

LIFE STAGE NUTRITION FOR HEALTHY DOGS AND CATS

CONTENTS

1. Why understand nutrition?
 - *The influence of nutrition on pet health*
 - *Nutrition as the 5th vital assessment*
 - *Dietary histories and nutritional recommendations*
2. Principles of life stage nutrition
 - *What is life stage nutrition?*
3. Nutrition for pregnancy and lactation
 - *Pregnancy*
 - *Lactation*
4. Nutrition for Growth
 - *Nursing*
 - *Weaning*
 - *Post weaning*
 - *Large Breed Puppies*
5. Senior nutrition
6. Appendix
7. References

1. Why understand nutrition?

- *The influence of nutrition on pet health*

Three main factors influence a pet's life: genetics, over which we have little to no control; the pet's environment, such as where and how it lives, preventive/medical care received throughout life; and nutrition, which is the one thing owners do every day for their pets which has a direct influence on the pet's length and quality of life

Nutrition has recently been incorporated as a standard of care, or a "vital assessment". A vital assessment is any determination of the status of a patient that should be performed at every veterinary visit. Traditionally veterinarians have performed three vital assessments - temperature, pulse and respiration. In the past 10 years, pain has become the fourth vital assessment, and, because of its importance, nutrition was elevated to the status of the 5th vital assessment in 2011.

- *Nutrition as the 5th vital assessment*

To make a good nutritional assessment, a good history is essential. While veterinarians are accustomed to taking patient histories, obtaining a comprehensive nutritional history means knowing everything that the pet eats in a day. Both the American Animal Hospital Association (AAHA) and the World Small Animal Veterinary Association (WSAVA) have recognised the need to develop nutritional assessment guidelines because there are many factors to be considered in assessing the nutritional needs of dogs and cats. The goal of the WSAVA Guidelines is to provide a framework for making nutritional assessments, and therefore nutritional recommendations, for patients.

What does this mean for you and your future practice? It means incorporating a nutritional assessment into the routine examination protocol for every patient, every time it visits. It means satisfying client expectations for a specific nutritional recommendation, and it means extending the health and special lifelong relationships between pets and their owners.

Visit the 5VA (5th Vital Assessment) website, www.everypeteverytime.com¹ for nutritional advice and resources, where you can find a motivational video, best practice video vignettes, down-loadable exam forms and checklists, FAQs, and PDFs of the Quick Reference Guide and Nutrition Reference Manual. Further resources on nutrition, including the WSAVA nutritional toolkit, are available from the WSAVA website.

- *Dietary histories and nutritional recommendations*

Research indicates that 90 % of clients want and expect nutritional recommendations for their pets from veterinarians, but only 15 % of clients perceive receiving such a nutritional recommendation.^{2,3} Even more alarming is the AAHA figure that only 7 % of pets that could benefit from a therapeutic food are actually on such a regimen.³ Clients depend on veterinarians and their staff to help them navigate through the literally thousands of products available - vets are the client's number one source of reliable information. It is worth considering who IS providing pet owners with the information they need if this advice is not coming from vets and their staff.

A consistent and systematic approach to taking dietary histories will get the most information. What is the animal currently being fed? How much is it being fed? Is the animal meal fed, or fed ad lib? Is the type and quantity of food appropriate for the animal's life stage and life style? What are the important nutritional considerations for this life stage/style? Do a complete physical examination and weigh the animal – is it over/underweight, and note its body condition score.* Check its mouth and coat. Make changes if there are discrepancies between what is being fed and what should be fed, and develop a feeding plan that is specific for that animal.

2. Principles of life stage nutrition

- *What is life stage nutrition?*

The objective of feeding is simple: all nutrient requirements should be met when the animal eats to meet its energy requirements.**

We should strive for optimum levels of nutrients that achieve nutritional balance, because complete and balanced nutrition is vital to keep pets in optimal health. This is where life stage nutrition becomes important - life stage nutrition is the practice of feeding foods that are designed to meet a pet's optimal nutritional needs at a specific age (life stage) or physiological state. Nutrient needs vary according to: age; activity / life style / special needs; environment; health status; and reproductive status.

Total Biological Dose-Response Curve



This total biological dose-response curve demonstrates the principle that for each nutrient there is an optimal intake. As the age and the physiological state of the pet changes, the optimal range may become narrower, thus demonstrating a reduced tolerance of nutrient excess or deficiency. Feeding pets according to their specific life stage helps to avoid nutritional excess in their diets, noting that diseases due to excessive nutrients are more common than diseases due to nutrient deficiencies.

