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METABOLISM

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Jeff P. Tinsley
DVM, DACVD

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Wendy Baltzer
DVM, PhD, DACVS-SA, DECVS,
DACVSMR-Canine, CCRP, MANZCVS-SMR

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Margaret E. Gruen
DVM, MVPH, PhD, DACVB



Promoting skin and coat health with fatty acids

Jeff Tinsley, DVM, DACVD

Animal Dermatology Clinic, Louisville, Kentucky, USA

Fatty acids are one of the most common ingredients in diets that influence the skin barrier of dogs and cats.¹ They reflect a key component in the lipid bilayer that surrounds each keratinocyte (skin cell) and physically strengthen the skin barrier which ultimately may help reduce transepidermal water loss, prevent penetration by harmful microbes, help regulate internal temperature, and many other basic, but vital functions (**Box 1**).¹

Omega-6 fatty acids (such as linoleic acid) play a key role in the lipid layer of the epidermis.² They also assist with overall glossiness of the coat, softness of the fur and reduction of scale (dandruff) seen in seborrheic conditions.² Omega-3 fatty acids (such as EPA, DHA, ALA, and DPA) are also essential. This group in particular has been championed for their anti-inflammatory effects in regards to leukotriene reduction. This may help reduce the overall inflammation experienced in atopic dogs.²

In some instances, the ratio of omega-6 to omega-3 fatty acids is seen as more important than the total volume of omega-3 fatty acids.¹ However, this nuance is still debated.

One of the most common conditions that affects the skin of dogs is canine atopic dermatitis (cAD). This has been characterized as a chronic inflammatory and pruritic skin disease with skin barrier dysfunction related to an overreaction of the immune system to allergens and genetic predisposition.³ As noted above, fatty acids have the ability to improve both the skin barrier and assist in inflammation reduction. Therefore they can provide significant benefit in cAD. It should be noted, though, that most cases of cAD require multi-modal therapy including the use of antipruritics, antimicrobials, and ideally allergen-specific immunotherapy. Sole fatty acid therapy is not always rewarding, but as a part of the overall treatment for cAD, fatty acids are an excellent option.

In fact, fatty acids have been shown to reduce pruritus, have steroid-sparing effects, and reduce the requirement for a variety of antipruritic medications such as oclacitinib and even cyclosporine.²⁻⁴

Of Note

- Fatty acids have been shown to reduce the need for antipruritic medications in canine atopic dermatitis.
- A 2- to 3-month trial is recommended to assess the efficacy of essential fatty acid supplementation.
- Veterinary therapeutic diets enriched with fatty acids have been shown to provide higher amounts of fatty acids than those in traditional supplements.

It is also important to note that fatty acids tend to have a slow onset of action. Some resources show effects at 9–12 weeks.³ Therefore, a 2- to 3-month trial on omega fatty acids is recommended prior to assessing overall efficacy.

One simple way to deliver fatty acids is via veterinary therapeutic essential fatty acid–enriched diets. These diets are formulated with effective amounts of fatty acids for the skin and other conditions. Although some countries require veterinary authorization to obtain veterinary therapeutic diets, ease of administration (simply having pets eat the diet) makes them ideal for owners who are busy or struggle with compliance via pill, oral liquid, or cutaneous topical administration.

Interestingly, some canine diets have higher amounts of fatty acids than those in supplements.² The choice of whether or not additional fatty acids are needed is clinician dependent. However, it is very fortunate that a diet change alone may be more than sufficient and potentially superior than reaching for individual supplements.⁴ This may improve overall client compliance by reducing the treatments and tasks required by the client on a daily basis.

Cutaneous topical formulations are also an excellent supplemental option. These are best applied by

Box 1. Benefits of essential fatty acids in the skin

- Essential for normal skin health and function
- Reduction of transepidermal water loss
- Reduction of inflammation
- Reduction of pruritus
- Required for normal keratinization
- Adjunctive therapy for canine atopic dermatitis
- Treatment for seborrheic skin conditions

parting the haircoat between the shoulder blades and squeezing a liquid filled pipette directly on to the skin. Some dermatologists prefer this route of fatty acid administration as it directly treats the target organ. Research directly comparing routes of administration of fatty acids, however, is still lacking.

