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Too Much of a Good Thing: Protein and a Dog's Diet

Dana H. Murphy

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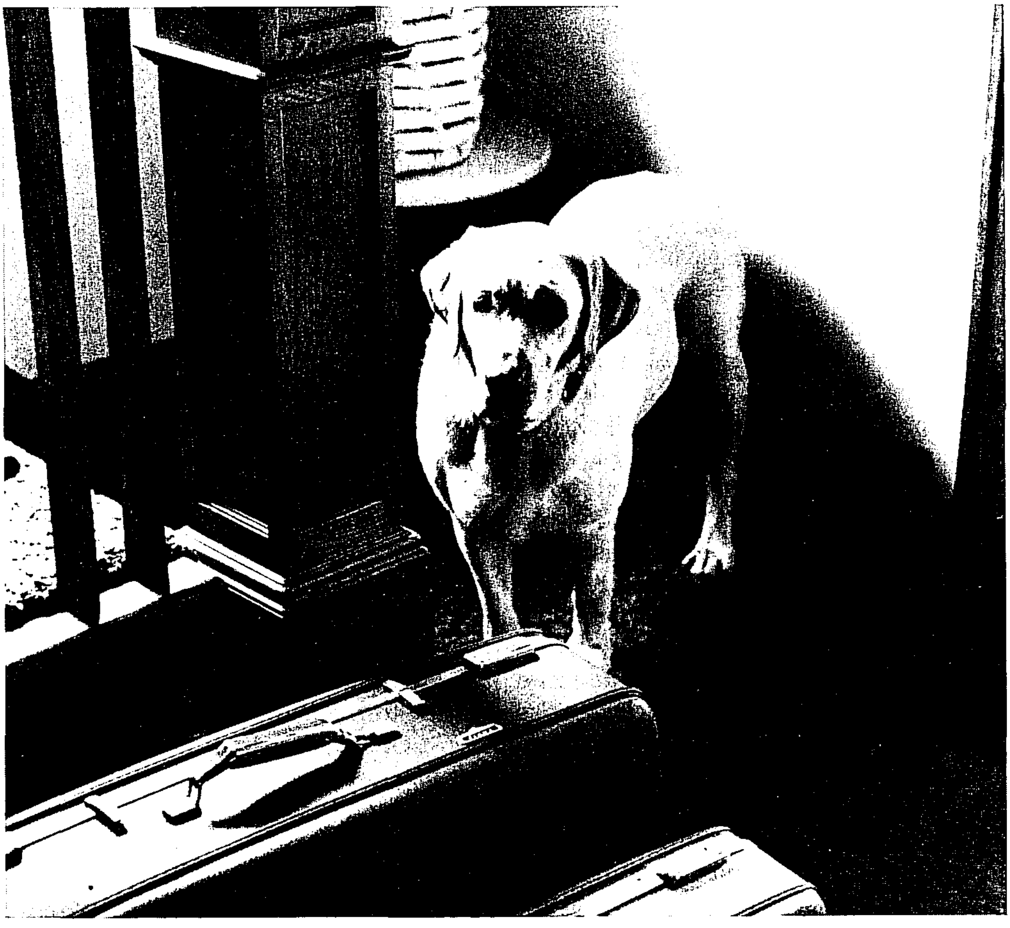
Yet in the same paper, Suter reports that all signs indicate that the Japanese whaling industry is actually winding down. He notes that in recent years a drastic reduction in work opportunities has occurred, and few young men have shown much inclination to enter an industry with such a bleak future.

But perhaps the most perplexing bit of information comes from the magazine *Agenda* (*3*(1):7, 1983). The Nippon Research Center, the Japanese affiliate of the Gallup Poll, published a study on October 30, 1982 which indicated that more than 75 percent of those Japanese sampled *favored* acceptance of the whaling ban. So perhaps the phenomenon of apparently entrenched Japanese opposition to the IWC decision may represent less a manifestation of cultural complexities, and more the obstreperous and well-organized voice of the native fishing industries.

