Natural Nutrition for Pets

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If we are going to talk about natural nutrition, then we should start by defining our terms. Previously nutrition was considered an adjunctive therapy to common diseases. Nutrients were seen as simple building blocks, cofactors, and enzymes. Now, nutrition is a cornerstone of treatment since we know that nutrients are regulators of cellular metabolism and gene transcription or translation.[1]

So, what of "natural" nutrition. AAFCO defines a natural food as "…a feed or ingredient derived solely from plant, animal or mined sources, either in its unprocessed state or having been subject to physical processing, heat processing, rendering, purification, extraction, hydrolysis, enzymolysis or fermentation, but not having been produced by or subject to a chemically synthetic process and not containing any additives or processing aids that are chemically synthetic except in amounts as might occur unavoidably in good manufacturing practices."[2]

Well, I guess that's one way to look at natural nutrition. My definition of natural nutrition is: A diet consisting of ingredients that a particular species has evolutionarily adapted to eat with the macronutrient and micronutrient balance that is ideal for their health. By definition I am speaking of a raw or as some say, an "unconventional" diet.

REDUTIONIST NUTRITION VS. FOOD SYNERGY

To understand natural nutrition, we need to understand the two main nutrition philosophies – reductionist nutrition and food synergy.

Reductionist nutrition is based on reductionism which is an approach to understanding the nature of complex things by reducing them to the interactions of their parts. In other words, a complex system is nothing but the sum of its parts. Likewise, reductionist nutrition, the nutritional philosophy employed in veterinary education, is the notion that foods can be fully understood by analyzing the nutrients that comprise them. So, a carrot is basically beta-carotene and Association of American Feed Control Officials (AAFCO) Profiles yield pet food.

Does this idea hold water? Well, let's take a look at a simple nutrient, sodium chloride. According to reductionist nutrition we can understand table salt by looking at its constituents, sodium and chlorine. As it turns out, sodium is a soft, white/silver, highly reactive metal that explodes in water. Chlorine is a yellow/green highly reactive gas that is poisonous. Did you find that a helpful process for understanding salt? It turns out that when you bring nutrients together in foods, something new is often created.

This same concept is true for other foods as well. You have probably heard that lycopene, a nutrient found in tomatoes, fights prostate cancer. Well, not so fast. It turns out that consuming tomatoes has more robust health effect on the human prostate than did taking an equal amount of lycopene.[3,4] In an interesting twist, the same concept holds true for peanut allergies. A study found that consuming the allergenic proteins of peanuts in isolation did not cause an allergic reaction in those allergic to peanuts.[5] In fact, according to the NIH clinical trials of pharmaceutical-like vitamin/mineral products have found that many do not work as intended or even have adverse effects.[6]

A more holistic view of nutrition is represented by *food synergy*. This is the concept that the biological effect of consuming nutrients in the form of the food matrix (the composite of naturally occurring food components) on biological systems is greater than, or different from, the actions of the individual food components.[7] According to proponents of this nutritional philosophy, "A fundamental feature of food is that the constituents are coordinated… A person or animal eating a diet consisting solely of purified nutrients in their Dietary Reference Intake amounts, without benefit of the coordination inherent in food, may not thrive and probably would not have optimal health."[7]

The "Dietary Reference Intake amounts" is basically the human version of AAFCO Profiles. AFFCO is responsible for setting nutritional standards for pet foods. Based on studies regarding nutritional deficiencies and toxicities, AAFCO determines the minimum and maximum levels of about 30 nutrients that should be in pet foods. According to food synergy scientists, relying solely on such a profile for pet food leads to sickly dogs and cats.

