (Brown et al, 1997). Slowing progression of early renal disease in affected older cats should increase longevity (Ross et al, 2006). Phosphorus may be reduced to as low as 0.3% of the food DM for cats with overt renal disease, otherwise the general population of mature adult cats should be fed foods containing 0.5 to 0.7% DM phosphorus. Although adult cats appear to be remarkably tolerant to perturbations in dietary calcium-phosphorus ratios (Kealy et al, 1996), a ratio between 0.9:1 to 1.1:1 maximizes availability (Scott and Scott, 1967) and ratios between 0.9:1 to 1.5:1 are recommended.

Sodium and Chloride

Avoiding excessive sodium intake to reduce risk factors appears even more important in older cats than in young adult cats. Although the sodium and chloride requirements of older cats are not likely to be different from those of young adults, the prevalence of chronic diseases associated with hypertension (e.g., renal disease, hyperthyroidism, cardiac disease) increases with age. The exact prevalence of secondary hypertension in the feline population is unknown, but it appears highest in older cats. In one study, systolic arterial pressures were significantly higher in older cats (Lawler et al, 1996). Furthermore, hypertension affects 60 to 65% of cats with renal disease and 23% of cats with hyperthyroidism (Ross, 1992; Kobayashi et al, 1990; Stiles et al, 1994). Chronic hypertension results in end-organ damage and progression of renal and cardiac disease; therefore, control of risk factors for "salt-sensitive" individuals is desirable. Unfortunately, accurate monitoring of blood pressure in all feline patients is uncommon and hypertension is rarely diagnosed until clinical signs are evident. Therefore, nutritional needs for sodium and chloride should be met, but excesses should be avoided.

Supplemental sodium chloride is used in commercial foods to reduce the occurrence of feline lower urinary tract disease (FLUTD) by increasing water intake. A long-term study (three months) evaluated the safety of salt supplementation (1.1 vs. 0.35% sodium and 0.7 vs. 2.06% chloride, DM) in normal, obese, aged cats and cats with preexisting kidney disease. In this study, none of the cats were hypertensive and blood pressure was unaffected when they were fed the high sodium chloride food. However, cats with preexisting kidney disease fed the salt-supplemented food had increased serum urea nitrogen, phosphorus and creatinine concentrations, suggesting progressive deterioration of renal function. Because many apparently healthy cats can have undetected renal dysfunction based on results of routine serum biochemistry screening, the risks associated with feeding high-salt foods to reduce the occurrence of FLUTD outweigh the benefits (Kirk et al, 2006).

Furthermore, in addition to possibly exacerbating hypertensive disorders and contributing to the progression of preexisting renal disease, high dietary sodium reportedly enhances urinary calcium excretion (Osborne et al, 1992), particularly in cats with impaired renal function (Kirk et al, 2006). This may explain the common occurrence of calcium oxalate uroliths in cats with kidney disease. Thus, sodium excess, particularly in the form of sodium chloride, should be avoided.

Regulation of acid-base homeostasis and normal plasma osmolality depends, in part, on adequate sodium and chloride intake. Deficiencies of sodium and chloride can have deleterious effects in older cats; therefore, over restriction should be avoided. The minimum dietary allowance of sodium for adult cats is 0.068% DM (NRC, 2006). The Association of American Feed Control Officials (AAFCO) recommends an

intake of 0.2% of the food DM, or almost threefold the minimum recommended allowance (2007). Some commercial moist foods exceed 1.0% DM sodium or almost 15 times the minimum recommended allowance. Sodium intake at this level is markedly above that needed for optimal health. The recommended range for dietary sodium for mature adult cats is 0.2 to 0.4% DM.

Chloride is now recognized as a co-determinant in salt-sensitive hypertension; thus, control of dietary excess is also important (Kurtz et al, 1987; Kotchen et al, 1987) (Chapter 36). Unfortunately, little information is available about the chloride requirement of cats. The minimum recommended allowance for dietary chloride is 0.096% DM (NRC, 2006); however, more typically, chloride values are approximately 1.5 times the concentration of sodium.