Focus

Too Much of a Good Thing: Protein and a Dog's Diet

Look at the wretchedly unhappy dog in the picture. If ever an animal's face showed a human-like expression, it's got to be this dog. What, precisely, is his problem? Well, according to the people at the Alpo Center for Advanced Pet Study and the University of Pennsylvania School of Veterinary Medicine, the dog is suffering from severe stress, because he has intuited that his owner is about to desert him for some sort of trip. And according to Alpo, the physiological drain the dog is likely to endure as a result of this stress is "as profound as a sled dog in a 20-mile race" (this from a press kit prepared for Alpo by the New York public



relations firm, Manning, Selvage & Lee). The kit also lists some other stressors that may have the same effect: travel, a long stay alone, grooming, noisy children, dog shows, and hunting.

The information in the kit tells us that emotional (and other) stressors can result in severe protein depletion, as the dog's body gradually becomes so worn down that he must catabolize his own tissue's protein to meet his energy requirements. This assertion is backed up by several research papers that are also included in the kit, by Dr. David Kronfeld of the University of Pennsylvania, on the nutritional needs of racing sled dogs. But note the equation that is being made here: the claim made by Alpo is that the physiological ramifications of *emotional* stress are precisely equivalent to those of *physical* stress and, in particular, the physical stress of a very special kind of situation, the rigors of athletic training.

Granted, the PR brochure, "A Dog's Life: Stress and Your Dog," does fudge a bit on the language, limiting its claim to: "the stress experienced by sled dogs racing at 20 miles an hour *parallels* (our emphasis) the stress undergone by the family dog beset with everyday problems." Yet the prescription for both conditions remains the same — more protein, which conveniently, is exactly what a can of Alpo can provide.

But within Kronfeld's own papers are data that undermine Alpo's facile argument, even though a considerable portion of what Kronfeld, and Alpo, state is, in fact, correct. As Kronfeld asserts, stress has been generally understood as a "nonspecific response of the body to any demand" (quoted by Kronfeld from the "Father of Stress," Hans Selye, in the latter's book, *The Stress of Life*, published by McGraw-Hill in 1976). It is also true that nearly all stressors elicit the same sequence of events in the central nervous system and endocrine glands. In stress, the hypothalamus of the brain is stimulated to activate the anterior pituitary, which produces adrenocorticotropic hormone (ACTH), which in turn acts upon the adrenal such that corticoids and catecholemines are secreted. These biochemicals induce a broad range of physical and chemical changes throughout the body. The catecholamine epinephrine increases both heart rate and the force of each heart constriction; smooth muscle in the lung and intestine become relaxed. At the same time, glucocorticoids prepare the body's concentrated stores of energy such as glycogen and lipid molecules for rapid mobilization. All of these dramatic changes serve to prepare the animal for the "flight or fight" that may be necessary in an emergency. Finally, if the stress is extremely severe, or if it lasts for too long a period of time, protein can be converted to glucose. It then becomes available as an additional source of fuel for the body, but it is energetically less efficient than lipid or glycogen because more complex biochemical transformations are required to convert it to oxidizable fuel (glucose).

Where the analysis done by Kronfeld on stress in dogs goes awry is in its implication that this conversion of protein reserves occurs during a mild or transient period of emotional turmoil. In point of fact, catabolism of proteins only begins after an extended duration of *severe* stress, as a consequence of an extreme condition like a long sled race or a bad infection. Therefore, a mildly stressed animal probably needs carbohydrates (and perhaps fats) far more than supplemental protein, since the former can be quickly and easily converted into bodily fuel. And in the case of the stress induced by mild illness, it is probably best to let the animal follow his natural instincts, and simply let him fast. The metabolism and consequent nutritional requirements of an animal in training — a racing sled dog — differ both qualitatively and quantitatively from those of an animal subjected to sudden and unexpected stress, whether of the transient, mild or the more severe type. Finally, there may be real danger in feeding a dog more protein than his body actually needs. Recent studies have documented a strong causal link between regular supplementation of an animal's diet with heavy doses of protein and progressive kidney disease. And it is virtually certain that a large daily ration of protein will exacerbate any pre-existing kidney conditions, especially in older dogs, since the damaged organ is simply unable to handle the extra work required to excrete the additional levels of toxic byproducts of increased protein catabolism.

