

Impact of dietary protein on cat health and wellbeing

Compared to dogs, cats require higher levels of protein in their diet to remain healthy. Based on current recommendations, commercially available cat food contains between 28% and 55% protein for cats of different ages and health conditions. Dietary protein levels are thought to influence disease susceptibility by affecting gut microbial communities. Dr Dayakar Badri and Dr Matt Jackson of Hill's Pet Nutrition, and Dr Dennis Jewell of Kansas State University, for the first time analysed the effect of varying protein levels within commercially available protein ranges on cats' health and wellbeing.

Hill's Feline GI Biome food.



Cats need nutrients that are found in animal flesh – they are obligate carnivores. Domestic cats don't have to go to the trouble of hunting for their food, as scientists, animal nutritionists, and pet-food companies have formulated a range of foods that contain all the nutrients they need. Cats are desert-adapted animals, and their physiology is highly adept at conserving water by concentrating urine through reabsorption of body water. Concentrating urine to maintain body water leads to a predisposition towards urinary and kidney stones; however, appropriate feline nutrition takes this into account. Cats have retained many of their natural instincts to hunt, and they are exceptionally good at it. Feral cats and barn cats who do catch their own prey typically have a diet low in carbohydrates, high in protein, and with variable amounts of fat; these three macronutrients form the basis of a balanced cat food. Despite eating what might be considered a 'wild' diet, however, excess dietary protein paired with inadequate hydration may exacerbate kidney disease. A challenge then in feline nutrition is to provide optimal amounts of dietary protein while helping support kidney health.

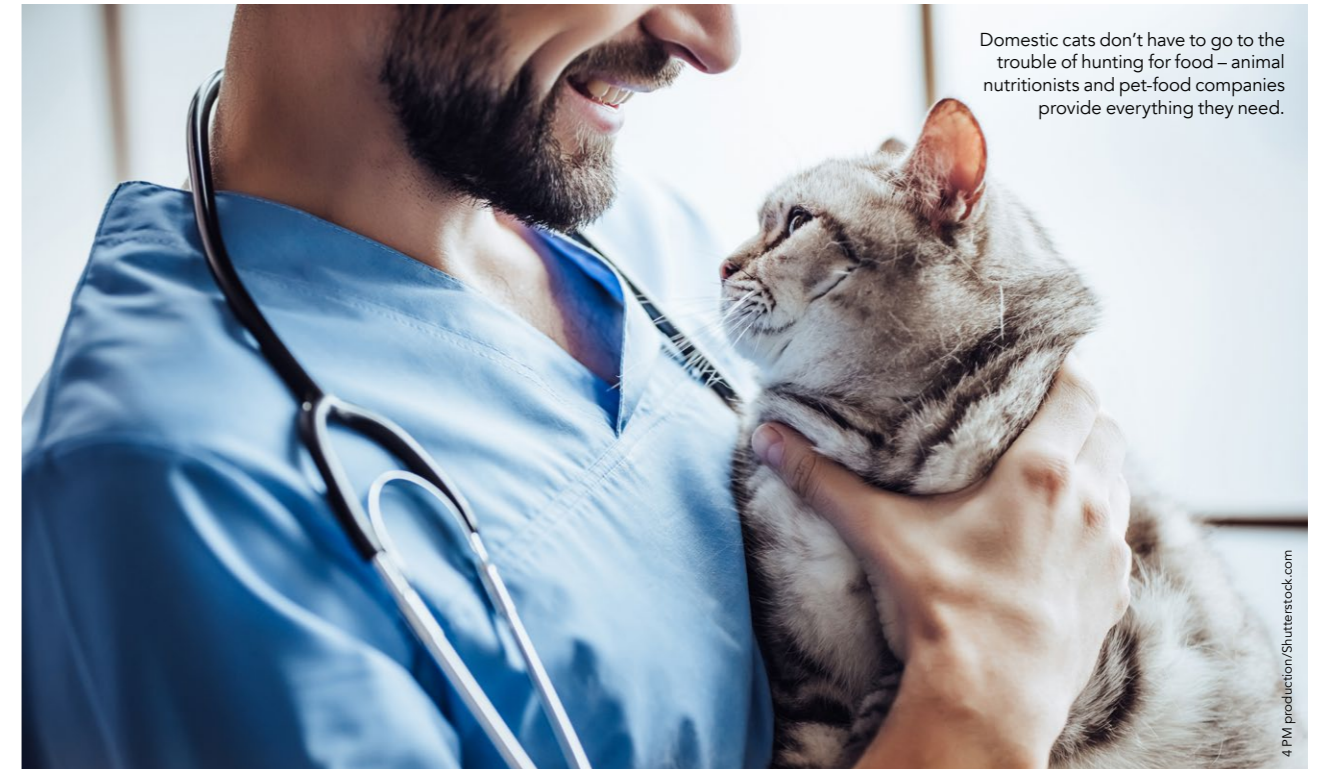
CAT NUTRITION – TAURINE AND ARGININE

Protein is broken down by the body into amino acids that can be used to build new proteins – which are used for muscle growth and reproduction, for example – or used as energy and for maintenance of blood glucose levels. As obligate carnivores, cats

need two additional essential amino acids which are best supplied by animal food products: taurine, which helps maintain normal reproduction, kitten growth, heart health, and eye health; and arginine, which is important in the nervous system and helps regulate ammonia levels in the body.