Potassium

The potassium requirement for older cats is thought to be greater than that for young adult cats. This impression comes from anecdotal reports of low serum potassium levels and improved attitude, appetite, muscle strength and renal function following oral potassium supplementation in older cats. However, the potassium requirement of healthy older cats has not been determined and an increased need remains speculative. Nevertheless, factors common in mature adult cats that support the need for increased dietary potassium include: 1) kaliuresis as a result of kidney disease, high dietary protein or high metabolic and/or dietary acid load, 2) reduced food intake and 3) increased intestinal loss. Mature adult cats with normal appetite and renal function probably do not benefit significantly from increased dietary potassium levels. However, hypokalemia can cause signs ranging from mild lethargy to marked polymyopathy and nephropathy. Thus, increasing dietary potassium to support moderate losses may benefit some older cats. Levels as low as 0.3% resulted in hypokalemia when provided in high-protein or acidified foods (DiBartola et al, 1993). The minimum recommended allowance for potassium in foods for adult cats is 0.52% DM (NRC, 2006). Dietary potassium levels for foods for mature adult cats should be at least 0.6% DM.

Magnesium

Increased losses of magnesium, similar to those seen with potassium, may affect magnesium balance in older cats. Hypomagnesemia has also been associated with refractory hypokalemia, particularly in cats with diabetes mellitus (Dhupa, 1995). The benefit of limiting dietary magnesium in cats is a reduced risk of struvite-mediated lower urinary tract disease. However, the risk of struvite-mediated disease is low in older cats (**Figure 21-2**) (Bartges, 1996). Furthermore, foods containing very low levels of magnesium have been associated with the development of calcium oxalate uroliths in an epidemiologic survey of cats (Thumchai et al, 1996) and deficiency increases risk of urolith formation in rats (Su et al, 1991). Therefore, magnesium should be provided at moderate levels (0.05 to 0.1% DM) and severe magnesium restriction should be avoided (<0.04% DM). The minimum recommended allowance for foods for adult cats is 0.04% DM (NRC, 2006).

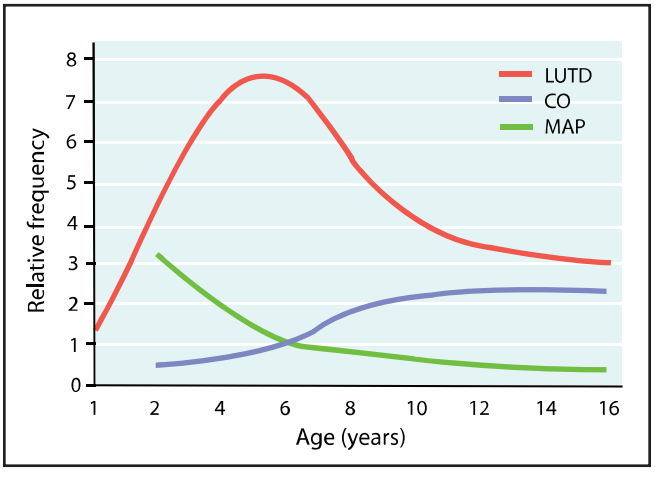

Figure 21-2. Relative frequency of feline lower urinary tract disease (LUTD), struvite (magnesium ammonium phosphate, MAP) urolithiasis and calcium oxalate (CO) urolithiasis in cats of varying age. Note that LUTD is most common in adult cats, struvite urolithiasis is most common in adult cats less than six years old and calcium oxalate urolithiasis is most common in cats over six years old. (Adapted from Bartges JW. Lower urinary tract disease in older cats: What's common, what's not. Veterinary Clinical Nutrition 1996; 3: 57-62. Thumchai R, Lulich JP, Osborne CA, et al. Epizootiologic evaluation of urolithiasis in cats: 3498 cases (1982-1992). Journal of the American Veterinary Medical Association 1996; 208: 547-551.)

Urinary pH

Older cats frequently have clinical or subclinical renal disease that may impair their ability to compensate for acid-base alterations resulting from metabolic and dietary influences. In a study in which cats were fed a food with higher urinary acidifying potential (pH 6.39 vs. 6.6 in the control food), older cats lost more weight, had lower red cell counts and had greater systemic acid loads than younger cats (Lawler and Ballam, 1995). This observation, combined with the reduced risk of struvite urolithiasis, increased risk of calcium oxalate urolithiasis and high frequency of kidney disease in older cats, supports the theory that foods fed to older cats should have a lower urine acidifying potential (i.e., higher published urinary pH averages) than foods for young adult cats. A safe range of measured urinary pH values in mature adult cats is between 6.4 and 6.6.