- *Life stages*

The life stages to consider from a nutritional standpoint are:

Growth and reproduction

- kittens and puppies (small and medium breeds; large and giant breeds)
- gestation and lactation

Adult

- young to middle age
- obese prone
- active/working dogs

Senior / geriatric pets

3. Nutrition for pregnancy and lactation

Vets need to be well-informed about practical nutrition for breeding and growth, and to ensure that sound nutritional information is conveyed to owners. The objectives of a feeding program for reproduction are to optimise conception, optimise the number of puppies/kittens in the litter, optimise the ability of the animal to deliver, and to optimise the viability of the fetuses and neonates. The three phases of reproduction in the female, oestrous and mating, pregnancy, and lactation each have specific nutritional needs.

- *Pregnancy*

Appropriate feeding prior to mating will increase the chances of successful reproduction. The bitch or queen should have an ideal body condition score of 3/5, as both underweight and overweight animals can have decreased ovulation rates, silent oestrous, and reduced litter size and milk production.

Adequately fed bitches gain 15 to 25 % body weight prior to whelping, with 5 to 10 % of this remaining after whelping. Obesity can cause dystocia, prolonged parturition, and hypoxic pups, while malnutrition can result in embryo loss, poor fetal development and low birth weight pups. Most of the weight gain in bitches occurs after 40 days gestation, which is the stage of rapid growth of the fetuses.

The pattern of weight gain during pregnancy is different in queens. They gain weight early in pregnancy due to the development of fat depots to support lactation, and only lose 40 % of the weight gained immediately after parturition. The remaining 60 % of the weight gained during pregnancy is lost during lactation. As with dogs, obesity can cause dystocia, stillbirths and an increase in caesarians; under-nutrition can contribute to fetal malformations, fetal death and underweight kittens.

Food provided to pregnant and lactating bitches and queens should have passed an AAFCO feeding trial for growth and reproduction in that species. While we used to advise feeding bitches and queens a growth diet only during the last trimester of pregnancy, it is now recommended to start feeding dams a growth diet immediately upon conception and to continue this diet through to weaning. This is due to pup/kitten's need for DHA (docosahexaenoic acid) for retinal and brain development. Clinical studies have shown that pregnant dogs and cats nourished with DHA-enriched foods give birth to offspring that demonstrate optimal mental and visual acuity.^{4,5}

Energy - in early pregnancy energy requirements for dogs are the same as they are for adult maintenance, but after day 40 the increase in energy requirements is exponential. In queens, energy intake peaks at 6 to 7 weeks gestation. Queens should be provided with 1.6 x RER from breeding, with

the intake increasing gradually to 2 x RER at parturition. Free choice feeding of queens allows them to adjust their intake to requirements. Unless obesity is an issue feeding an energy dense food in the last few weeks is indicated.

Protein requirements increase during late gestation, and provision of essential amino acids for growth and development of fetuses is important. In cats levels greater than 35 % dry matter are required; in dogs 20 to 25 % DM (dry matter) of a high quality protein is sufficient.

Fat levels in the diet can be higher late in pregnancy to increase the energy density of food, thus compensating for the limitations on intake from abdominal fill.

Carbohydrates - bitches have a high requirement for glucose in the last weeks of pregnancy; increasing the CHO content of food for queens to >10 % DM has a protein sparing effect.

Calcium (Ca) and phosphorus (P) - in bitches the requirement for Ca during lactation increases by 60 %, however excessive levels may predispose to eclampsia during lactation. The Ca:P ratio should be maintained at approx 1:1, and Ca supplements should not be given if animals are on a balanced commercial diet. Eclampsia is uncommon in queens, however the same principle applies, which is to maintain the Ca:P ratio at 1:1 to 1.5:1. As the bitch or queen eats to meet her energy requirements, the correct amount and ratio of Ca and P are automatically provided without excess in an appropriately formulated diet.

Digestibility - should be >85 % due to increasing nutrient needs and limitations on intake from abdominal fill late in gestation.

Note that large breed pregnant bitches DO NOT need a large breed puppy food. No matter her size, a pregnant or lactating bitch needs a high level of energy and calcium in her diet.

