Optimal performance in exercising canines is influenced by nutrition, genetics, training, and conditioning. Optimizing performance can be described as prolonging endurance, increasing speed, improving physical recovery, improving mental alertness, greater training efficiency, or various other aspects of physical activity and exercise. As trainers and/or dog owners, we ultimately strive for optimal performance to increase the success of our dog in competitions, on hunting grounds, or with work-related activities.

From a nutritional perspective, exercise is a physiological state that incurs a greater caloric demand, increases protein metabolism and turnover, and shifts nutrient metabolism. In addition, physical activity lasting longer than one minute will require greater oxygen demand and metabolism for energy generation to sustain muscle movement, and consequently result in the natural generation of oxygen radicals. Proper nutrition to support the increased metabolic demand of exercise is critical in ensuring that performance is optimized for a dog to reach its own highest potential.

An important aspect of performance diets is to provide elevated levels of protein and fat, with reduced proportion of calories derived from carbohydrates, to support the increased caloric demand and elevated protein turnover. However, an additional advantage comes from these nutrients promoting an increase in fat metabolism that ultimately increases the metabolic capacity of the dog and optimizes its level of endurance. Diets with higher levels of fat generate greater amounts of free fatty acids present in the blood and promote higher mitochondria content in the muscle, thus having greater quantities of energy-generating substrates and also greater capacity to metabolize the substrates. Elevated dietary protein complements the benefits associated with the increased fat metabolism, as a greater abundance of amino acids promotes an anabolic state by maintaining a positive protein balance that enables increased mitochondrial biosynthesis and increased vascular capacity. Importantly, these changes lead to improved natural metabolic endurance and respiratory metabolism, as maximal oxygen metabolism (VO2 max) is increased, which is critical for physical endurance.

Although an increase in dietary fat is important to exercising canines, the type of fat also provides critical benefits that can translate into optimal performance. Polyunsaturated fatty acids (PUFA) like omega-3's, particularly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), are largely derived from fish and have important nutritional benefits. EPA has been shown to serve as a substrate for COX-2 enzymes and is considered to be a less-inflammatory fatty acid compared to omega-6 fatty acids like arachidonic acid. Nutrients like EPA, glucosamine, strong antioxidants and increased protein intake can all contribute to optimizing performance by promoting a healthy skeletal system.

Additional ways of optimizing performance through feeding specific nutrients in the diet is by addressing the dog's senses. Specifically, DHA is necessary to maintain optimal retinal health, particularly in the rod cells of the eye to improve rod sensitivity. Although this research has
largely been conducted in young people and animals, including puppies, some recent research in adult animals is accumulating that demonstrates the benefit of DHA is important at all ages. Also, maintaining mental acuity during and after exercise is critical to the dog's endurance and performance. Mental stamina starts to decline as blood glucose declines. The primary source of blood glucose during exercise is from liver glycogen stores and this acts to complement the muscle glycogen stores dedicated for physical activity. However, because high fat diets promote an increased metabolism for fat, they also promote a lower dependence on muscle glycogen, which is primarily driven by the shift in nutrient preference from carbohydrate to fat. Therefore, high fat diets are "glycogen sparing" and assist in reserving the blood glucose for maintaining brain function instead of supporting muscle function, and thus improving mental stamina.

Finally, exercise naturally is a highly oxidative process that causes oxidative stress during and after exercise, and is believed to contribute to muscle cell membrane damage, which ultimate causes muscle soreness following exercise. The body has natural antioxidant defenses to protect against oxidative stress and these are complemented by the ingestion of antioxidant-rich foods. Research in exercising dogs indicates, that Vitamin E and carotenoids, like astaxanthin, provide antioxidant protection, but that astaxanthin is more potent and has a prolonged benefit up through 24 h after exercise. Astaxanthin was observed to reduce the levels of oxidative stress markers, specifically F2-isoprostanes and malondialdehyde.

Through feeding a performance diet that delivers an optimal nutrient balance, proper nutrition can be achieved that complements the nutritional requirements and oxidative stress of exercising or working dogs. Also, feeding a performance diet all year long will assist in maintaining the dog's metabolic capacity, even when not in training or exercising, and contribute to maintaining lean body condition and optimal health. This can be achieved by reducing the feeding portion during the off-season or periods of reduced activity to complement the caloric needs to maintain proper body condition.

**Biographical Profile**

**Dr. Brian Zanghi** earned a Doctor of Philosophy in Canine Nutritional Physiology from the Department of Animal Sciences at the University of Kentucky in Lexington, Kentucky in 2004. He continued his training at the University of Kentucky, as a Postdoctoral Research Scientist working on nutrient metabolism in aging animals. Dr. Zanghi joined Purina in 2005 where he currently serves as a Senior Scientist in the Molecular Biology Group at the Nestle Research Center, which maintains a research program in molecular nutrition and cellular nutrition focused on protein metabolism, gastrointestinal and exercise physiology, and aging. He and his family live in Hillsboro, Missouri and owns three dogs.

**Optimal Nutrition for the Exercising Dog – conference notes**

Are you really are what you eat? No BUT, 

What you eat can change what you are … optimal nutrition can be: stronger, leaner, healthier, faster and more alert. Therefore, perform better.

Optimal nutrition is achieved through consuming food that provides a proper balance of all appropriate nutrients. Nutrients are utilized by every cell as:
Building blocks
- Used to form structure
- Metabolized - precursor to full energy
Signaling molecules
- Energy – degraded metabolized building blocks

The body will adapt to changing levels and or proportions of different nutrients to utilize or discard them depending on the physiological state
- States: working, weaning, times of stress, etc

Exercise physiology
- Incurs greater caloric demand and expense
- Increases protein metabolism
- Shifts nutrient utilization for energy in muscle from glucose to fat
- Requires greater oxygen demand
- Generates greater quantities of oxygen radicals requiring anti-oxidants

Majority of studies in sled dogs who require endurance

Dietary fat is critical as a source of caloric intake – fat and oxygen metabolism for endurance
- Promotes fat metabolism as preferred source of energy
- Maintaining high levels of fatty acids in blood from high fat diets
- High levels of dietary protein and fat promote increased mitochondrial synthesis for increased oxygen metabolism
- Maintain natural metabolic endurance and respiratory metabolism

* He claims that there is no genetic link to endurance – but *I* wonder if this study is flawed because sled dogs studies are all hybrids as the mushers are experimenting with their dogs – adding sighthounds to their lines.

Changing from a performance formula in the off season is equivalent to de-training your dog … feed high protein/fat diet year round.

This presentation, in my opinion was rather flawed. He was basing his talk on “sled” dogs. Who are these sled dogs? Iditarod dogs? These dogs are not pure-bred and are hybrids. If studying these dogs while on the Iditarod, these dogs are not just fed kibble, mushers supplement kibble with a fish stew that is all fat and protein – either seal or fish based.