There are thousands of phytochemicals present in whole (unprocessed) foods. These work together synergistically to promote health in the body. According to researchers, these nutrients "in some sense could equally be deemed essential for life [as vitamins and minerals]… It seems a good assumption that the vast majority of components of plant and animal-based food is functional, that it has some kind of biological activity."[8]

MACRONUTRIENT BALANCE

We all know that the macronutrients in pet food are protein, fat, and carbohydrate. Carbohydrate consists of starch (AKA N-free extract) and fiber. In the studies we'll be looking at, we will analyze the macronutrient balance of various diets based on the level of calories they contribute to the food (AKA percentage of metabolizable energy, or %ME). Since fiber is non-digestible and does not contribute energy to the food, when the studies refer to carbohydrate, they are referring to starch. And for the following analyses starch is the nutrient of interest.

Macronutrient balance is important in wide range of animals and has multiple effects. It influences growth rate and size.[9,10] It can affect levels of obesity,[11] longevity,[12] and disease resistance.[13] It is also important to note that predators select food based on the macronutrient balance that best assures their survival.[14,15] Animals evolve o match their environmental niche, and available food is an important part of their environment.

CAT MACRONUTRIENT BALANCE

With that groundwork laid and with our quest to determine the ideal macronutrient balance for pet food in mind, let's look at the diet of cats. How can we determine the ideal macronutrient balance for these predators? Well, one group of researchers assembled an meta-analysis of 27 studies of the macronutrient profile selected by free-roaming, feral cats.[16]

They found that as a percentage ME the Protein:Fat:Starch (P:F:S) levels were 52:46:2. These researchers went on to affirm that "The calculated nutrient profile may be considered the nutrient intake to which the cat's metabolic system has adapted."[16] In other words, this is the ideal macronutrient profile for cats.

Another group of researchers studied the macronutrient profile selection for adult domestic cats.[15] The process used involved giving that cats their choice of foods with various macronutrient balances and then doing a geometric analysis to determine the preferred macronutrient profile. In this study the selected P:F:S was 52:41:7. These researchers concluded, "Our analysis indicates that cats have a ceiling for carbohydrate intake, which limits ingestion and constrains them to deficits in protein and fat intake (relative to their target) on high-carbohydrate foods."[15] In other words, if you have too much starch in a cat's diet, they will not get their ideal levels of protein and fat.

For the sake of completeness, I need to also report another study that explored the macronutrient profile selection for adult domestic cats.[17] These researchers considered that the reason that in previous studies cats selected low levels of starch is that they simply like the taste of protein and fat better. And, of course, the cat's sense of taste evolved to fool cats into eating diets high in protein and fat. Instead, the body's metabolism should be the only factor involved in macronutrient selection. The researchers endeavored to offer their study subjects diets of various levels of macronutrients, just like the previous study. The difference is that they made the diets conform to a similar level of palatability so that no macronutrient balance would have a taste advantage.

You need to read the details of the study to see just how the researchers achieved their palatability goal. Here is how they explained it, "Because cats like chicken more than pea protein, pea protein (9.0%) and wheat gluten (35%) were used as protein sources instead of as much chicken (13.1%) in the high protein food."[17] In other words, the cat's refined metabolic processes could select the correct macronutrient balance but could not decipher the difference in amino acid profile or digestibility of the different proteins offered. Hey, protein is protein.

Needless to say, this study's macronutrient profile of P:F:S = 30:27:43 is an outlier. Seriously, 43% starch is ideal for the diet of an obligate carnivore? To me the only thing this study proves is that if you try hard enough, you can get cats to eat a macronutrient profile that is hazardous to their health. By the way, I'm sure this has nothing to do with the design of the experiment, but the study was sponsored by Hills.

For comparison we can look at the AAFCO Adult Cat Food Standards which yield o P:F:S = 25;21:54. When I explained my comparisons of realistic cat macronutrient profile selection to the AAFCO standards I was told that that was unfair because most diets do much better than that. For her sake, I analyzed what many veterinarians consider to be the highest quality cat kibble, Hill's® Science Diet® Adult Optimal Care® Original (Feline). For this food the P:F:S =

28:43:29. Yes, 29% starch is better than AAFCO's 54% but s a far cry from the ideal 2% selected by the feral cats.