When cats do not have enough dietary protein or specific amino acids, their bodies compensate by breaking down muscle tissue to meet their daily requirements. As cats age and their digestive systems and absorption become less efficient, their protein requirements increase. For this reason, cats over the age of 12 should benefit from increased levels of protein in their diet – but this can cause them other problems as excess dietary protein increases the risk of kidney disease, to which cats are increasingly prone as they age.

The Association of American Feed Control Officials (AAFCO) recommends that cat food contains a minimum of 26% protein, with a minimum of 30% protein for growing cats or those in reproduction phases (in a 4,000 kcal/kg food). Maintenance cat food therefore typically contains 30–45% protein, while protein level is decreased to 28% for sufferers of chronic kidney disease, and increased to 50–55% for some cats needing to lose weight or suffering metabolic-related diseases (Gross et al, 2010). Maintaining optimal macronutrient levels in this way can benefit cats' overall health and wellbeing.



Domestic cats don't have to go to the trouble of hunting for food – animal nutritionists and pet-food companies provide everything they need.

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DIETARY PROTEIN EXPERIMENT

It has been reported (Backlund et al, 2010; Ephraim et al, 2020; Wernimont et al, 2020) that dietary protein levels can affect the production of microbial-derived toxic metabolites – the product of metabolism by microbes – in the gut, which potentially contribute to kidney problems in cats. Previous studies by other researchers have examined the impact of dietary protein levels on adult cats' gut microbiome (the community of microbes in the gut) (Lubbs et al, 2009) and also in kittens (Deusch et al, 2014; Hooda et al, 2013). These studies broadly found that the composition of major bacterial groups in the cat microbiome (Firmicutes, Bacteroidetes, Actinobacteria, and Proteobacteria) can be altered by the type of fibre (eg, soluble fibre prebiotics) and macronutrients (protein content) in the diet. The food in these evaluations, however, also differed in their levels of fat and fibre.

Dr Dayakar Badri and Dr Matt Jackson from Hill's Pet Nutrition, Topeka, USA, and Dr Dennis Jewell from Kansas State University, wanted to build

on these findings to discover how different formulations of cat food impact the metabolism of the feline gut microbiome as well as cats' overall wellbeing. Their study (Badri et al, 2021) is the first to systematically analyse the effect of three different foods differing in their protein:carbohydrate ratios while maintaining the relative levels of individual amino acids and the animal to plant protein sources, all while keeping

Maintaining optimal macronutrient levels can benefit cats' overall health and wellbeing.

fat and fibre levels constant across the foods. The researchers selected 30 healthy adult cats (15 males and 15 females) to take part in the study. Baseline health data metrics were calculated from blood, urine, and faecal samples taken from each cat after an initial pre-study period during which time they ate their regular diet. Cats were then assigned to one of three experimental groups where they were fed a cat food formulated with different protein levels – P28 (28% protein), P35 (35% protein) and P55 (55% protein) – that reflect the range of levels available in commercial cat food. Throughout the

study, blood, urine, and faecal samples were collected from the cats to analyse against baseline data.

The cats showed no significant difference in the amount of food they ate throughout the course of the study. Badri and colleagues found that the cats eating these foods maintained normal concentrations of analytes used in their clinical assessment of health based on blood, urine, and faecal samples. On the surface, it appeared that protein content did not make much difference; however,

changes in the cats' microbiome were evident.

PROTEIN AND THE MICROBIOME

The gut microbiome contains different microbial communities that collectively thrive in the environment by changing consumption patterns depending on food availability. The microbiome in cats that were fed P28 and P35 had higher levels of bacteria such as *Bifidobacterium*, *Lactobacillus* and *Megasphaera*, which can feed on carbohydrates and proteins and will feed on whichever presents least competition with other microbes. In contrast, cats that were fed the high-