Many cutaneous topical formulations come in preset amounts that do not require guesswork for administration. In contrast, dosing of oral fatty acids is trickier as ranges vary widely among literature resources. For oral pills and liquids, some resources indicate 125 mg eicosapentaenoic acid (EPA) + 75 mg docosahexaenoic acid (DHA) per kg body weight given daily.⁵ Other resources quote 50–220 mg per kg body weight daily.⁶ Anecdotally, a common daily dose of roughly 80 mg per kg body weight (EPA and DHA combined) has been used as a starting point among dermatologists for dogs.

Overall, the use of fatty acids seems to lead to healthier and more comfortable pets and is considered safe to try for most patients experiencing chronic skin conditions.

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The role of omega-3 fatty acids in joint health

Wendy Baltzer, DVM, PhD, DACVS-SA, DECVS, DACVSMR-Canine, CCRP, MANZCVS-SMR

University of Minnesota, St. Paul, Minnesota, USA

Osteoarthritis (OA) or degenerative joint disease is a progressive degeneration of diarthrodial synovial joints which results in articular chondrocyte death, synovial inflammation, loss of normal joint fluid and cartilage, subchondral bone sclerosis, osteophyte and enthesophyte formation, and ultimately loss of joint function and chronic maladaptive pain. OA is very prevalent in dogs and cats. A multimodal approach is recommended with treatment including physiotherapy, calorie restriction, oral nutraceutical supplementation or a veterinary therapeutic diet, and pain management (**Table 1**). This article will focus on omega-3 fatty acids as a component of nutritional management of joint disease.

Omega-3 Fatty Acids

Dietary supplementation with the omega-3 fatty acids eicosapentaenoic acid and docosahexaenoic acid (EPA-DHA) is essential in the management of OA with up to 70% of clinical trials showing clinical efficacy in OA management.¹ EPA-DHA reduces catabolic enzymes in the arthritic joint including matrix metalloproteinases. EPA-DHA reduces systemic inflammatory biomarkers including arachidonic acid, interleukin-1, and serum and joint prostaglandin E₂, which may explain their effects on reducing the pain and progression of OA.^{1,2} Numerous studies support the use of these fatty acids for OA management in adult dogs including objective and subjective pain relief, reduction in lameness, and improved quality of life.^{3,4} Elbow and hip dysplasia-predisposed puppies fed a fish-based growth diet from 3 to 12 months of age had reduced severity of OA progression compared to littermates fed a chicken-based diet.⁵ An omega-3 supplemented diet fed following cranial cruciate ligament surgery resulted in improved weight-bearing on objective kinetic gait analysis, reduced owner-reported lameness, and reduced radiographic OA progression in the 6 months following surgery.^{2,3} In cats, omega-3 fatty acids supplemented orally reduce the clinical signs of OA and improve the cat's quality of life.⁶

The optimal dose of EPA-DHA supplementation is not uniformly accepted. Incorporation of the oil into a

Of Note

- Omega-3 fatty acids have been studied extensively for osteoarthritis management and have been found effective for reducing clinical signs and disease progression.
- Dogs and cats can have an improved quality of life with omega-3 fatty acid supplementation.

commercial diet, such as a veterinary therapeutic joint diet, may improve EPA-DHA absorption. In turn, this may increase the clinical effects.⁷ Pain and OA-induced lameness are reduced in dogs fed diets featuring high omega-3 to omega-6 fatty acid ratios because competition for enzymes by omega-6 fatty acids may affect the response to omega-3's.⁸

EPA-DHA supplementation not only improves weight-bearing and reduces lameness but it slows the progression of OA as well, making it a vital component of OA treatment.

