

How Functional Ingredients Support Health and Wellness in Companion Animals A Scientific White Paper

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Abstract

This scientific white paper explores how functional nutritional ingredients contribute to the health, resilience, and longevity of dogs and cats. Rather than focusing only on basic nutrient requirements, the paper highlights how specific bioactive compounds influence immune function, oxidative balance, digestion, structural integrity, and metabolic health at cellular and molecular levels.

Micronutrients such as vitamins A, C, D, and E, along with trace minerals including zinc, selenium, and magnesium, play essential roles in immune regulation and metabolic processes. Adequate intake supports enzyme activity, cellular signaling, and immune responsiveness, helping maintain physiological balance and reduce vulnerability to illness.

Antioxidants help counteract oxidative stress caused by reactive oxygen species, which can damage tissues and contribute to inflammation and chronic disease. Nutritional antioxidants support cellular integrity, immune stability, and healthy aging, particularly in animals exposed to environmental stressors or inflammatory conditions.

Omega-3 fatty acids influence immune signaling, gene expression, and inflammatory pathways. Their inclusion in companion animal nutrition is associated with support for skin health, joint function, cardiovascular balance, and overall immune regulation through mechanisms that promote balanced inflammatory responses.

Dietary fibers and prebiotics play a central role in gastrointestinal health by shaping the gut microbiome, improving stool quality, and strengthening intestinal barrier integrity. Research demonstrates that these ingredients support immune function through microbial interactions and the production of beneficial metabolites such as short-chain fatty acids.

Flavonoids, tannins, and other plant compounds contribute antioxidant and immunomodulatory activity. These phytonutrients influence immune signaling pathways, metabolic health, and detoxification processes, supporting a holistic approach to nutritional wellness in companion animals.

Structural nutrients such as collagen and silicon-containing compounds support connective tissue strength, skin integrity, and joint stability. These components may aid mobility and recovery by maintaining the physical framework that supports movement and resilience.

The paper emphasizes that nutrition plays a significant role in chronic disease prevention. Functional ingredients may help regulate inflammation, oxidative stress, and metabolic balance, all of which influence long-term health outcomes and quality of life in companion animals.

Functional ingredients provide a science-based framework for supporting whole-body health in companion animals. Vitamins and minerals build the biochemical foundation of immune and metabolic activity, antioxidants help maintain oxidative balance, fatty acids regulate inflammation, fibers support gut health, phytonutrients offer additional protective effects, and structural nutrients contribute to connective tissue strength. Together, these nutritional strategies highlight the growing role of evidence-based functional nutrition in veterinary wellness and preventive care.

Introduction

Nutrition plays a fundamental role in promoting health, disease prevention, and overall well-being in companion animals. Beyond meeting minimum nutrient requirements, functional components such as vitamins, minerals, antioxidants, fatty acids, fibers, phytonutrients, and structural proteins can influence physiological systems at both cellular and molecular levels. Growing evidence from veterinary and comparative nutrition research demonstrates that these compounds support immune competence, oxidative balance, gastrointestinal integrity, connective tissue health, and metabolic regulation in dogs and cats. As companion animals experience longer lifespans, nutrition has become an increasingly important tool for reducing the risk of chronic disease and improving quality of life. This white paper reviews scientific evidence across major categories of functional ingredients and their roles in maintaining animal health and wellness. The discussion focuses on immunomodulation, digestive support, antioxidant defense, structural integrity, and metabolic regulation, drawing exclusively from peer-reviewed veterinary and nutritional journals.

Micronutrients and Immune Modulation

Micronutrients such as vitamins and minerals are essential for enzyme activity, cellular signaling, and proper immune system function in companion animals. Deficiencies or imbalances can compromise immune defenses, increase susceptibility to illness, and disrupt metabolic processes. According to Barroso et al., micronutrients including vitamins A, C, D, and E, along with trace minerals such as zinc, selenium, and magnesium, serve as key regulators of both innate and adaptive immune responses in dogs. These nutrients influence leukocyte activity, cytokine production, and antioxidant enzyme function, collectively supporting immune resilience.

Trace minerals also vary in bioavailability depending on their chemical form and dietary matrix. As highlighted by Byrne and Murphy (2022), more bioavailable mineral sources enhance absorption and utilization while reducing the risk of subclinical deficiencies. Adequate mineral status supports nervous system function, muscle contraction, and metabolic homeostasis, all of which indirectly contribute to immune competence. Together, sufficient micronutrient intake provides the biochemical foundation necessary for whole-body health and immune stability in companion animals.