The Alpo-Kronfeld Dossier

One of the items in the packet from Manning, Selvage & Lee is a paper by Dr. Kronfeld, entitled "Protein for Hard Working Dogs" (*Pure-Bred Dogs American Kennel Gazette,* November 1980). This paper is intended to provide the principal scientific underpinning for the brochure's claims that stressed dogs need more protein. The article first discusses the different roles played by protein within the body, and then explains how protein needs change when dogs are placed in conditions of physical stress. Protein, Kronfeld tells us, can be used in three ways: to supply amino acids for oxidation, to provide materials for construction and repair of bodily tissues, and, of special importance for racing dogs, "to promote the generation of red blood cells...in canine athletes." RBC's increase in both number and volume during training, in order to supply more oxygen to working muscles. However, during periods of maximal stress in the racing season, the number of RBC's decreases if the dogs' diet contains only 31 percent protein. On two other diets, with 40 and 53 percent protein, RBC numbers were sustained during stress.

Kronfeld concludes:

> *The protein requirements for stress and hard work is [sic] more than 38 percent but not 40 percent on a dry matter basis. In terms of available energy, at least 28 percent should be provided in the form of protein which has a quality (efficiency of utilization) of about 70 percent. Comparable figures are about 25 percent protein (energy basis) for growth, gestation and lactation, and 9 percent protein as a minimum for maintenance (if dogs will eat such a low protein diet).*

For Kronfeld (and Alpo) it is a short hop from these data on the protein needs for physical endurance in sled dogs, to other physical stressors such as traumatic injury, and thence to emotional stressors. As Kronfeld stated in a letter to us (September 15, 1982): "The same controls evoke the same biochemical responses to emotional or physical stimuli. The kinds of responses are the same in all stress situations; they differ only in degree."

With his letter, Kronfeld also sent along an article, "Nutritional Demands Imposed by Stress" (National Dairy Council, *Dairy Council Digest* 51(6):31-35, 1980). This piece was supposed to resolve our qualms about the precise relationship between physical and emotional stress. Interestingly, although both psychological and physiological stressors are discussed at the beginning of the article, only data from physiological stress, such as exposure to cold in rats, are cited further on. Based on these kinds of findings, the article states that "If the stressor is short-lived, the changes in stress hormone levels will be transient and unlikely to induce a catabolic response." And later:

> *For usual stresses encountered in daily living (i.e., stresses which result in transient increases in urinary nitrogen excretion, the Food and Nutrition Board, NAS-NRC, advises that nutrient intakes in excess of those indicated in the Recommended Dietary Allowances (RDAs) are unnecessary.*

So much for transient physical stress. But what happens in a true emergency as, for instance, severe physical injury such as surgery, burns, or infection? It is this sort of drastic situation that initiates the complete sequence of the CNS-hormonal cascade described above. The hormones that pour out into the blood as a response to injury induce the body to meet its augmented energy requirements from available carbohydrate stores (principally, the glycogen contained in liver and muscle tissue). Then, if stress is protracted, that is, lasts for more than 24 hours, Kronfeld tells us that protein begins to be used as a fuel supply. But even then, its caloric contribution is supplemented by energy supplied by the body's lipid stores. And, of course, if the dog is fed during this period, he can go even longer before protein or lipid will begin to be depleted.

It would seem, then, that the case for a daily intake of large amounts of protein (and Alpo contains about 45 percent protein, on a dry-weight basis) is based on a dubious linking of a number of scientific data, each of which, however, is true enough if considered in isolation. Racing sled dogs do indeed need more protein, probably because of the increase in RBC count and individual blood cell volume. Physical stress does induce neurological and hormonal alterations, resulting in increased expenditures of body fuel. And, after 24 hours, protein may begin to be converted to glucose and oxidized, along with newly mobilized fatty acids derived from concentrated lipids. Finally, as noted in the Dairy Council report, emotions like fear and anxiety do increase energy expenditure. However, it is clear that these separate facts simply do not add up to the conclusion promulgated by Alpo in its PR campaign on dogs and stress, namely, that stressors as a *class* of phenomena will be likely to result in protein depletion, and that a high-protein diet is therefore necessary to maintain sound physical condition. For it is highly unlikely that the kinds of problems mentioned in the press kit brochure, "A Dog's Life: Stress and Your Dog," such as a 3-hour drive, a single trip to a dog show, or staying outdoors during the day, will trigger sufficiently strong CNS stimuli to result in much more than a depletion of some carbohydrate (glycogen). Therefore, the protein catabolism rate will be unlikely to increase by much.

So the dog in the picture may be sad; he may need some supplemental carbohydrate; but he certainly does not require high level feeding of protein.

How Much Protein Does a Dog Really Need?