The acidifying potential of commercial foods for older cats is not typically tested despite the fact that older cats generate a significantly lower urinary pH than younger cats fed the same foods (Smith et al, 1997). To achieve a normal urinary pH, the acidifying potential of foods for mature adult cats should be lower than that of foods for young adult cats. Published urinary pH averages should be greater for foods for older cats than for foods for young adults, unless the foods have been specifically tested in old or very old cats and found to be safe. Providing food with less acidifying potential helps avoid metabolic acidosis and its complications in older cats (Thumchai et al, 1996; Kirk et al, 1995).

Table 21-4. Comparison of recommended levels of key nutritional factors for foods for mature adult cats (normal/underweight and inactive/obese prone) with levels in selected commercial foods.*

Dry foods	**Energy density (kcal/cup)****	**Energy density (kcal ME/g)**	**Fat (%)**	**Fiber (%)**	**Protein (%)**	**Ca (%)**	**P (%)**	**Na (%)**	**K (%)**
Recommended levels (normal/underweight)	**–**	**4.0-4.5**	**18-25**	**≤5**	**30-45**	**0.6-1.0**	**0.5-0.7**	**0.2-0.4**	**≥0.6**
Hill's Science Diet Adult Oral Care	337	4.2	22	7.5	34.1	0.82	0.75	0.37	0.69
Hill's Science Diet Mature Adult Hairball Control	326	4.0	20	8	34	0.86	0.70	0.39	0.80
Hill's Science Diet Mature Adult Indoor	326	4.0	20.1	8	34	0.86	0.71	0.39	0.81
Iams Eukanuba Senior Mature Care	414	4.1	19.0	2.0	39.5	1.39	1.12	0.43	0.85
Nutro MAX Cat Senior Roasted Chicken Flavor	359	3.9	14.3	2.2	31.9	1.10	0.99	0.38	0.66
Nutro Natural Choice Complete Care Senior Cat Food	329	4.0	16.5	2.7	34.1	1.10	1.04	0.44	0.66
Purina Cat Chow Vitality 7+ Formula	397	4.1	13.7	5.4	37.6	1.49	1.32	0.40	0.71
Purina ONE Vibrant Maturity 7+ Senior Formula	437	4.4	16.0	1.7	42.0	1.65	1.39	0.48	0.90
Purina Pro Plan Senior 11+ Indoor Care Turkey & Rice Formula Cat Food	513	4.8	19.8	3.1	50.2	1.45	1.25	0.47	0.78
Royal Canin Mature 27	282	4.2	16.5	7.1	29.7	0.86	0.69	0.34	0.92
Moist foods	**Energy density (kcal/can)****	**Energy density (kcal ME/g)**	**Fat (%)**	**Fiber (%)**	**Protein (%)**	**Ca (%)**	**P (%)**	**Na (%)**	**K (%)**
Recommended levels (normal/underweight)	**–**	**4.0-4.5**	**18-25**	**≤5**	**30-45**	**0.6-1.0**	**0.5-0.7**	**0.2-0.4**	**≥0.6**
Hill's Science Diet Mature Adult Active Longevity Gourmet Turkey Entrée Minced	87/3 oz. 160/5.5 oz.	4.1	20.1	4.8	34.5	0.96	0.64	0.28	0.84
Hill's Science Diet Mature Adult Active Longevity Savory Chicken Entrée Minced	91/3 oz. 168/5.5 oz.	4.4	23.3	3.7	39.2	1.02	0.69	0.49	0.82
Nutro Natural Choice Complete Care Indoor Senior Chicken & Lamb Formula	169/5.5 oz.	4.5	27.1	1.3	39.6	1.25	1.04	0.29	na
Dry foods	**Energy density (kcal/cup)****	**Energy density (kcal ME/g)**	**Fat (%)**	**Fiber (%)**	**Protein (%)**	**Ca (%)**	**P (%)**	**Na (%)**	**K (%)**
Recommended levels (inactive/obese prone)	**–**	**3.5-4.0**	**10-18**	**5-15**	**30-45**	**0.6-1.0**	**0.5-0.7**	**0.2-0.4**	**≥0.6**
Hill's Science Diet Mature Adult Hairball Control	326	4.0	20	8	34	0.86	0.70	0.39	0.80
Hill's Science Diet Mature Adult Indoor Cat	326	4.0	20.1	8	34	0.86	0.71	0.39	0.81
Hill's Science Diet Adult Light	316	3.5	9.5	6.9	35.1	1.00	0.73	0.4	0.67
Iams Eukanuba Senior Mature Care	414	4.1	19.0	2.0	39.5	1.39	1.12	0.43	0.85
Nutro Natural Choice Complete Care Indoor Senior	364	4.0	16.5	2.7	34.1	1.32	0.88	0.38	0.71
Purina ONE Special Care Healthy Weight Formula	362	3.7	12.2	3.7	46.1	1.42	1.41	0.40	1.15
Purina Pro Plan Senior 11+ Indoor Care Turkey & Rice Formula	513	4.8	19.8	3.1	50.2	1.45	1.25	0.47	0.78
Purina Pro Plan Weight Management Formula	413	4.2	12.0	3.4	50.5	1.19	1.08	0.54	0.82
Royal Canin Indoor Light 37	285	3.5	9.9	10.2	40.7	1.16	1.07	0.80	0.68
Moist foods	**Energy density (kcal/can)****	**Energy density (kcal ME/g)**	**Fat (%)**	**Fiber (%)**	**Protein (%)**	**Ca (%)**	**P (%)**	**Na (%)**	**K (%)**
Recommended levels (inactive/obese prone)	**–**	**3.5-4.0**	**10-18**	**5-15**	**30-45**	**0.6-1.0**	**0.5-0.7**	**0.2-0.4**	**≥0.6**
Hill's Science Diet Adult Light Liver & Chicken Entrée Minced	75/3 oz. 138/5.5 oz.	3.6	14.2	10.1	35.6	0.85	0.69	0.32	0.77
Nutro MAX Cat Gourmet Classics Lite with Chicken & Lamb	140/5.5 oz.	3.9	15.2	1.7	41.3	1.74	1.30	1.09	1.09
Nutro Natural Choice Complete Care Indoor Senior Chicken & Lamb Formula	169/5.5 oz.	4.5	27.1	1.3	39.6	1.25	1.04	0.29	na

