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Canine Performance & Rehabilitative Nutrition

PART 2: CANINE REHABILITATIVE NUTRITION

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The **American College of Veterinary Nutrition** (**acvn.org**) and ***Today's Veterinary Practice*** are delighted to bring you the **Nutrition Notes** column, which provides the highest quality, cutting edge information on companion animal nutrition, provided by the ACVN's foremost nutrition specialists.

The primary objectives of the ACVN are to:

- Advance the specialty area of veterinary nutrition
- Increase the competence of those practicing in this field
- Establish requirements for certification in veterinary nutrition
- Encourage continuing education for both specialists and general practitioners
- Promote evidence-based research
- Enhance dissemination of the latest veterinary nutrition knowledge.

The ACVN achieves these objectives in many ways, including designating specialists in animal nutrition, providing continuing education through several media, supporting veterinary nutrition residency programs, and offering a wide array of resources related to veterinary nutrition, such as this column.

Injured dogs—whether sedentary or active—benefit from specific nutritional considerations during recovery from musculoskeletal trauma or surgery. An expanding body of evidence suggests best practices for dietary modification during rehabilitation, and practitioners should be prepared to discuss these practices with interested owners.

Read Part 1 of this article series, **Canine Performance Nutrition**, in the November/December 2014 issue of *Today's Veterinary Practice*, available at **tvpjournal.com**.

APPROACH TO REHABILITATIVE NUTRITION

In canine patients, nutrition is increasingly used to modify the response to tissue injury as part of a multimodal approach. Several nutritional factors should be evaluated, including dietary protein, fatty acid composition, and energy intake (**Table 1**).

Presently no diets are expressly marketed for rehabilitation. However, several diets labeled for osteoarthritis are suitable while others contain potentially suboptimal levels of protein for rehabilitation. Diets formulated for growth, athletic performance, or working dogs are more likely to contain the targeted levels of macronutrients compared with many maintenance formulas. The guaranteed analysis of any diet can be used to calculate and objectively compare the amount of each nutrient (grams) per 1000 kcal of food.

TABLE 1.
Suggested Target Macronutrient Profiles for Canine Rehabilitation

PATIENT	PROTEIN	FAT	CARBOHYDRATE	EPA + DHA
Rehabilitation Patient	75	> 35	< 100	> 1

Nutrient values provided in g/1000 calories.

Learn More

See **Beyond the Guaranteed Analysis: Comparing Pet Foods** available in the Resources section, In-Clinic Materials, at **tvpjournal.com**.

Protein

Injured dogs may have higher rates of protein turnover and decreased energy expenditure due to inactivity. As a result, in most cases, diets elevated in protein should be selected (> 75 g/1000 kcal) to prevent relative deficiencies. Specific amino acids, such as leucine, help decrease exercise-induced proteolysis in dogs during muscle activity.[1] Extensive data in humans suggest that leucine stimulates skeletal muscle protein synthesis, and this benefit most likely applies to convalescing dogs as well.[2]

Information about the leucine and overall amino acid composition of many diets is not easily obtained. However, selection of a high protein diet generally increases an animal's leucine intake because adequate leucine is present in both animal-source proteins and in some concentrated vegetable proteins commonly used in pet foods.

Fatty Acids

Dogs undergoing rehabilitation frequently present with concurrent osteoarthritis, and several studies support a role for fatty acid modulation in this condition.

- The polyunsaturated omega-3 fatty acids—eicosapentaenoic acid (EPA; 20:5n3) and docosahexaenoic acid (DHA; 22:6n3)—found in select commercial fish oil products influence inflammatory processes by encouraging production of less inflammatory eicosanoids.
- High doses of EPA and DHA (> 7.5 g/1000 kcal) resulted in the most improved canine arthritis scores in a dosing study.[3] However, few commercial diets provide this level of EPA and DHA, and diets with 1 to 3 g/1000 kcal have also demonstrated clinical effects.
- In addition, hypothetically, a 20-kg dog consuming 1000 kcal of a diet containing 1 g of EPA and DHA would require 22 "standard" fish oil capsules, or 6 teaspoons of fish oil, daily to achieve a dose of 7.5 g/1000 kcal. Not only is this amount of fish oil expensive and impractical, but administration of very large amounts of fish oil has been anecdotally reported by some practitioners to cause diarrhea.
- Mild reductions in nonsteroidal anti-inflammatory drug dosing and improved peak vertical forces have been reported with a lower fish oil concentration (about 2.5 g/1000 kcal) administered via a therapeutic joint diet fed for 3 months.[4,5]

Therapeutic doses of fish oil can be administered by adding capsule or liquid products to commercial foods. Standard fish oil capsules contain about 300 mg of EPA + DHA, and a dose of 1 to 3 fish oil capsules (300–900 mg of EPA + DHA) per 10 pounds (4.54 kg) of body weight (BW) has been suggested as a supplemental dose for diets low in fish oil.

