Many factors influence the diets that humane organizations feed the dogs in their care. Shelters often feed dogs whatever food the public kindly donates, the cheapest option available, or the product from a pet food company with whom the shelter has a business relationship. This can lead to a plethora of food products in the storeroom, foods that differ greatly in cost, nutritional content, and quality.

Since the nutritional content of a diet can affect how a dog behaves, shelter staff need to understand how to incorporate dietary management into a behavior modification plan. To some degree, the dietary choices the shelter staff make can exacerbate—or, with the correct knowledge, alleviate—existing behavioral problems.

Diet and behavior
Most of us recognize that food noticeably affects our mood. Both the comfortable, relaxed state we enjoy after eating Thanksgiving dinner, and the energy highs and lows after consuming too much chocolate, can be profound!

These fluctuations in energy level can be extreme, and we might assume from these examples that diet has an immediate and short-lived effect on how we feel. Our blood sugar levels and stomach distention can certainly produce fairly immediate changes in our mood and whether or not we feel “full.” Dogs experience these short-term effects as well, and—just as our diets can have long-term effects on our emotional outlook—research into the relationship between food and behavior in dogs indicates that what they eat may influence their anxiety, activity, and even levels of aggression, over many weeks or months.

Why the link?
Food provides the building blocks for our muscles, organs, bones, hormones, and blood supply. It also provides the components needed to make and regulate the neurotransmitters (chemicals which help to relay messages through the brain) that affect mood, emotions, and ultimately behavior.

Many behavioral problems in dogs arise as a result of mood disorders. Generalized anxiety, separation anxiety, defensive aggression, and obsessive-compulsive behaviors, for example, often manifest in dogs with underlying anxiety disorders and are rife in the shelter dog population. In one study I conducted of 3,500 dogs adopted from British Columbia SPCA shelters, two-thirds exhibited some level of separation anxiety within their first three months in a new home.

These problems are associated with imbalances of key neurotransmitters in the brain, and thus can often be improved by administering medications that alter the neurochemical imbalances.

At present, diet cannot induce brain changes to the extent that medications can, but nutritional management may still be a helpful adjunct to a behavioral modification plan, and is well...
within the grasp of most humane organizations, both fiscally and in terms of accessibility.

For shelters, the issue is this: What foods and nutritional supplements are best for dogs prone to behavioral problems in the shelter? Just how beneficial is it to incorporate diet choice into a behavioral management plan? And do different diets address different behavioral issues?

With so many brands and formulas to choose from, how do you choose which one is right for your dogs? Most supermarket brands of dog food have low to moderate protein levels and are nutritionally very well balanced.

What’s best for dogs—high- or low-protein diets?
People have strong opinions regarding the source and level of protein that their dog’s food should contain. There is no universally agreed-upon cutoff for what constitutes a high- or a low-protein food. However, based on the results of some studies, 30 percent protein or greater may be considered high, while 26 percent or lower may be considered low.

Advocates for high-protein diets often argue that they are better for dogs because they are what dogs would eat under “natural” conditions. Higher-protein diets increase lean body mass and increase satiety—that is, they make dogs feel fuller after consuming less, and thus may help to reduce the incidence of obesity. Working dogs certainly need more protein than nonworking, more sedentary dogs.

Despite these features, many owners and veterinarians support feeding lower-protein foods. Dogs predisposed to, or with existing liver and kidney disease and urinary stone formation, may be healthier on lower-protein diets. More recently, the behavioral benefits of feeding lower-protein diets have been the subject of scientific inquiry. While the method, or mechanism, for the relationship between protein and behavior is fairly well understood, research evidence to substantiate the effect of varying protein levels on behavior is less clear.

Tryptophan and serotonin

The neurotransmitter serotonin is present in all animals and serves many important functions. It contributes to feelings of well-being and happiness, and is also involved in the regulation of moods (particularly anxiety and depression), compulsive disorders, sleep, mating, appetite, predatory behavior, memory, and learning. Broadly speaking, the more of it we have, the better/less anxious/less depressed we feel.

Serotonin levels can be elevated using prescription medications, the two main classes being the SSRIs (e.g. fluoxetine, branded as Reconcile for dogs) and the TCAs (e.g. clomipramine, branded as Clomicalm for dogs). But can serotonin levels also be affected by diet?