Key: ME = metabolizable energy, g = grams, Ca = calcium, P = phosphorus, Na = sodium, K = potassium, Mg = magnesium, VOHC = Veterinary Oral Health Council Seal of Acceptance (plaque control, Chapter 47), na = information not available from the manufacturer.
*From manufacturers' published information or calculated from manufacturers' published as fed values; all values are on a dry matter basis unless otherwise stated.
**Energy density values are listed on an as fed basis and are useful for determining the amount to feed; cup = 8-oz. measuring cup.
To convert to kJ, multiply kcal by 4.184.

Antioxidants

The consequences of prolonged oxidative stress (e.g., free radical damage) to cell membranes, proteins and DNA contribute to and/or exacerbate a wide variety of degenerative diseases including several of those listed in Table 20-1. The consequences of free radical damage to cells and tissues have also been associated with the effects of aging. Although aging is a complex, multifactorial process, the free radical theory of aging may account for many of associated degenerative changes (Harman, 1956). This theory proposes that free radicals produce cell damage and age-dependent pathologic alterations may be the cumulative result of some of these changes.

Many phenomena initiate free radical formation. Although environmental pollutants and radiation are direct and indirect sources of free radicals, the primary source is normal oxidative metabolism (McMichael, 2007). The body defends itself

Mg (%) 0.05-0.1	Urinary pH 6.4-6.6	Vit. E (IU/kg) ≥500	Vit. C (mg/kg) 100-200	Se (mg/kg) 0.5-1.3	VOHC plaque (Yes/No) Yes
0.06	6.3	670	171	0.7	Yes
0.06	6.6	940	133	0.8	No
0.07	6.6	940	193	0.6	No
na	na	na	na	na	No
0.088	na	330	88	0.9	No
0.088	na	330	99	0.6	No
0.12	na	na	na	na	No
na	na	na	na	na	No
0.09	na	na	na	na	No
0.12	na	725	330	0.4	No
Mg (%) 0.05-0.1	**Urinary pH 6.4-6.6**	**Vit. E (IU/kg) ≥500**	**Vit. C (mg/kg) 100-200**	**Se (mg/kg) 0.5-1.3**	**VOHC plaque (Yes/No) Yes**
0.07	6.5	217	na	1.0	No
0.07	6.5	241	na	1.2	No
na	na	na	na	na	No
Mg (%) 0.05-0.1	**Urinary pH 6.4-6.6**	**Vit. E (IU/kg) ≥500**	**Vit. C (mg/kg) 100-200**	**Se (mg/kg) 0.5-1.3**	**VOHC plaque (Yes/No) Yes**
0.06	6.6	940	133	0.8	No
0.07	6.6	940	193	0.6	No
0.07	6.2	693	189	0.7	No
na	na	na	na	na	No
0.09	na	330	104	0.9	No
na	na	na	na	na	No
0.09	na	na	na	na	No
0.84	na	na	na	na	No
0.11	na	604	220	0.5	No
Mg (%) 0.05-0.1	**Urinary pH 6.4-6.6**	**Vit. E (IU/kg) ≥500**	**Vit. C (mg/kg) 100-200**	**Se (mg/kg) 0.5-1.3**	**VOHC plaque (Yes/No) Yes**
0.08	6.2	401	na	1.5	No
0.10	na	174	87	0.5	No
na	na	na	na	na	No

against the effects of free radicals through a complex network of protective antioxidants. Antioxidants protect biomolecules by scavenging free radical compounds, minimizing free radical production and binding metal ions that might increase the reactivity of poorly reactive compounds. Besides these classic mechanisms, many antioxidants exhibit second messenger regulatory function, cell cycle signaling and control of gene expression (Chapter 7). Combinations of antioxidants work synergistically to reduce oxidative stress and are more effective than individual antioxidants.