DOG MACRONUTRIENT BALANCE

As we turn our attention to the dog preferred macronutrient profile, I found an early study[18] dating to 1979 that looked at the stomach contents of wild carnivores (coyote, fox, wolf, bobcat, cougar, and lynx) as a guide for domestic dog nutritional needs. They justified this approach because the gastrointestinal tracts of these animals are very similar to that of the dog. These researchers did not do a detailed quantitative analysis but concluded that these wild carnivores consume a diet high in animal protein, bulk, and roughage and low in carbohydrates.

It is interesting to compare the above study[19] to that published in the journal *Nature* in 2013. This research was conducted by a group of evolutionary biologists who compared the genomes of domestic dogs to that of wolves. They focused on differences in three key starch-digesting enzyme systems that indicated the dogs are able to digest starch better than wolves. So, there are digestive differences between dogs and wolves, but this still does not give us quantitative information. Also, I like to point out that I can easily digest sucrose and ethanol but that does not mean I would thrive on a diet rich in Twinkies and tequila. Just because you can digest something does not mean you should.

I wanted to get a sense of the canine ancestral diet. From the section on the ancestral diet in Steve Brown's book *See Spot Live Longer,*[20] I roughly estimated the macronutrient preference for ancient dogs to be P:F:S = 44:50:6. This is more satisfying quantitatively but it is derived from estimates derived from conjecture since there is no direct information about the dog's ancestral diet.

More recently another group of researchers were undaunted by the *Nature* study and did a comprehensive review of 50 diets of wild wolves reported in the literature.[21] They determine the P:F:S for wolves to be 54:45:1. So, wolves thrive on a diet that contains only 1% ME starch.

The researchers concluded, “The nutritive characteristics of commercial foods differ in several aspects from the dog’s closest free-living ancestor in terms of dietary nutrient profile and this may pose physiological and metabolic challenges.”[21] Maybe that explains the many problems we see in our canine patients.

Next, we have a study[22] that looked at the macronutrient selection of domestic dogs. In fact, they studied the diets of five diverse breeds including the papillon, miniature schnauzer, cocker spaniel, Labrador retriever, and St Bernard. They determined the P:F:S = 30:63:7. They go on to state, “… the overriding conclusion is that the recent rapid divergence among dog breeds is not substantially reflected in their macronutrient priorities...”[22] So, no matter the size or breed of the dog, the appropriate level of starch is 7% ME.

Another group of researchers did a follow-up to the previous study. They analyzed the macronutrient selection of 15 Harrier hounds.[23] When they averaged the profiles of days nine and ten of the diet protocol, they found a P:F:S of 47:49:4. They found that over 10 days, the preference trend was toward less fat and more protein. Of course, my nutrient of interest is starch. These last three studies prove that the Nature study was correct. When given the choice, dogs do consume much more starch than wolves: 4%-7% ME for dogs vs. 1% ME for wolves.

Once again, for the sake of completeness, there is another study[24] of dog macronutrient selection that I am compelled to include. As in the obligatory cat study, the researchers assumed that the dog is mislead by the chemical receptors in its mouth and nose to eat foods far too low in starch. They made the foods to be of similar palatability and found the P:F:S to be 23:41:36. Yes, a whopping 36% ME of starch! (One of these things is not like the others.) In order to derange the dogs’ selection to this level they use a palatability enhancer of “natural chicken flavor” that was titrated from 0.5% – 2.5% of the diet. As you might have guessed, this study was funded by Hills.

Meanwhile, AAFCO Adult Dog Food Standards yield a P:F:S of 19:12:69, and Hill's® Science Diet® Adult Advanced Fitness Original (Canine) yields 21:33:46.

RESEARCH: RAW VS. PROCESSED PET FOODS

I have heard for years that there is just no research validating the benefits of a raw diet for pets. I used to believe this until I recently went down the raw pet food research rabbit hole. There is more out there than you may realize. Many of the studies are small but when taken together, I think raw pet food fares well. Most of these studies are quite recent, including several that were published just this past year, so we are all forgiven for not knowing all this information was out there. What follows are brief descriptions of the interesting studies I found.