Certainly, ingesting serotonin alone does not increase serotonin levels in the brain because serotonin cannot be absorbed directly across the blood-brain barrier. However, diets rich in tryptophan, the amino acid from which serotonin is made, may have some behavioral effects.

It has been demonstrated that increasing the relative amount of tryptophan in food compared to other amino acids may lessen the severity of aggression problems in dogs previously diagnosed as being territorial. The relative availability of tryptophan in a diet can be increased in three ways: a) feeding a low-protein diet; b) supplementing a diet with additional tryptophan; and c) feeding carbohydrates to stimulate insulin production.

Let’s examine each:

a) Feeding a low-protein diet

The scientific literature here provides mixed insights into the behavioral effects of feeding high- versus low-protein diets. When diets are high in protein, the absorption of tryptophan in the brain can decrease, as the other types of proteins out-compete tryptophan for absorption. Reduced tryptophan absorption means that less serotonin is made, which may increase symptoms of low serotonin, such as anxiety, fearfulness, and aggression. Indeed, a 1996 study by Nicholas Dodman and his colleagues from Tufts University reported that dogs fed high-protein diets (32 percent) were more territorially aggressive than dogs fed lower-protein diets of 25 percent or 17 percent. But there were other measures of aggression that did not appear to differ with protein intake.

b) Tryptophan supplementation

In a 2009 study, Guido Bosch of Wageningen University in the Netherlands and his collaborators showed that adding tryptophan to the diets of behaviorally “normal” dogs had no significant impact on their behavior. However, it should be noted that the dogs used in this study were considered behaviorally normal; the impact of tryptophan supplements on behaviorally abnormal or very stressed dogs in a shelter population may yield different results, as has been shown in other species under stressful con-
stances, often referred to as fillers. Fillers have a bad reputation among some in the dog community, because they are considered to be a cheap and potentially harmful component of dog food, due to their potential for contamination. Corn and wheat gluten, contaminated with aflatoxins and melamine, respectively, have both been implicated in toxicity and food recalls in the last six years. For those who prefer their dogs to produce less poop to scoop, fillers are also an undesirable component of dog food.

The source of most filler in dog food is fiber. Fiber is non-nutritive plant material, and may be a) soluble (e.g. legumes, nuts, oats, bananas, root vegetables), which is readily fermentable (i.e. broken down into simpler compounds in the absence of oxygen) into gases in the colon, or b) insoluble (e.g. wheat, bran, whole grains, some vegetables), absorbing water as it passes through the intestines, thus easing defecation.

Are fillers bad?
Typically, diets that are high in protein are often low in nutritionally less-valuable sub-
Despite its relative lack of nutritional value and bad reputation, though, fiber has other properties that can aid digestion and enhance mood.

Insoluble fiber has a high water-binding capacity, which increases the weight and volume of food in the stomach, causing feelings of fullness. Insoluble fiber can also slow down the rate at which food passes through the small intestine, again leaving the dog feeling fuller for longer. This slowing down also provides more opportunities for nutrients to be absorbed through the intestinal wall, leading to more stable blood glucose and insulin levels. It also produces much less gas than the soluble fibers, because it has low fermentability.

So it’s important to know the source and type of filler, or fiber, you’re using before you decide whether it’s likely to benefit or harm a dog’s behavioral health. One notable study indicated that the type of fiber added to food can affect the behavior of kenneled dogs. In 2009, Bosch and his co-workers again studied beagles who were fed either an insoluble, low-fermentable fiber diet containing cellulose, or a soluble, high-fermentable fiber diet containing sugar beet and inulin (a dietary fiber found in plants). Dogs who got the soluble fiber, sugar-beet, and inulin-rich diets were significantly less active than the dogs fed insoluble fiber, presumably because they felt fuller for longer.

Knowing how to make dogs feel full, especially when they are on a calorie-controlled diet, can be very important. Whereas severe restrictions in calories can reduce activity in dogs, small restrictions can actually lead to an increase in activity and possibly barking. Managing this effect by making sure dogs feel satiated may reduce stress and noise levels in a facility.

How do nutritional supplements affect behavior?