> *The search for an absolute minimum is like the search of the philosopher for the absolute truth. There is not one but many protein minima, [each] a resultant of many factors. (E.P. Cathcart, quoted in Nutrient Requirements of Dogs, National Academy of Sciences, Washington, D.C. 1974).*

Part of the complexity involved in determining an exact figure for the protein requirement of dogs stems from the multiple roles that proteins play within the body. The amino acids that make up proteins, on one hand, comprise the chief building blocks of the body's architecture. They are the principal structural elements in muscle, tendon and connective tissues; with lipids, they form the semi-permeable membranes that surround all cells; and they constitute the special-function molecules like some hormones, antibodies, and enzymes, which catalyze the energy-producing and energy-using chemical reactions in the body. On the other hand, protein can be oxidized to provide energy for cellular work. What's important about these two possible pathways for ingested protein is that both depend, although to differing degrees, on the amount and type of protein provided in the diet.

Early work by W.C. Rose and E.C. Rice (*Science 90*:186, 1939) showed that nine amino acids were required by dogs as constituents of the proteins they ingest (the so-called "essential" amino acids), since the animals' bodies are unable to synthesize these in sufficient quantities for optimum health. These amino acid requirements, therefore, establish one minimum baseline for daily intake of protein.

However, once the need for the amino acids that are used for bodily proteins like enzymes has been met, an animal will use as fuel any excess that is ingested, as the need for energy requires. At the same time, the several fuels used by the body are virtually interchangeable: If too little carbohydrate and lipid are provided, even those amino acids that are necessary for bodily growth and repair will be "spent" as fuel. The principal end product of amino acid metabolism is the nitrogenous compound urea, which is eliminated from the body through the kidney.

The second complicating factor is the confusing number of ways that protein content of dog food is discussed, precisely because protein plays so many roles within the body. Individual protein sources, like meat and soybeans, can be rated according to many parameters: the percentage that is digested, the amino acid composition, and the calorie values of the other ingredients in the diet. Then, too, dogs in different conditions and of different ages have different protein requirements. Also, there are three basic types of dog food to consider—"dry" (which is actually 10 percent moisture), "semi-moist" (25 percent water), and "canned" (75 percent water). So all protein requirements must be calculated on a dry-matter basis.

Finally, there's an additional hitch introduced by the way dogs actually eat: they eat to satisfy their *energy* needs. Therefore, diets high in fat (and so also high in metabolizable energy) will be consumed in smaller amounts. High-fat diets should thus contain higher relative percentages of protein, minerals, and vitamins. From recent research (K.A. Houpt and S.L. Smith, *Can Vet J* 22:77, 1981), we have also found that dogs seem to have other kinds of taste preferences: cooked meat, for example, is more palatable than raw meat. So even after a dog has had an ample portion of cooked-meat food, he will still seem hungry to his owner, who is then sorely tempted to give him more. But it's that extra portion that will make the dog, in time, obese. Obesity is a widespread problem among dogs in the U.S., according to Dr. Michael Fox of the ISAP, which can aggravate arthritis pain and intervertebral disk herriation, and impair cardiac function. It also increases surgical risk, and raises the probability of hernia and lipoma tumor development; obesity reduces disease resistance, too, as well as the incentive to be active. In sum, life-span is shortened.

But setting all these caveats aside for a moment, there *are* some rough guidelines about protein content (expressed as percentages of dry matter) that can be established for healthy adult dogs. The data cited most frequently are those of the National Academy of Sciences publication, *Nutrient Requirements of Dogs*. For the various types of dog foods, the Academy's requirements for protein are:

Dry type	
(10 percent water)	20 percent
Semi-moist	
(25 percent water)	16.5 percent
Moist	
(75 percent water)	5.5 percent

Since dog food labels only give percentages of total protein, and do not disclose the exact amino acid composition, we asked Dr. Mark Morris, Jr., of Mark Morris Associates in Topeka, KS, whether the consumer need be concerned about meeting his/her dog's minimum requirements for essential amino acids. He replied that there was little need for anxiety, because *all* of the commercially available dog foods contain so much *extra* protein than what is actually required, that it would take an intrepid and lengthy search to find a food that didn't have sufficient quantities of the important nutrients. Alpo, for example, is about 45 percent protein—more than 7 times the amount that's necessary.