The first study[25] I'll touch on accidentally found a benefit of raw dog food. This was a "prospective study (July 2011 to October 2014) on shedding *Toxocara* eggs in a cohort of 938 household dogs older than six months from all over the Netherlands. The median follow-up time was 14 months."[25] An incidental finding that the researchers could not explain was that a raw meat-based diet was protective against Toxocara canis infections. It has been suggested that the raw diet positively affected the dogs' passive immunity.

In this study,[26] 6 DSH (20–28 weeks old) were fed 3 different diets in a Latin square crossover design. The three diets were: a commercially available canned heat-processed diet, a complete commercial pre-frozen raw diet, and a raw diet supplement mixed with ground raw meat. Food samples and all feces were sent for analysis of crude protein, crude fiber, ash, crude fat, moisture, and caloric density. They found higher dry matter, organic matter, and protein digestibility in raw diets compared with the heat-processed diet.

The next study[27] examined the apparent total GI tract energy and macronutrient digestibility, N balance, and blood metabolites of domestic cats (n = 11) using a 4 × 4 Latin square design testing 1 of 4 chicken-based dietary treatments: 1- to 3-d-old whole chicks (WHO), ground adult chicken product (GRO), a chicken-based canned diet (CAN), and a chicken-based extruded diet (EXT). The nutrient digestibility for cats fed GRO was greater than that for CAN and EXT which was greater than WHO. The researchers suggested the that the lower digestibility for WHO might have been do to the down interfering with digestion and/or absorption.

The next study[28] analyzed the gene expression profiles of peripheral blood mononuclear cells of raw red meat diet fed dogs (n = 7) compared to kibble diet fed dogs (n = 8). They found that a kibble diet appeared to be proinflammatory and the raw red meat diet anti-inflammatory within 3 weeks.

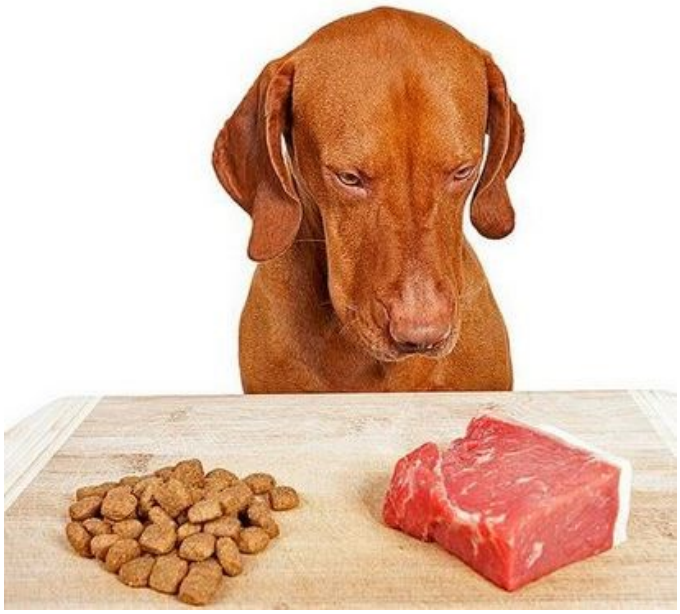
In 2020, a study[29] of a validated internet-based questionnaire in Finland analyzed data about 406 dogs with canine atopic dermatitis (CAD) and 1830 controls. They concluded that, "Although no causality can be established, feeding a non-processed meat-based diet early in life [prenatal/early postnatal] seemed to be protective against CAD, while ultra-processed carbohydrate-based diet could be considered a risk factor."[29]