The following key nutritional factor recommendations focus on vitamins E and C and selenium. Selenium is an essential component of the antioxidant enzyme glutathione peroxidase. These antioxidants are key nutritional factors because: 1) they are biologically important, 2) they act synergistically (e.g., vitamin C regenerates vitamin E after it has reacted with a free radical), 3) of safety and 4) information regarding inclusion levels in pet foods is usually available. Animal studies and clinical intervention trials in people have shown selenium to be anticarcinogenic at much higher levels (five to 10 times) than the recommended allowances for people or the minimum requirements for animals (Combs, 2001; Neve, 2002). For improved antioxidant performance, foods for older cats should contain at least 500 IU vitamin E/kg DM, 100 to 200 mg vitamin C/kg DM and 0.5 to 1.3 mg selenium/kg DM. The antioxidants discussion in Chapter 20 reviews the basis for these recommendations.

Palatability and Digestibility

Reduced smell or taste, oral disease or metabolic disturbances, medication use or a combination of factors can impair appetite and food intake in older cats (**Table 21-1**). Foods for very old cats should be highly palatable and highly digestible to lessen concerns about weight loss and inadequate food intake. Foods with an energy density greater than 4 kcal/g (16.7 kJ/g) DM are more likely to be highly digestible because they are likely to be lower in fiber and higher in fat.

Texture

Oral disease is the most common disease of mature adult cats (Lund et al, 1999). Age-related changes include an increased prevalence of dental calculus, periodontal disease, loss of teeth and oral neoplasia (Guilford, 1996). Cats with poor oral health have more difficulty eating, and pathologic lesions may act as a portal for bacteria into the body. Additionally, decreased salivary secretions and immune function may exacerbate oral infection and disease (Hefferren et al, 1996). Food texture can play an important role in the well-being of older cats. As in young adult cats, the texture of dry foods fed to older cats may result in less calculus and plaque accumulation than if moist foods are fed (Logan, 1996; Studer and Stapley, 1973). However, the dental efficacy afforded by most commercial dry foods appears not to be clinically important and such claims should generally be regarded with skepticism. Dry foods designed with dental cleansing benefit improve oral health by reducing accumulation of dental plaque and the severity of gingivitis (Logan, 1996; Logan et al, 1997). If the labels of such foods carry the Veterinary Oral Health Council (VOHC) Seal of Acceptance, they have been successfully tested, according to specific protocols, to clinically reduce plaque (Chapter 47). Conversely, hard dry foods (e.g., bones) may cause oral pain if fed to cats with gingivitis or periodontitis. Dry foods with softer texture, semi-moist foods or moist foods may be easier to chew. The optimal texture depends on

Table 21-5. Feeding plan summary for mature adult cats.