Antioxidants and Oxidative Stress Regulation

Oxidative stress results from an imbalance between the production of reactive oxygen species and the body's antioxidant defense system, in which reactive species exceed the system's capacity to neutralize them, leading to cellular damage, inflammation, and disease progression. Antioxidants play a critical role in neutralizing free radicals and maintaining redox balance. As described by Stoia and Oancea (2022), both synthetic and naturally derived low-molecular-weight antioxidants can help prevent oxidative damage to lipids, proteins, and nucleic acids. Antioxidant support is particularly important in aging companion animals, those with chronic in-

flammatory conditions, and individuals exposed to environmental toxins.

The authors further note that oxidative stress contributes to renal and systemic injury in veterinary cases, while nutraceutical antioxidants may exert protective effects (Longobardi et al., 2022). Through regulation of oxidative pathways, antioxidants help preserve cellular integrity, support immune function, and limit inflammatory burden. These findings underscore the importance of nutritional interventions with antioxidant properties in promoting long-term health and resilience in companion animals.

Fatty Acids and Immune Regulation

Polyunsaturated fatty acids, particularly omega-3 fatty acids, exert strong immunomodulatory and anti-inflammatory effects. According to Bodur et al. (2025), omega-3 fatty acids influence immune cell membrane composition, eicosanoid production, and gene expression. In companion animals, these mechanisms contribute to enhanced immune function and reduced inflammatory responses.

The systemic effects of fatty acids, especially omega-3s, are evident in dermatological health, joint function, and cardiovascular regulation. By modulating inflammatory signaling pathways, these fatty acids support immune regulation and tissue health by promoting resolution rather than amplification of inflammation. Their inclusion in companion animal nutrition reflects an evidence-based approach to supporting inflammatory balance and immune-mediated conditions.

Digestive Health, Fiber, and the Gut Microbiome

The gastrointestinal tract plays a central role in nutrient absorption, immune function, and overall wellness. Dietary fibers and prebiotics are key modulators of gut health, influencing microbial composition and intestinal barrier function. In a study examining the therapeutic role of fiber in digestive disorders, Fritsch et al. (2022) demonstrated that dietary fiber supplementation improved stool quality and clinical outcomes in dogs with chronic large bowel diarrhea.

Montserrat-Malagariga et al. (2024) further showed that dietary fibers exert immunological effects beyond digestion, as fiber source influences fecal microbial composition and immune markers in adult dogs. Additionally, non-digestible oligosaccharides have been shown to support gut barrier integrity and reduce intestinal permeability, commonly referred to as “leaky gut” (Mavogeni et al., 2022).

The use of dietary cellulose as a supportive intervention was shown to aid clinical recovery in dogs with acute diarrhea, facilitating microbiota normalization and reinforcing the role of fiber in gastrointestinal health (Holz et al., 2025). Furthermore, Tuohy et al. (2024) reported that prebiotics selectively stimulate beneficial microorganisms, leading to the production of short-chain fatty acids, which support intestinal integrity and immune function. Collectively, these findings highlight dietary fibers and prebiotics as foundational nutritional components in companion animal wellness.

Phytonutrients and Plant Bioactives

Phytonutrients such as flavonoids, tannins, and other plant-derived compounds contribute to health through their antioxidant, anti-inflammatory, and immunomodulatory properties. According to Hoskin and Coombs (2022), the effectiveness of flavonoids in immune signaling pathways, including their influence on cytokine production and cellular responses, depends on their interaction with key immune regulators. These actions may enhance immune responsiveness while helping to prevent excessive inflammatory reactions.

Additional applications of tannins and flavonoids as dietary supplements in animal systems are described by Sultanayeva et al. (2023), who highlight their potential to support metabolic health and overall product quality. While this research originates largely from production animal models, the underlying principles are applicable to companion animals, as these species share comparable physiological pathways.

The field of pharmacognosy further supports the use of plant-derived bioactive compounds as functional components in veterinary nutrition. Raju et al. (2022) report that phytochemicals possess biologically active properties driven by complex molecular interactions, supporting their classification as functional nutritional ingredients. Through roles in detoxification, oxidative balance, and immune support, these compounds contribute to a holistic approach to nutritional planning for companion animals.

Structural Support and Connective Tissue Health

Connective tissue health is essential for mobility, skin integrity, and overall physical strength in companion animals. Collagen is a primary structural protein that provides tensile strength to joints, tendons, ligaments, and skin. De Araújo et al. (2025) reported that collagen supplementation reduced the incidence of orthopedic injury in trained foals, indicating improved connective tissue resilience. Although species differences exist, the fundamental role of collagen in connective tissue maintenance extends to dogs and cats.

In addition to collagen, connective tissue and skeletal health are influenced by silicon-containing compounds. In a review of the safety and biological relevance of silicon dioxide, the EFSA Panel on Food Additives and Flavourings (2024) noted its involvement in connective tissue structure and mineral metabolism. Adequate intake of nutrients that support structural integrity may contribute to joint stability, skin condition, and recovery from physical strain in companion animals.