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Table 1. Multimodal recommendations for dogs and cats with OA

	Diet	Additional Considerations
Young adult dog at risk of OA	<ul style="list-style-type: none"> –Maintain ideal weight or start a weight loss plan if BCS \geq 6/9 –Omega-3 fatty acids (total EPA and DHA > 100 mg/kg/day) 	<ul style="list-style-type: none"> –Moderate intensity exercise and focus on lean muscle development to reduce risk of OA –Disease modifying drugs can be added such as pentosan sulfate
Adult dog with mild/moderate OA	<ul style="list-style-type: none"> –Maintain ideal weight or start a weight loss plan if BCS \geq 6/9 –Omega-3 fatty acids (total EPA and DHA > 100 mg/kg/day) 	<ul style="list-style-type: none"> –Multimodal therapy of OA required –Do not administer all supplements simultaneously, rather reserve some for OA progression –Add analgesics such as intermittent NSAIDs, amitriptyline, amantadine, gabapentin, etc.
Adult dog with severe OA	<ul style="list-style-type: none"> –Maintain ideal weight or start a weight loss plan if BCS \geq 6/9 –Ensure adequate intake of dietary protein –Omega-3 fatty acids (total EPA and DHA > 100 mg/kg/day) 	<ul style="list-style-type: none"> –Multimodal therapy of OA –Improve muscle mass and activity –Intermittent NSAIDs administered as needed and tolerated –Add analgesics such as intermittent amitriptyline, amantadine, gabapentin
Geriatric dog with OA	<ul style="list-style-type: none"> –Weight loss if BCS > 6/9 –Ensure adequate intake of dietary protein, provide increased protein concentrations when tolerated (sarcopenia risk) –Omega-3 fatty acids (total EPA and DHA > 100 mg/kg/day) 	<ul style="list-style-type: none"> –Consider comorbidities when devising therapy –Add analgesics such as intermittent NSAIDs, amitriptyline, amantadine, gabapentin
Cat with OA	<ul style="list-style-type: none"> –Weight loss if BCS > 6/9 –Ensure adequate intake of dietary protein, provide increased protein concentrations when tolerated –Omega-3 fatty acids (total EPA and DHA = 80-120 mg/kg/day) 	<ul style="list-style-type: none"> –Consider comorbidities when devising therapy –Improve muscle mass and activity –Add analgesics such as intermittent NSAIDs, amitriptyline, amantadine, gabapentin

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The benefits of medium-chain triglycerides on cognition

Margaret Gruen, DVM, MVPH, PhD, DACVB

North Carolina State University, Raleigh, North Carolina, USA

Across many species, aging is associated with changes in cognition and cognitive function. Alterations across multiple pathways contribute to decreases in cognitive flexibility and executive function that may span from mild cognitive impairment to more significant cognitive dysfunction. In dogs, this more severe form of cognitive dysfunction is often referred to as canine cognitive dysfunction syndrome (CCDS) and is characterized by changes in domains represented by the acronym DISHAAL. These include **D**isorientation, changes in social **I**nteractions, **S**leep-wake cycle disturbances, **H**ousesoiling (in a previously housetrained dog), **A**ctivity, **A**nxiety and impaired **L**earning. These behavioral alterations are reflections of changes in the brain that may include ventricular enlargement, frontal and temporal lobe atrophy, and an increase in lesions in the frontal cortex and caudate nucleus.¹ In addition, brain tissue shows reduced cellular metabolism, decreased glucose utilization, and a decline in cellular repair mechanisms. Decreased mitochondrial function is associated with more free radicals and oxidative stress that increases neurodegeneration. While advanced age is the most significant risk factor for development of CCDS, several other risk factors have been identified, including low quality diets.²