1. Select a food from **Table 21-4** that most closely matches the recommended levels of key nutritional factors; for foods not in **Table 21-4**, contact the manufacturer for key nutritional factor content.
2. Select a food with an appropriate energy density.
   Inactive/obese-prone mature adult = 3.5 to 4.0 kcal (14.6 to 16.7 kJ) ME/g dry matter.
   Underweight/low body condition mature adult = 4.0 to 4.5 kcal (16.7 to 18.8 kJ) ME/g dry matter.
3. The selected food should be approved by a credible regulatory agency (e.g., AAFCO).
4. Determine the preferred feeding method (Table 20-5); food-restricted meal feeding is best for obese-prone cats.
5. For food-restricted meal feeding, estimate the initial quantity of food based on DER calculation (DER ÷ food energy density, as fed); food energy density as fed (the amount/8-oz. measuring cup or can may be obtained from **Table 21-4** or from the manufacturer's information).
6. Body condition and other assessment criteria will determine DER. DER estimate is calculated by multiplying RER by an appropriate factor (Table 5-2). Remember, DER calculations are estimates and should be used as guidelines or starting points for individual cats and not as absolute requirements. Body condition and other assessment criteria are used to refine the amount to feed.
7. RER can be calculated from Table 5-2.
   Inactive/obese-prone mature adult (eight to 11 years) = 1.1 to 1.4 x RER
   Normal or underweight mature adult (≥12 years) = 1.1 to 1.6 x RER
8. Regularly monitor body condition, body weight and general health.

Key: ME = metabolizable energy, AAFCO = Association of American Feed Control Officials, DER = daily energy requirement, RER = resting energy requirement.

the oral health and food texture preference of individual mature adult cats.

FEEDING PLAN

Older cats are more prone to weight loss, cardiac disease, renal disease, cancer and metabolic aberrations and usually have a decreased activity level than younger cats. The feeding plan should be based on the information obtained in the assessment and any detected risk factors. Nutritional surveillance and therefore the number of contacts per year should be increased for older cats. Although general feeding goals remain the same as those listed in Chapter 20 for young adult cats (maximize health, longevity and quality of life), each patient should be evaluated individually. The feeding plan includes assessing and selecting the best food and feeding method for the individual patient as described for young adult cats.

Assess and Select the Food

Foods currently being fed should be evaluated to:

- Ensure the food was formulated according to the guidelines of a competent regulatory agency (e.g., AAFCO). Review product labels for nutritional adequacy statements (Chapter 9).
- Compare the key nutritional factor levels of the current food with key nutritional factor targets. **Table 21-4** lists selected foods for mature adult cats and key nutritional factor levels for those foods and compares them to the key nutritional factor recommended levels.
- Identify discrepancies between the key nutritional factor targets and those in the food currently fed. A different food should be selected if important discrepancies are found between the recommended levels of key nutritional factors and those in the current food.

It may not always be necessary to change the food and feeding method when managing healthy mature adult cats. However, a thorough evaluation includes verification that an appropriate food and feeding method are being used. Older cats should be reevaluated at each examination because nutrition and health needs change with disease status, risk factors and overall health.

An important goal when managing the nutrition of mature adult cats is to ensure adequate food intake. There is little need to change the form of food a cat eats well because of age. In fact, some cats will refuse to eat a new food with a different form or texture. However, cats with inadequate food intake may benefit from changing food forms if the new food is more palatable and easier to chew.