Veterinary-exclusive "joint" diets vary widely in composition and should not be considered interchangeable (**Table 2**). Joint diets with a minimum of 75 g of protein per 1000 calories should be used in food-restricted obese patients in order to preserve lean body mass.[6]

Energy

Energy provided during rehabilitation should be adjusted to prevent weight gain.

- For dogs, the energy cost of sitting and standing is as much as 30% to 46% higher than that expended when the dog is lying laterally.[7] As a result, dogs confined to a cage generally require 25% to 30% less food to maintain ideal BW.
- Paralyzed animals, even if active in a cart or with sling support, are likely to have lower energy requirements than before paralysis based on data in other species.[8] A reduction in muscle, secondary to neurogenic atrophy, is probably responsible for this phenomenon.

Underwater treadmill therapy may mildly increase a patient's energy expenditure if performed routinely at higher speeds, such as during inpatient rehabilitation.

- Fit dogs walking on an underwater treadmill with elbow-height water used 1.9 kcal/kg$^{0.75}$ per kilometer.[9]
- For a 50-pound (22.68-kg) dog, a 30-minute session at a walking speed would increase daily energy requirements by about 1.5%. Only at high speeds for an average-length session would expenditure substantially increase (> 5%).

OVERWEIGHT PATIENTS

Overweight animals are theorized to be at a greater risk of musculoskeletal injury given increased loading forces on limbs. Therefore, weight loss can be an important part of rehabilitative nutrition.

Nutrient Restriction

Calorie restriction—but not protein restriction—should be pursued in overweight animals to achieve a slow rate of weight loss of 0.5% to 1% weekly. Higher rates may be associated with a greater risk of lean body mass loss. Caloric reduction by a minimum of 33% is often necessary.

Diets high in protein appear superior to those with moderate amounts of protein,[6] and the energy

Learn More

To learn more about managing osteoarthritis in dogs and cats, read our Managing Chronic Pain in Dogs & Cats Series:

- Part 1: **The Two Most Important Tools in the Management of Osteoarthritis**
- Part 2: **The Best of the Rest in the Management of Osteoarthritis.**

These articles, published in the November/December 2013 and September/October 2014 issues, respectively, are available at **tvpjournal.com**.

density of the diet is often decreased by limiting the fat content (the energy density of fat is greater than 2× that of protein and carbohydrate), increasing the moisture content, or adding dietary fiber. Detailed recommendations for weight loss can be found in the article, **Treatment of Obesity**, published in the September/October 2013 issue of *Today's Veterinary Practice,* available at **tvpjournal.com**.

Weight Loss Initiation

Weight loss protocols and diet changes are best initiated 2 weeks following any surgery to avoid inadvertent muscle loss in the immediate post-recovery period, and to prevent food aversion to the new diet. Most activity- or cage-restricted patients should, however, have their daily intake initially reduced by 10% to 15% to account for reduced activity during this period.

Long-term caloric restriction for weight loss typically requires *less than 70 × (ideal BW in kg)$^{0.75}$ kcal/day* in normal animals, or generally 2/3 of the known weight-stable intake. Dogs with postsurgical cage confinement may require restriction to *50 × (ideal BW in kg)$^{0.75}$ kcal/day or less* to achieve the target rate of weight loss. Diets for weight loss must be higher in protein, essential fatty acids, and some vitamins and minerals per calorie to prevent deficiencies.

Use of Exercise

Increased exercise is unlikely sufficient to achieve weight loss unless calories are concurrently reduced. For example, an obese dog that weighs 35 kg—its ideal BW should be 25 kg—fed 1000 calories Q 24 H would use only 6% more calories daily if walked a total of 3.2 miles.