There is a range of nutritional supplements now available that claim to make dogs smarter, calmer, reduce their anxiety, and enhance their well-being. These supplements, often referred to as nutraceuticals, are mostly nonprescription, which makes them easily accessible to shelters with problem dogs. But do they work?

These products tend to fall into three broad categories—a) those that enhance serotonin, b) those that affect GABA receptors (GABA is a substance in the brain that causes calming), and c) those that help protect the brain from damage arising from aging and stress.

L-theanine (branded for dogs as Anxitane) is a derivative of tea, and appears to have a short-term effect on GABA, and a longer-term effect on serotonin when given over six weeks. A 2010 study by the University of Toronto’s Joseph Araujo and collaborators found that, compared with a placebo group, kenneled dogs given Anxitane showed reduced fearfulness toward unfamiliar people, and were actually friendlier.

Alpha-casozepine (branded for dogs as Zylkene) is a dietary supplement derived from milk and seems to cause calming effects similar to GABA. A study by Claude Beata and his French colleagues in 2007 examined its effects on 38 pet dogs recruited through veterinary clinics. After eight weeks, anxiety measures in the treated dogs had declined. Furthermore, the alpha-casozepine was found to be as effective in doing this as a prescription medication also approved for treating behavioral problems.

Theresa DePorter and her colleagues published a study in the Journal of Veterinary Behavior this year on the effects of giving dogs Harmonese, a supplement containing Magnolia officinalis and Phellodendron amurense, which may also modulate GABA. Sixty percent of dogs with noise sensitivities were mildly less fearful during a simulated thunderstorm, compared to a 25 percent improvement in the placebo group. In general, these products do show some behavioral and emotional benefits for dogs—perhaps to a lesser degree than their prescription counterparts, but also with fewer side effects.

In addition, there are many products that specifically address cognitive signs of aging in older dogs, but may hold some benefit to puppies and adult dogs who are experiencing chronically stressful conditions, such as long-term confinement. To varying degrees, products such as Aktivait, Senilife, and NOVIFIT have been shown to improve dogs’ interactions with people, problem-solving abilities, and sleep/wake cycles, and may also improve the learning ability of dogs undergoing stressful events such as basic training in a shelter. Omega-3 fatty acids (in-
Including PUFAs and DHA) are key ingredients in some of these products, and may be given separately when cost is a major concern.

**Do specialist behavior diets work?** Diets are now available that are formulated with one or more of the behavior-modulating features described above. The protein levels in all of these diets are low, and some are supplemented with ingredients aimed to enhance learning, calmness, and well-being. These diets all meet basic nutritional requirements, so feeding them to any dog is unlikely to do harm. But do they create the behavioral improvements that they claim to? These diets show promise, and their claims are slowly being validated, but they have limitations.

Royal Canin’s CALM diet has been formulated to include therapeutic levels of tryptophan and alpha-casozepine. Currently the alpha-casozepine content is only high enough to be effective in small breeds. However, a study led by Maki Kato at Azabu University in Japan found that, when subjected to nail-clipping, small-breed dogs who had been fed the CALM diet were less stressed (measured using urinary cortisol) than dogs fed a control diet. The effect of the CALM diet on shelter animals, to the best of my knowledge, has not yet been published. In addition, there are some diets supplemented specifically to address cognitive changes in senior dogs, such as the Hills B/D Diet. These diets also show some significant benefits for aging animals, and should be given when available.

**A final word** The relationship between diet and behavior is something every welfare and behavior manager should be aware of. Dietary management alone is unlikely to cure a dog of her behavior problems, but it may contribute to overall behavior modification success.

While the mechanisms for changing mood through diet are well-understood, individual responses are highly variable, and much research still needs to be done to determine its benefit specifically in shelters. However, this information likely also applies to owned dogs, and thus is advice worth passing on to adopters. When faced with an array of food choices, at least the potential impact of certain diets can now be a considered decision rather than a random choice. Choosing which dog gets what food is relatively “low-hanging fruit” when it comes to shelter management.

Rebecca Ledger is an animal behavior scientist and clinical ethologist from Vancouver, British Columbia. Originally from the U.K., she holds a master’s degree in applied animal behavior and animal welfare, and a doctorate in the assessment and treatment of behavioral disorders in shelter dogs. She presented the material in this article in February at the annual Masters in Behavior Conference in Portland, Ore.

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