- *Lactation*

Successful lactation depends on adequate nutrition during pregnancy and maintaining this during lactation. Nutrient requirements depend on the size of the litter, and are greater than at any other adult life stage, and in some cases may be greater than for growth. For example a German Shepherd with six pups may produce 1.7 L of milk per day at 3 to 4 weeks lactation, and 750 mL/day on average over a 3 month period. Bitches do not need a body fat store for successful lactation, however queens should weigh 700 to 900 g above their pre-breeding weight to support milk production and this weight should be lost over the course of lactation. Puppy and kitten growth rates are a good indicator of adequate milk production by the dam.

Colostrum is especially critical to the survival of newborn kittens, and it should be consumed in the first 12 hours for passive transfer of immunity. Immunoglobulins are absorbed intact across the intestine during this time. Milk also provides factors that enhance digestion, and local immunoglobulins provide local passive immunity in the gut.

Water - the requirement for water is often overlooked, but it is needed in large quantities and clean fresh water should be available at all times. Queens sometimes are reluctant to leave the nest, so it is important to provide both food and water within her reach in the first week or so.

Energy – requirement peaks at 3-5 weeks of lactation, when it can be two to four times greater than maintenance. Energy density and digestibility of the food are the limiting factors as to whether the animal can eat enough food to meet energy needs.

Protein – the protein requirement increases even more than the energy requirement during lactation. A diet with 25 % DM protein from mixed sources and with high digestibility should be provided to dogs. Lactating queens need a diet with at least 35 % protein, with animal tissue being the main protein source. Inadequate protein can cause poor growth of kittens and pups.

Digestibility - should be above average, > 85 %. Unless the food is easily digestible, the bitch or queen might not be able to ingest enough food to meet the energy and protein requirements.

Fat - fat is an important source of energy, and also provides essential fatty acids present in the milk. Bitches milk is high in linoleic acid and dietary fat levels of more than 10% are recommended; queens milk contains linoleic and arachadonic acids and dietary fat levels in excess of 18% are recommended.

Carbohydrates (CHO) - 10 to 20 % of the energy intake should be in the form of soluble CHO to support normal lactose production. Note that dry foods generally have a higher CHO content than moist foods.

Ca and P - in bitches the calcium needs are determined by the number of nursing puppies. The Ca:P ratio should be maintained at 1.3:1, but 2 to 5x more Ca is required at peak lactation than for adult maintenance. While Ca supplementation may be necessary for home cooked diets, supplements should NOT be given if a balanced commercial ration is being fed.

4. Nutrition for Growth

Food provided to puppies and kittens should have passed an AAFCO feeding trial for growth in that species. Feeding free choice is usually the best approach. Puppies and kittens can be allowed access to the dam's food from the age of 3 weeks. Just before and during weaning, restricting maternal intake may help lessen mammary engorgement in the bitch or queen.

Selecting the right nutrition is one of the most influential things owners can do for their new pets

- for optimal growth and development
- for long term wellness and longevity

There are three phases of growth, and each has its own requirements and challenges:

Nursing - the transition from in-utero to post-partum

Weaning – can be stressful due to changes in food and environment

Post-weaning – the period from 2 to 12 months. This is a critical time for skeletal and other development, particularly for large and giant breed pups.

- *Nursing*

Pups and kittens have immature immune systems. They depend primarily on antibodies (and other nutrients) derived from the intake of colostrum. The quality of the mother's milk is pre-determined by her nutritional status both during pregnancy and lactation.

- *Weaning*

Weaning should be gradual. Phase 1 is the introduction of solid food, and generally begins at 3 to 4 weeks. Milk production will progressively decline as the pups/kittens intake of solid food increases, making the second phase (complete weaning, by 8 to 10 weeks) less stressful.

As long as the dam's food is complete and balanced for growth, a suitable food for weaning pups and kittens can be made by blending the mother's moist food with warm water or grinding up dry food and mixing it with warm water. As the interest in solid food by pups and kittens increases, the gruel can gradually be replaced with solid food by reducing the amount of water mixed in. Drinking water should also be available from 3 weeks. By 5 weeks maternal milk production will be declining - pups and kittens should be well-established on solid food by then.

The appearance and weight of pups and kittens should be monitored, as should the colour and consistency of stools. Crying pups and kittens indicates hunger, discomfort, cold, disease, or isolation. As puppies and kittens get older they should become progressively more active and adventurous. Pups and

kittens can be removed from the dam at 6 to 8 weeks, and maintained on the same food they ate during weaning. They will recognise and accept it, and GI upsets will be minimised.

Protein digestibility should be high, but will be met by the mother's milk as long as the offspring are consuming enough energy from the mother's milk.