Nutrition, Chronic Disease, and Preventive Health

Nutrition plays a critical role in the management and prevention of chronic disease. Amaral et al. (2025) describe the relationship between diet and oncology in dogs and cats, noting that nutritional components influence inflammation, oxidative stress, and immune surveillance, all of which are relevant to cancer development and progression. Functional ingredients that support antioxidant defenses and immune regulation may therefore contribute to disease prevention.

Zhang et al. (2025) further discuss the role of nutritional composition in metabolic health and its systemic effects in dogs and cats. These findings support the concept that nutrition not only enhances physiological resilience but also actively shapes long-term health outcomes and disease risk.

Conclusion

Functional ingredients play a multifaceted role in promoting health and wellness in companion animals. Vitamins and minerals form the biochemical foundation of immune and metabolic activity, while antioxidants help mitigate oxidative damage and inflammation. Omega-3 fatty acids have been shown to support immune balance and regulate inflammatory processes within the body. Dietary fibers and prebiotics improve gastrointestinal function, influence microbiota composition, and support immune regulation, underscoring the central role of gut health in overall well-being. Phytonutrients provide additional antioxidant and immunomodulatory support, while structural components such as collagen and silicon contribute to connective tissue integrity and physical resilience.

Taken together, scientific evidence indicates that targeted nutritional interventions incorporating functional ingredients may support improved health outcomes, aid in disease prevention, and enhance quality of life in companion animals. Continued research will further refine the evidence-based application of these ingredients within veterinary nutrition and preventive medicine.

References

1. Amaral AR., et al. "Connection between nutrition and oncology in dogs and cats: Perspectives, evidence, and implications—a comprehensive review". *Frontiers in Veterinary Science* 11 (2025): 1490290.
2. Barroso C, Fonseca AJ and Cabrita AR. "Vitamins, minerals and phytonutrients as modulators of canine immune function: A literature review". *Veterinary Sciences* 11.12 (2024): 655.
3. Bodur M., et al. "Immunomodulatory effects of Omega-3 fatty acids: Mechanistic insights and health implications". *Molecular Nutrition & Food Research* 69.10 (2025): e202400752.

4. Byrne L and Murphy RA. "Relative bioavailability of trace minerals in production animal nutrition: A review". *Animals* 12.15 (2022): 1981.
5. de Araújo Júnior AMC., et al. "Evaluation of collagen supplements to reduce the occurrence of orthopedic injuries in trained foals". *International Journal of Equine Science* 4.1 (2025): 81-90.
6. EFSA Panel on Food Additives and Flavourings (FAF), et al. "Re-evaluation of silicon dioxide (E 551) as a food additive in foods for infants below 16 weeks of age and follow-up of its re-evaluation as a food additive for uses in foods for all population groups". *EFSA Journal* 22.10 (2024): e8880.
7. Fritsch DA., et al. "A prospective multicenter study of the efficacy of a fiber-supplemented dietary intervention in dogs with chronic large bowel diarrhea". *BMC Veterinary Research* 18.1 (2022): 244.
8. Holz M., et al. "Effects of dietary cellulose on clinical and gut microbiota recovery in dogs with uncomplicated acute diarrhea: A randomized prospective clinical trial". *Journal of the American Veterinary Medical Association* 263.2 (2025): 169-177.
9. Hoskin DW and Coombs MRP. "Immune modulation by flavonoids". *Frontiers in Immunology* 13 (2022): 899577.
10. Longobardi C., et al. "Ochratoxin A and kidney oxidative stress: The role of nutraceuticals in veterinary medicine—a review". *Toxins* 14.6 (2022): 398.
11. Mavrogeni ME., et al. "Direct action of non-digestible oligosaccharides against a leaky gut". *Nutrients* 14.21 (2022): 4699.
12. Montserrat-Malagarriga M., et al. "The impact of fiber source on digestive function, fecal microbiota, and immune response in adult dogs". *Animals* 14.2 (2024): 196.
13. Raju MD, Mishra MJ and Bisoi MD. *Fundamentals of Pharmacognosy*. AG Publishing House (AGPH Books) (2022).
14. Stoia M and Oancea S. "Low-molecular-weight synthetic antioxidants: Classification, pharmacological profile, effectiveness and trends". *Antioxidants* 11.4 (2022): 638.
15. Sultanayeva L., et al. "Tannins and flavonoids as feed additives in the diet of ruminants to improve performance and quality of the derived products: A review". *Bulgarian Journal of Agricultural Science* 29.3 (2023).
16. Tuohy K., et al. "Prebiotics in food and dietary supplements: A roadmap to EU health claims" (2024).
17. Zhang J., et al. "Grain-free diets for dogs and cats: An updated review focusing on nutritional effects and health considerations". *Animals* 15.14 (2025): 2020.