While underwater treadmill therapy has been shown to be a part of a successful weight loss protocol, the study lacked a control group, and effect of hydrotherapy alone was unclear.[10] Studies in normal dogs walking on an underwater treadmill showed only slightly increased energy expenditure as compared to walking at the same speed on a dry treadmill, as described earlier in the article.

ROLE OF SUPPLEMENTS

Supplements are aggressively marketed for use in osteoarthritis but have limited evidence supporting their use, with the exception of DHA and EPA.[11]

Glucosamine & Chondroitin

Studies of glucosamine and chondroitin are mixed. One study showed a benefit after 70 days, whereas another 60-day trial found no improvement.[12,13]

TABLE 2.
Veterinary-Exclusive Joint Diets: Comparison of Nutrient Profiles

NUTRIENT (PER 1000 CALORIES)	DIET A	DIET B	DIET C	DIET D
Protein (g)	51	79	66	76
Fat (g)	41	33	32	34
EPA + DHA (g)	1.26 (EPA)	NR	1.45	NR
Glucosamine (mg)	NR	340	237	137 (min)
Chondroitin (mg)	NR	NR	26	13
Caloric density (kcal/cup)	356	408	324	296

NR = not reported

Glucosamine and chondroitin products are absorbed orally, but owners should be counseled that their efficacy is not well established.[14,15] If owners administer these products, wait at least 2 months before evaluating effectiveness. Client reports of immediate improvement should be met with skepticism based on the available literature. Hyaluronic acid is included in some glucosamine and chondroitin supplements for osteoarthritis and is absorbed following oral administration, but clinical efficacy has not been shown in dogs.

Green-Lipped Mussel

Green-lipped mussel is touted as an alternate dietary source of glucosamine, omega-3 fatty acids, and trace minerals for osteoarthritic patients.[16] Studies suggest that some owners will document dramatic improvements, even when given a placebo to administer to their pets, and that clinical improvements with this supplement are mild.[17]

Boswellic Acid

Boswellic acid, derived from frankincense, is found in some veterinary joint supplements. An anti-inflammatory action has been documented in laboratory studies,[18] but only uncontrolled veterinary trials suggesting an effect are available.[19]

Curcumin

Curcumin is found in veterinary nutraceuticals marketed for arthritis. Its utility as a natural NF-kB (nuclear factor kappa-light-chain-enhancer of activated B cells) and cyclooxygenase-2 inhibitor is documented in humans but not in dogs.[20] However, its gastrointestinal absorption in most species appears to be poor. An extract of turmeric, the spice from which curcumin is derived, produced subjective, but not objective, improvements in dogs with arthritis.[21]

Learn More

To learn more, see **ACVN Nutrition Notes: Surveying Supplements: Current Trends, Research, & Recommendations** (May/June 2014), available at **tvpjournal.com**.

Avocado/Soybean Unsaponifiables (ASU)

Compounds from the oil portion of avocados and soy are extracted to produce ASU. Human clinical trials have suggested a nonsteroidal anti-inflammatory drug sparing effect. Synovial fluid analyses of dogs receiving the supplement showed increased transforming growth factor beta (TGF-beta) compared with control animals, and TGF-beta is thought to mediate the synthesis of collagen by mitigating effects of interleukin-1.[21] Inhibition of nitric oxide synthase and matrix metalloproteinases by ASU at 10 mg/kg has also been shown in experimentally-induced canine arthritis.[22]

Elk Velvet Antler

A study identified positive changes in force plate analyses and lameness scoring when dogs were fed labeled doses of an elk velvet antler product.[23] The mechanism of effect is unclear but is thought to result from the large collagen content of the product or the unique proteins found in the antler. Adrenal lesions and subsequent death were reported in 2 dogs receiving the supplement, but this could not be linked to the study product.

Other Supplements

Gelatin hydrolysate, protein fractions from hyperimmunized cow milk, and undenatured type II collagen are other supplements that have been preliminarily studied in dogs, and additional information is necessary on their efficacy.

IN SUMMARY

Rehabilitation protocols are individualized to the patient, and nutritional interventions are no different. Nutrient requirements and caloric expenditure vary widely between breeds, individuals, and injuries; therefore, close monitoring of any nutritional intervention is critical to the success of the rehabilitation protocol.

ASU = avocado/soybean unsaponifiables; BW = body weight; DHA = docosahexaenoic acid; EPA = eicosapentaenoic acid; TGF-beta = transforming growth factor beta

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