Protein and the Kidney

In an article in *Gun Dog* (*1*(3):26-27, 1982), Dr. Morris stated: "High-protein dog food is not good for your dog, and if he has kidney problems, an all-meat dog food can kill him." What is the scientific basis for this statement? The main reason why lots of protein is not good for your dog is that, with a high-protein diet, protein is burned by the body as fuel, producing high concentrations of the toxic nitrogen-containing end product, urea. If the kidneys are compelled to process too much urea, existing urinary conditions may be aggravated, especially in older dogs. In fact, recent data have demonstrated that continuous ingestion of high protein levels may even cause kidney degeneration.

We asked Dr. Kronfeld for his comments about the potential danger of high-protein diets in older dogs. He responded (letter, September 15, 1982);

> *The point in the course of moderate or severe failure when the disadvantage of accumulating nitrogenous toxins (principally urea) outweighs the disadvantage of low protein diets on kidney blood flow, filtration, and tubular reabsorption has not been well-established clinically.*

In rebuttal to this statement, Dr. Morris said that, while it is true that high protein volumes do enhance one of the measures of kidney function, the glomerular filtration rate (or kidney throughput), the high levels of urea produced in the process impose too heavy a workload on the kidney. What one is doing, in a sense, is "using protein to stimulate an organ that's already degenerated."

Kronfeld's stance seems to be chiefly based on one series of studies by K.C. Bovee *et al.* (*Invest Urol,* 1979). Bovee and colleagues surgically removed 25 to 50 percent of the kidney mass in dogs, and then found that kidney function remained quite satisfactory. Questioned as to whether there was something faulty in an experimental model that yielded such unexpected results, Dr. Morris noted that, after surgical removal of a portion of the kidney, the intact sections tend to hypertrophy to compensate for the loss. So, said Dr. Morris, what Bovee *et al.* were probably measuring was the functioning of a kidney of near normal capacity.

But perhaps the most fascinating, and gratifyingly unifying, hypothesis on the role of protein in kidney function appeared in the September 9, 1982 issue of the *New England Journal of Medicine,* in an article by B.M. Brenner *et al.* They noted that the short-term increases in glomerular filtration rate that appear after a protein-rich meal are, "by cumulative effect, responsible for the sustained hyperfiltration and accompanying renal hypertrophy seen in animals maintained on high-protein diets." Brenner and colleagues theorize that these changes, in turn, affect the selective permeability of the glomerular membranes such that larger protein molecules like albumin begin to travel across the capillary wall. As a result, these proteins may become deposited on the cell walls of kidney tissue, eventually leading to glomerular sclerosis.

Brenner *et al.* speculate that the problems caused in the kidney by a steady diet of high protein may be the consequence of an odd glitch in evolution. Long before any of the canids had ready access to food in cans, all carnivores ate according to a particular pattern: they consumed large meals, at infrequent intervals. As a result, two different populations of nephrons (the structural unit of the kidney) developed. The first population of deeper nephrons served to carry on excretory business-as-usual between big meals, whereas the second, superficial population were used as reserve capacity, to handle the extra work required after ingestion and catabolism of protein.

But with the advent of daily, ad libitum protein intake, both deep and superficial populations had to be kept at work all the time. Brenner and co-workers think that this change in protein-eating patterns, with its attendant burden on the kidney, may contribute to the age-associated glomerular sclerosis repeatedly observed in laboratory animals (including dogs) and in human beings. As proof, the note that the simple limiting of food intake, or giving food every other day, has been shown to retard the development of kidney lesions in rats and mice.

Food Fads and Fetishes (vs. Nutrition)

We have all been conditioned, by now, to believe that we live perpetually in a climate that is rife with trauma and stress, and that this kind of environment is of relatively recent origin. Unfortunately, we have no real way of knowing whether the pressures of deadlines, urban sprawl, etc., are really more damaging than the prospect of a dry cow or a barren field was to our ancestors. In any event, most of us feel that plenty of protein is one way to construct the tough-hewn "lean machine" that will insulate us against those terrible external stressors. Various fad diets, as they come and go, have also endowed the word "protein" with a kind of magic. And so, in a prime example of anthropomorphism, we project our own fears and beliefs onto our companion animals, and are easily cajoled into believing that the family dog, too, needs heavy protein doses to survive the day. While some researchers allege that an all-vegetable diet may be difficult for larger dogs to digest, there is certainly a plethora of choices of dog foods that provide a happy medium — enough protein, but not too much, thank you.

Dana H. Murphy