Energy - in newborn puppies, body fat is only 1.5 % of their total body weight, increasing to 10 % at 2 weeks, 17 % at 1 month and reaching an ideal of 22 % in normal adults. The dam's milk must contain enough energy to support this rapid increase in fat reserves and will depend on the food intake of the bitch during lactation.

Carbohydrate is mainly in the form of lactose in the first weeks.

Calcium and phosphorus levels are as previously outlined for lactation. During the first 3 to 4 weeks iron stores are depleted to below levels at birth, especially in large and giant breeds of dogs. The reserves increase again as the intake of solid food increases, and levels normalise at 4 months.

Taurine is an important nutrient in kittens and is required for normal growth and development. Home-made milk replacements based on cow's milk need taurine supplementation.

- *Post weaning*

Post weaning to adulthood lasts from 8 to 10 weeks until 10 to 12 months, depending on the species/breed. The specific objectives of this period of growth are to optimise growth, minimise obesity and prevent developmental orthopaedic diseases. The ultimate goal is of course to create a healthy adult.

In dogs growth rates depend on breed and nutrition. The aim should be for optimal growth rate, which, it is important to note, is not the same as maximal growth rate. Small to medium breeds (up to 25 kg) reach 50 % of adult weight at 4 months of age. Large to giant breeds reach 50 % of adult weight at 5 months. Kittens should grow at around 100 g per week until 20 weeks, and thereafter males grow at 20 g per day, and females at 11 g per day. The growth rate slows once kittens reach 80% of adult weight. Kittens reach skeletal maturity at 10 months, with further weight gains up to 12 months due to maturation and muscle development.

Energy is needed for maintenance and for growth, with fat providing the greatest amount of energy. Initially, the energy for maintenance and the energy for growth is 50:50 but as the growth curve reaches a plateau, the proportion for maintenance increases progressively while that for growth decreases. At 80 % of adult body weight, growth utilises 8 to 10 % of the total energy intake.

Puppies should receive 3 x RER until they are 50 % of adult weight; 2.5 x RER from 50 % to 80 %, and 1.8 to 2.2 x RER from 80 % to 100 % adult body weight. Management of obesity should start at weaning, as excess intake while growing can predispose to obesity. Excessive growth from over-nutrition increases the load and stresses on immature bones and contributes to skeletal disorders. If there is a rapid gain in muscle mass it exceeds the ability of the skeleton to support it, with resulting increased joint wear and tear.

Calcium is perhaps the most misunderstood component of puppy diets. Calcium homeostatic mechanisms in puppies are poor until about 10 months. Food for large and giant breeds should contain 0.7 to 1.2 % DM calcium; for smaller breeds the range is wider at 0.7 to 1.7 %. Osteochondrosis (OCD) and hip dysplasia are common skeletal abnormalities which can be linked to Ca excess. The calcium: phosphorous ratio should be maintained at between 1:1 and 1.8:1. Calcium excess is not associated with developmental orthopaedic disease in kittens as it is in puppies, but very high levels will reduce Mg

availability. Ca deficiency and P excess is seen in kittens fed an all meat diet, and causes nutritional secondary hyperparathyroidism.

Protein requirements for growth are different from adults in both puppies and kittens. Kittens have a higher requirement for sulphur containing amino acids, while puppies have a higher requirement for arginine than adults. There is a higher requirement for protein during growth, both for growing tissues and because proteins manufacture antibodies in the developing immune system. The increased protein requirement is usually met by the increased intake of growing animals to meet their energy requirements. A mixture of high quality, highly digestible protein sourced from animal and plant origin (e.g. chicken/egg and soybean) enables the right balance of amino acids to be supplied and thus improves the overall quality of protein in a diet. In kittens at least 19 % of the protein should be from animal sources.

Digestibility - puppies and kittens have relatively small stomachs and relatively high energy demands, therefore providing food with higher than average digestibility is indicated during growth. Food with low digestibility can lead to a pot-bellied appearance, flatulence and diarrhoea. Consuming a diet with high digestibility has several significant benefits to the pet and the pet owner. If a pet is consuming a highly digestible pet food, it doesn't need as much volume of that food to meet its nutritional needs and the pet owner doesn't have to buy food as often. Less food in also leads to less food out, which means less to pick up in the backyard or the litter box.

Antioxidants mop up free radicals that cause cell damage. A study in 2005 by Khoo et al⁶ showed puppies supplemented with a particular antioxidant bundle demonstrated an increased immune response to vaccination compared to puppies fed a control commercially available food with lower antioxidant levels.