Once CCDS has developed, treatment frequently focuses on addressing specific clinical and behavioral signs and slowing the progression. Earlier detection and diagnosis may improve outcome, and a focus on prevention through supporting brain health and cognitive function with enrichment, exercise, and social interaction is key. Several nutritional strategies may help mitigate factors that contribute to cognitive decline. For example, B-vitamins, such as thiamine, pyridoxine, folate, and cobalamin, support brain metabolism. Omega-3 fatty acids have neuroprotective and anti-inflammatory activity, particularly by increasing docosahexaenoic acid in the brain; these have been shown to improve cognition alone or in combination.³

Of Note

- CCDS is a neurodegenerative condition in aging dogs, presenting with behavioral changes (DISHAAL) linked to structural brain atrophy and metabolic decline.
- MCT supplementation supports brain energy metabolism, improves cognitive function, and shows clinical benefit in both prevention and treatment of CCDS.
- Early detection and proactive management—through nutrition, enrichment, and regular screening—are key to preserving cognitive health and quality of life.

Medium-chain triglycerides (MCTs) also play a role in supporting cognition. Brain health may be promoted by ensuring that easily metabolized energy is readily available. In dogs, the metabolic rate of the brain decreases with age, with evidence of a decrease of 25% in dogs over 6 years of age.⁴ As energy sources, the brain can use both glucose and ketones; however, ketone bodies require fewer metabolic steps than glucose, making ketones a more efficient energy source. When MCTs are metabolized, they form ketone bodies (beta-hydroxybutyrate and acetoacetate) which may be used as fuel by the brain. Providing MCTs is associated with improved cognitive performance in humans with mild cognitive impairment and Alzheimer's disease.⁵

Diets supplemented with MCTs have been shown to improve cognitive function in both senior dogs without significant cognitive decline and clinical patients with CCDS. This is important, as it highlights the potential role for MCTs in both prevention and treatment of cognitive decline. Healthy senior beagle dogs were fed either a control diet or a diet supplemented with

5.5% MCTs. Over a period of ~8 months, the dogs were assessed on cognitive tasks that required them to discriminate between two choices, remember rewarded objects, and switch between rewarded contingencies. In dogs with cognitive decline, the ability to learn and remember may be impaired, but often the most revealing tests are those that require switching of contingencies and depend on cognitive flexibility. For example, when dogs are taught that choosing a blue square is rewarded with a treat, and choosing a yellow circle is not, dogs with cognitive decline may take longer to learn the task, but the difference may be small. However, if suddenly the blue square is no longer rewarded and the yellow circle is, dogs with cognitive decline will have more difficulty switching, will make more errors, and will continue to choose the blue square on multiple trials. In the diet trial, even for healthy senior dogs, performance on the cognitive tasks was improved while on the MCT diet, particularly as the tasks increased in difficulty.⁶