The next study[30] looked at the metabolome, specifically the serum (*n*=20) and urine (*n*=8) metabolites in client-owned Staffordshire bull terriers. Some had been diagnosed with CAD (*n*=14) and others were healthy (*n*=6). These dogs were divided into 2 cohorts based on diet. Some were fed a raw meat-based diet (RMBD) (*n* = 11, CAD diagnosed *n* = 8, healthy *n* = 3) and others a kibble diet (KD) (*n* = 9: CAD diagnosed *n* = 6, healthy *n* = 3). The diet intervention period lasted a median of 135 days. The KD cohort had a higher concentration of methionine and cystathionine. These metabolites have been associated with increased inflammation in mammals. The KD-fed cohort showed elevated bile acid concentrations which has been

associated with colon cancer in humans. The RMBD cohort had lower serum methionine which is associated with long life span and considered beneficial for metabolic health.

A subset of the above study participated in another study[31] looking at the transcriptome. RNA sequencing of skin samples was performed on eight client-owned Staffordshire bull terriers CAD (*n*=4) / healthy (*n*=4). These dogs were divided into two cohorts based on diet. Some were fed a processed kibble diet (KD) - CAD (*n*=2) / healthy (*n*=2) and others a raw meat-based diet (RMBD) - CAD (*n*=2) / healthy (*n*=2). The diet intervention period lasted a median 137 days. They found many more differentially expressed genes between the CAD and healthy dog groups after the diet intervention. This indicates that nutrition has a significant epigenetic effect on dogs with skin disease. Furthermore, the gene transcription profile of the RMBD cohort compared to the KD group is consistent with an improvement of innate immunity and decreased oxidative stress.

Another study[32] involved fecal samples from 27 BARF fed dogs and 19 commercially fed dogs. The fecal microbiota were analyzed in all of them, and the fecal metabolome was analyzed in ten of the BARF fed dogs and nine of the commercially fed dogs. Notable findings include that the BARF fed dogs had higher fecal isomaltose and gluconic acid levels. These compounds are possible prebiotics. On the microbiome front, the conventional fed dogs had higher abundance of fecal *Clostridiaceae*, *Erysipelotrichaceae*, *Ruminococcaceae*, *Lachnospiraceae* whereas the BARF fed dogs had higher abundance of *Lactobacillales, Enterobacteriaceae, Fusobacterium* and, *Clostridium*. More specifically the BARF fed dogs had significantly higher abundance of *E. coli* and *C. perfringens* and increased Dysbiosis Index (DI). It should be noted that the DI is based on the quantitative abundance of seven bacterial groups[33] and may or may not be relevant for raw fed dogs.



This study[34] included 15 adult dogs that were put into two diet groups for 9 weeks - Premium kibbled diet (*K*; *n* = 8) and Raw red meat diet (*M*; *n* = 7). Apparent protein digestibility and energy were higher in M. Furthermore, diet significantly affected 27 fecal microbial families and 53 genera. Levels of *Bacteriodes*, *Prevotella*, *Peptostreptococcus* and *Faecalibacterium* were lower and *Fusobacterium*, *Lactobacillus* and *Clostridium* were all more abundant in M. It is important to note that Clostridiaceae had a positive correlation with fecal health score and a negative correlation with fecal output.

The final study,[35] involves six dogs fed a natural diet (90% raw meat: 10% vegetables) and 5 dogs fed a commercial feed (Kibble). Here, fecal metagenomic DNA samples were analyzed. They found that "The microbiota of the natural diet group was characterized by higher richness and diversity compared with the commercial feed group."[35]

CONCLUSION

In this paper we have taken a broad look at natural nutrition for pets. We explored the nutrition philosophies of reductionist nutrition, which is the basis of commercial, processed diets, and food synergy, which is the domain of natural diets. We looked at the importance of macronutrient balance and found that conventional diets tend to be far too high in starch. Finally we looked at research comparing the effects of a natural, raw diet versus processed foods and found that in general, raw diets promote health while processed diets may do more harm than good.

Dr Doug Knueven presented a webinar for CIVT, *Natural Nutrition*, you can find out more about the webinar by clicking this link - https://civtedu.org/webinars/natural-nutrition

End Notes

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