L-carnitine is included in the diets of growing animals because it increases bone mass and bone density. Growing animals also use a lot of fat for energy, and L-carnitine helps them burn fat more efficiently, thus reducing the deposition of body fat and increasing lean body mass. This is particularly important for large and giant breed dogs. High levels of L-carnitine are found in skeletal and cardiac muscle, reflecting the high energy needs of those tissues. Because common pet food ingredients are low in L-carnitine, adding it to food may be important for managing the health of dogs and cats. The body can synthesise sufficient L-carnitine for some life stages, but dietary sources may become important in growth, for high performance, and in ageing pets.

Fatty acids - both omega 3 and omega 6 fatty acids help maintain a healthy skin, promote a strong immune system and play a role in cell growth. Puppies and kittens need n=6 for immune system development and n=3 (especially DHA) for visual and cognitive development. DHA has been shown to be vital for the development of the brain and retina in humans, cats, dogs and other animals (piglets, mice). It optimises the development of rods in the retina leading to enhanced visual acuity.

- *Large Breed Puppies*

Large breed puppies are those whose adult size will be over 25 kg. One third of all puppies are large breeds, and three of the five most popular breeds (Labradors, Golden Retrievers, German Shepherds) are large breeds. Diseases such as hip dysplasia and OCD are affected by genetics, environment *and* nutrition, and primarily affect fast-growing large breed dogs.

Energy - when large breed puppies are fed too many calories and/or too much calcium during rapid skeletal development, abnormal bone and cartilage development is more likely. Controlling the rate of growth of these puppies helps reduce the risk of developmental skeletal disorders.⁷ In a study of 48 pair matched pups aged between 8 weeks and 2 years in which one group was fed ad lib and the other group was fed 25 % less, it was found that 66 - 75% of the ad lib fed group developed hip dysplasia, compared to an incidence of 20 - 30 % in the calorie restricted group. The study, which continued for the life time of the dogs, also showed that dogs on restricted feeding lived on average 2 years longer.⁷

When a potential pet owner is looking for a large breed puppy, many want the largest pup in the litter, thinking it will grow up to be the biggest dog. They then feed it a lot so it can reach an even bigger size, however, a puppy will reach whatever size it was meant to be no matter how fast it grows, and growing faster doesn't mean it will end up as a larger adult dog. If the puppy is fed to grow at a slower rate it will still reach its ultimate adult size more slowly, which is a healthier way for it to grow.

Calcium - excess calcium in a puppy's diet can have extremely detrimental effects on the skeleton.

Unfortunately, many breeders of large breed puppies are still recommending calcium supplements during the first year (and in some cases, up to 18 months). Remember, that calcium supplementation doesn't just refer to calcium tablets and can be in the form of bone, milk, cottage cheese, cheese, etc

L-carnitine - growing animals use a lot of fat for energy and need to be able to metabolise the fat efficiently. L-carnitine is thus an important component of the diet for large breed dogs.

As with large breed puppies, large breed adult dogs have some nutritional needs that differ from those of small and medium sized breeds. Since large breed dogs have a tendency to develop degenerative joint disease as they age, this tendency is addressed by adding glucosamine and chondroitin sulfate to help maintain healthy joints and joint mobility. Many of these large breeds also tend to gain weight as adults, and added L-carnitine can help maintain lean body mass and more efficiently convert fat into energy.

5. Nutrition for Senior Pets

Dogs and cats are often considered older when they reach half of their life expectancy. A food change should be considered around the age of 5 years for large and giant-breed dogs and around 7 years for small and medium-breed dogs and for cats. While pets of this age may not outwardly appear old, there is an increased prevalence of age-related diseases at around this time.⁸

Energy/Fat - older pets may become less active and require less energy to meet their needs, but maintaining ideal body weight is still important in older pets. Being overweight or obese can increase the risk of many diseases.⁹ As for other life stages, individual needs must be catered for - very senior pets can become underweight and may need an increase in calorie intake.

Omega 3 fatty acids in the diets of older pets help maintain skin and coat health, joint health eicosapentaenoic acid (EPA), and cognitive function. In animals with kidney disease n3 fatty acids in the diet help maintain renal perfusion, reducing glomerular hypertension and hypertrophy.

Protein – senior foods often have decreased protein levels, however it is important to maintain lean body mass, and protein levels must be sufficient to support a healthy immune function. These needs must be weighed up against an increased prevalence of renal disease as pets age. Moderate levels of high quality proteins are indicated in this age group, and enough can be provided by increasing protein quality rather than increasing the absolute amount of protein.