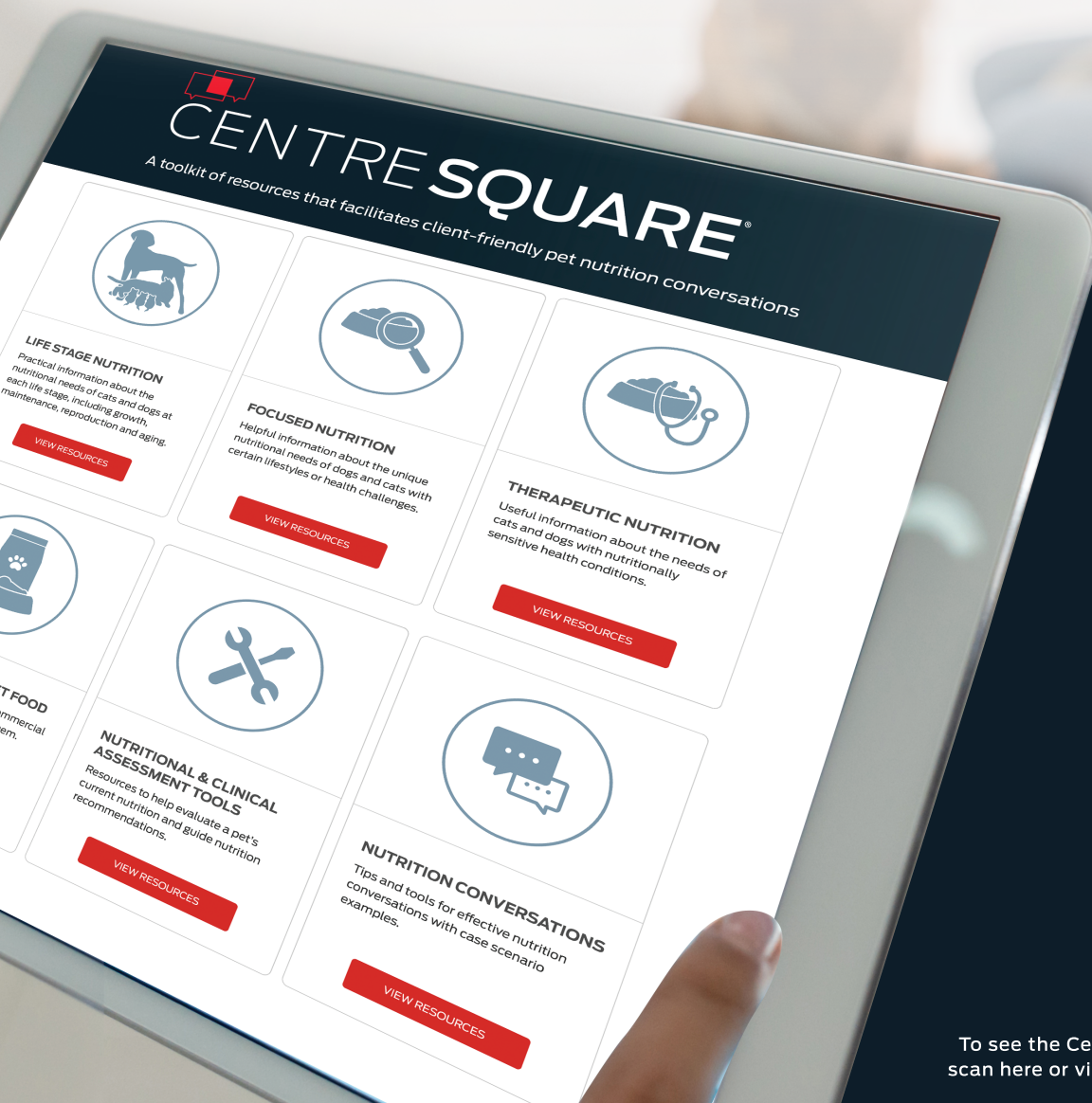
While work is ongoing in many groups to develop cognitive tasks that can be performed in the clinic and at home, most of the monitoring for cognitive decline and CCDS is accomplished using owner questionnaires such as the DISHAA scale or the Canine Cognitive Assessment Scale (CCAS). These questionnaires ask owners to rate their dog's behavior across the domains known to be affected by CCDS, with threshold scores for designating dogs as normal, at risk, mildly affected, or severely affected by CCDS. Using one such scale, pet dogs diagnosed with CCDS were fed either a control diet, a diet supplemented with 6.5% MCT, or a diet supplemented with 9% MCT, and their changes in scores were monitored over 3 months. In this clinical population, dogs in all groups improved on some domains, but those who were in the 6.5% MCT supplementation group improved in all 6 tested domains, with the majority of dogs (88%) improving overall, and the highest number of responders (92%) in the social interaction domain. Dogs in the 9% MCT diet group also improved in their scores, but fewer dogs accepted the diet.⁷

Overall, these data support the use of nutritional strategies for the promotion of brain health, and a role for MCT supplementation in supporting cognitive function. As the prevalence of CCDS is likely to increase as dogs live longer and fuller lives, it is increasingly important to consider ways to prevent cognitive decline, and slow progression when it is present to protect dogs' quality of life.

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