Assess and Determine the Feeding Method

The feeding method includes how much to feed and how it is fed. Healthy mature cats may be fed free choice, meal fed or fed by a combination of methods. Overweight cats should be offered measured amounts of food. The measured quantity may be fed in meals or dispensed at one time to allow continuous access throughout the day. Underweight cats should be allowed to eat free choice. Only dry and semi-moist foods may be fed free choice and these foods are generally less palatable than moist foods. Table 20-5 summarizes advantages and disadvantages of feeding methods. Older cats may have reduced olfaction and taste perception; therefore, it may be preferable to feed moist and warm foods to encourage food intake. Providing dry foods free choice and several moist food meals throughout the day may optimize food intake. Adding broth or canned meat juices to dry foods may enhance food and water intake in older cats. However, when considering broths or meat juices to improve palatability, evaluate the product for excessive sodium chloride content. (See Key Nutritional Factor discussion, above.) **Table 21-5** summarizes a feeding plan for mature adult cats.

Although most cats do not experience digestive upsets with typical food changes, a gradual transition to a new food may benefit mature adult cats. Progressively exchanging the new food for the usual food over four to seven days will minimize untoward effects and food refusal (Chapters 1 and 20 provide exact details).

REASSESSMENT

Veterinarians should examine older cats and conduct a nutritional assessment regularly. The frequency of monitoring

depends on the overall health of the cat and the presence or absence of chronic diseases. Annual veterinary examinations are usually recommended for mature adult cats, whereas biannual checkups are recommended for very old cats.

The owner should evaluate body condition every two to four weeks. Although lean body mass tends to decline as cats reach 16 years or so, significant loss of muscle mass or body weight warrants immediate evaluation by a veterinarian. Owners should also monitor daily food and water intake and stools and urination. Any persistent change, whether increased or decreased, should prompt the owner to seek veterinary advice. The veterinarian should assess the cat and perform diagnostics as indicated.

Dental disease is the most frequent diagnosis made in older cats (Lund et al, 1999). Therefore, a dental health program should be a part of every mature adult cat's preventive health care plan (Chapter 47).

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REFERENCES

The references for **Chapter 21** can be found at www.markmorris.org.

CASE 21-1

Weight Loss in a Mature Adult Cat

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Patient Assessment

A 14-year-old neutered male domestic shorthair cat was examined as part of a routine geriatric health maintenance program. The owner reported no major illnesses except for one episode of urethral obstruction four years earlier. The diagnosis at that time was bacterial cystitis. The cat spends most of its time sleeping on the couch interspersed by brief forays into a pasture to catch voles, field mice and crickets. The owner mentioned that the cat seemed to be losing weight although its appetite had not changed.

Physical examination revealed a bright, alert, 3.5-kg cat with slight loss of body fat and muscle (body condition score [BCS] 2/5). The cat weighed 4.4 kg and had a BCS of 4/5 when last examined 18 months earlier. Oral examination revealed moderate dental disease with several missing teeth and odontoclastic resorptive lesions involving the left upper 4th premolar and both 1st molar teeth. The lesions on the upper 4th premolar were so severe that the crown had fractured leaving a small portion of the tooth root exposed. Moderately severe gingivitis was present. No other abnormalities were noted.

The hospital at which this cat was seen had a health maintenance program for mature adult cats that included a complete blood count, serum biochemistry profile, urinalysis, fecal flotation test, thoracic radiographs, thyroxine (T_4) measurement, ocular fundic examination and tests for feline leukemia and feline immunodeficiency virus infection. Results of the complete blood count, fundic examination, T_4 measurement, thoracic radiographs and urinalysis were normal. The fecal flotation test and tests for viral infection were also negative. The serum biochemistry profile was normal except for a slightly elevated serum urea nitrogen concentration (28 mg/dl, normal 10 to 25 mg/dl) and slightly decreased serum potassium concentration (3.5 mEq/l, normal 3.7 to 5.2 mEq/l). The urinalysis was normal; the urinary pH was 6.0 and the urine specific gravity was 1.030.

Assess the Food and Feeding Method

The cat ate commercial dry and moist specialty brand foods (Science Diet Feline Maintenance[a]). The dry food was offered free choice, and a variety of moist products (beef formula, seafood formula or turkey formula) were offered once daily. The owner was unsure how much dry food was consumed daily. The bowl was filled with dry food as needed. The cat also caught one to two voles or mice per week and ate only the head, leaving the body on the porch. Water was available at all times. The cat often drank from the faucet when allowed.