Fibre - senior pets can be more prone to constipation due to a reduction in intestinal motility.

Insoluble (slowly fermenting) fibre promotes normal intestinal motility and aids hairball control in cats. Fibre also dilutes the caloric density of the diet, thus aiding prevention of obesity. Moderately fermentable fibre provides food for colonocytes.

Glucosamine and chondroitin sulfate are the building blocks of cartilage. As animals age and continued stress is placed upon the joints, the body may not be able to make enough glucosamine and chondroitin to build and repair damaged cartilage. Senior diets thus often have added glucosamine and chondroitin to help maintain joint health. This can be particularly important for older large breed dogs which have increased stresses and wear and tear placed upon their joints.

Large and giant breed dogs typically have a more compressed life span compared to smaller breeds, and should be transitioned to a senior diet at an earlier age. A senior diet is recommended from the age of 5 to 6 years for large and giant breed dogs, compared to 7 years for cats and medium and small breed dogs.

Appendix * Body condition score chart

3 NORMAL		<ul style="list-style-type: none"> • Ribs – Easily felt with slight fat cover • Tail Base – Smooth contour with slight fat cover • Side View – Abdominal tuck • Overhead View – Well-pronounced waist 	
4		<ul style="list-style-type: none"> • Ribs – Difficult to feel under moderate fat cover • Tail Base – Some thickening bones palpable under moderate fat cover • Side View – No abdominal tuck • Overhead View – Back is slightly broadened at waist 	
5 OBESE		<ul style="list-style-type: none"> • Ribs – Difficult to feel under thick fat cover • Tail Base – Thickened and difficult to feel under thick fat cover • Side View – No waist, fat hangs from abdomen • Overhead View – Back is markedly broadened 	

BCS	3	4	5
Body Fat*	16-25 %	26-35%	>35%

**An animal’s resting energy requirement (RER) can be calculated using the formula: $RER = (30 \times \text{body weight}) + 70 \text{ kcal/day}$ (for pets weighing between 2 and 45 kg). A more accurate RER for animals outside this weight range is $RER = 70 \times (\text{body weight})^{0.75} \text{ kcal/day}$. To calculate the daily energy requirement (DER), the RER is multiplied by a factor determined by the pet’s age and physiological status, that is, its life stage and life style.

Canine

Growth DER (kcal/day)

Up to four months = $3 \times RER$
 Four months and older = $2 \times RER$

Maintenance DER (kcal/day)

Average, neutered adult = $1.6 \times RER$
 Intact adult = $1.8 \times RER$
 Obese prone = $1.4 \times RER$
 Weight loss = $1.0 \times RER$

Work DER (kcal/day)

Light work = $2 \times RER$
 Moderate work = $3 \times RER$
 Heavy work = $4-8 \times RER$

References

1. www.everypeteverytime.com
2. Quantifying Opportunities Available by Increasing Compliance Rates. The Path to High-Quality Care: Practical Tips for Improving Compliance. Lakewood, CO: American Animal Hospital Association; 2003:77.
3. Data on File, AAHA 2003, USA
4. Pawlovsky RJ, Denkins Y, Ward G, Salem N. Retinal and brain accretion of long-chain polyunsaturated fatty acids in developing felines:the effects of corn-oil based maternal diets. *Am J Clin Nutr* 1997; 65: 465-472.
5. Zicker SC, Jewell DE, Yamka RM, Milgram NW. Evaluation of cognitive learning, memory, psychomotor, immunologic, and retinal functions in healthy puppies fed foods fortified with docosahexaenoic acid-rich fish oil from 8 to 52 weeks of age. *J Am Vet Med Assoc* 2012; 241:583-594
6. Khoo C, Cunnick J, Friesen K et al. The role of supplementary dietary antioxidants on immune response in puppies. *Vet Ther* 2005; 6:43-56
7. Kealy RD, Lawler DF, Ballam JM et al. Effects of diet restriction on life span and age-related changes in dogs. *J Am Vet Med Assoc* 2002; 220:1315-1320
8. AAHA Senior Care Guidelines for Dogs and Cats. March/April 2005, Vol. 41.
9. Lund EM, Armstrong, PJ Kirk CA, Klausner JS. Prevalence and risk Factors for obesity in adult cats from private US veterinary practices. *J Appl Res Vet Med* 2005; 3: 88-96