Questions

1. Has the assessment found any reason for the cat's weight loss?
2. What key nutritional factors are important for this patient?
3. Outline a treatment and feeding plan (food and feeding method) for this cat.
4. How should this patient be monitored?

Answers and Discussion

1. The only abnormalities noted on the assessment are dental disease and laboratory results consistent with possible early chronic renal disease. The extensive dental disease may contribute to weight loss if food intake is reduced because of oral pain. Renal insufficiency would not be expected to cause weight loss at this time. Hyperthyroidism is a common cause of weight loss in older cats, but is less likely in this patient because no cervical mass was found and the serum T_4 concentration was normal. However, hyperthyroidism may occur in cats without these abnormal findings. Repeating the resting T_4 concentration test or performing a T_3 suppression test should be considered for this patient. Many older cats have reduced lean body mass due to: 1) the high occurrence of disease in this age group, 2) reduced food intake because of impaired appetite or sensory function and 3) an age-related decline in food assimilation.
2. Key nutritional factors in older cats include water, energy, protein, fat, minerals (phosphorus, calcium, magnesium, potassium, sodium, chloride), urinary pH, palatability, digestibility and food texture. Water intake is important in older cats because chronic renal disease is very common in this age group. Fat and energy intake are also important in older cats that are susceptible to weight loss. Cats over 12 years of age should be fed energy-dense foods (4.0 to 4.5 kcal metabolizable energy [ME]/g dry matter [16.7 to 18.8 kJ ME/g]) and caloric intake should not be restricted, except as necessary to treat or prevent obesity. Excessive dietary phosphorus, protein, sodium and chloride should be avoided to help control progression of renal disease and hypertension. Hypokalemia is a potential complication of chronic renal disease and has also been reported to occur in older cats. Therefore, potassium-replete foods should be used. The reduced risk of struvite urolithiasis, increased risk of calcium oxalate urolithiasis and decline in renal function observed in older cats support the use of foods with a lower urine acidifying potential (higher published urinary pH values) compared with foods for young adult cats. Because weight loss and inadequate food intake are concerns for many very old cats, their foods should be highly palatable and digestible to ensure optimal intake and nutrient usage. The optimal food texture for older cats depends on the individual's oral health and food texture preference.
3. The cat should be anesthetized for a thorough dental examination and appropriate treatment (i.e., cleaning, extractions, etc.). Commercial foods formulated for older cats are appropriate for this patient. Many of these products have appropriate nutrient levels as discussed above. Many cats and their owners favor the concurrent use of dry and moist foods. The use of more than one form of food and the current feeding method are appropriate and can be continued. An estimated daily energy requirement (DER) should be calculated and the owner encouraged to monitor whether the cat is eating enough food to meet this requirement.
4. Monitoring should include an oral examination and complete physical examination every six months, including a complete blood count, serum biochemistry profile and urinalysis to assess renal function and measurement of potassium and resting T_4 concentrations. Feeding a veterinary therapeutic food formulated for cats with renal failure may be indicated if renal function deteriorates. Adding a potassium supplement will be necessary if serum potassium concentrations remain low.

Progress Notes

An oral antibiotic (clindamycin[b]) was dispensed for administration at home for one week before anesthesia was planned for dental examination and treatment. Tooth scaling, polishing and extractions were performed and the cat recovered uneventfully. The antibiotic was continued for another week. The food was changed to a formula for older cats (Science Diet Feline Senior[a]). The DER was estimated to be 1.2 to 1.4 x resting energy requirement for an ideal body weight of 4.0 kg (230 to 270 kcal [962 to 1,130 kJ]). This energy requirement would be met by feeding one 5.5-oz. can (165 kcal [690 kJ]) and one-fourth to one-third cup of dry food per day. The owner agreed to monitor the cat's daily food intake and to weigh the cat weekly. An appointment was made to reassess the cat in six months.

Endnotes

a. Hill's Pet Nutrition, Inc., Topeka, KS, USA. These products are currently available as Science Diet Adult Original and Science Diet Mature Adult 7+ Original.
b. Antirobe. The Upjohn Company (Animal Health Division), Kalamazoo, MI, USA.

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