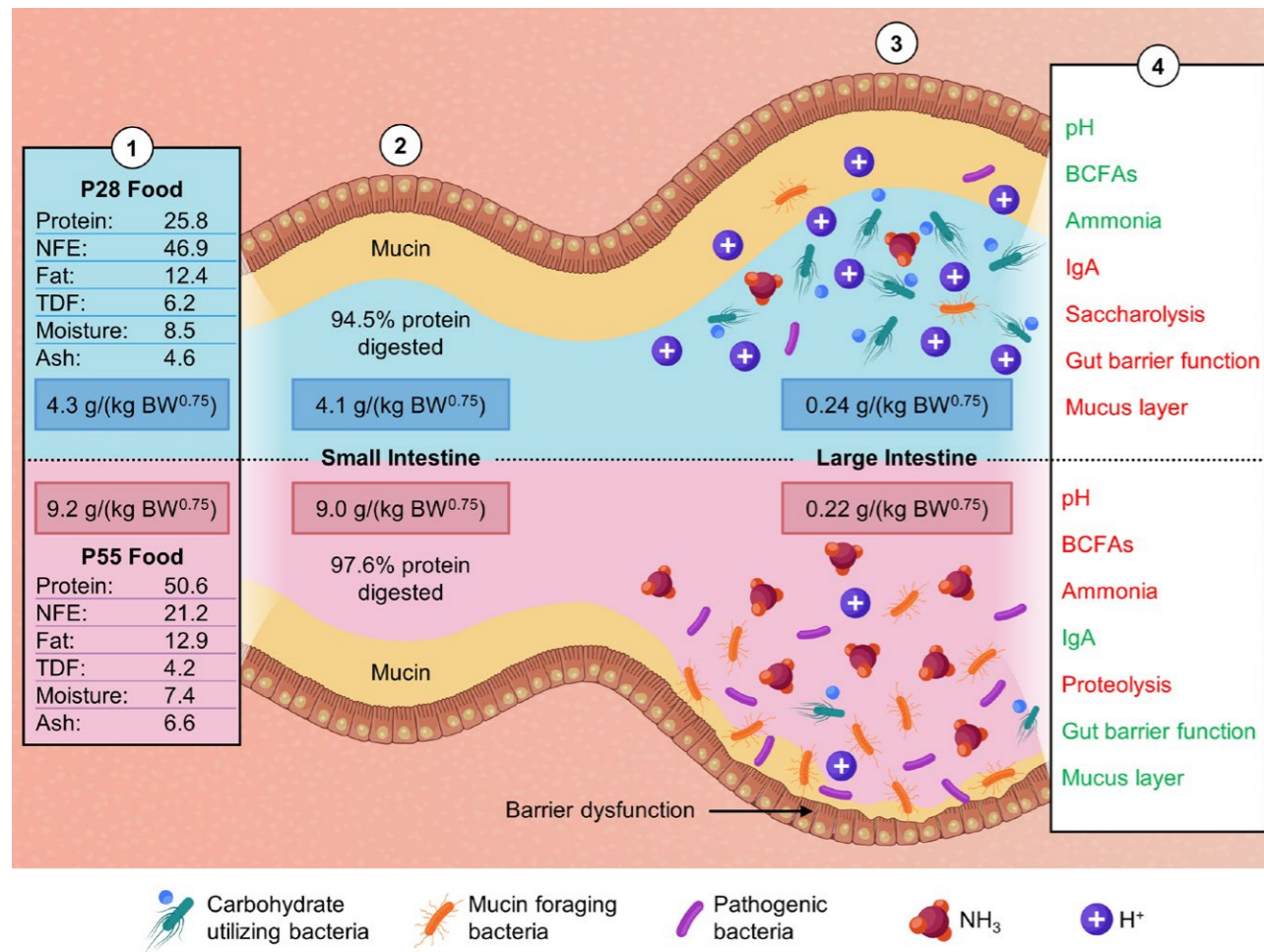


Illustration depicting: 1) the composition of foods and the intakes of protein, 2) the amount of digested protein in the small intestine, 3) the amount of protein reaching the gut microbiome in the large intestine, and 4) the microbial metabolism changes. BW, body weight; NFE, nitrogen-free extract (aka, carbohydrate); TDF, total dietary fibre; BCFA, branched-chain fatty acid.

protein P55 had higher levels of bacteria, such as *Clostridium*, *Ruminococcus*, *Eubacterium*, and *Faecalibacterium*. These bacteria feed on mucins, the glycoproteins that make up the mucus layer of the gastrointestinal tract; mucin protects against pathogens. Because the consumption of P55 food limited the availability of digestion-resistant carbohydrates in the large intestine, it became advantageous for these bacteria to feed on mucin instead.

Mucin glycan foraging and amino acid metabolism (breakdown of proteins through proteolytic activity) by the gut microbiome produces waste products such as ammonia. In healthy cats, this ammonia is mainly converted to urea by the liver and is eliminated from the body in urine from the kidneys; when ammonia

levels are too high for the renal system to cope with, the excess is excreted in the faeces. Badri and colleagues found elevated faecal ammonia levels in healthy cats who were fed the high-protein P55 diet, which suggests that inadequate

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dietary availability of digestion-resistant carbohydrate may exacerbate existing renal conditions. Cats with renal disease are less able to get rid of urea, which can increase levels of harmful ammonia produced by the gut bacteria.

Overall, Badri and colleagues have demonstrated that an overtly healthy gut microbiome can generate harmful

metabolites when dietary availability of digestion-resistant carbohydrates is insufficient. While healthy cats showed no significant health changes following the dietary study, their gut microbiomes were impacted by protein levels. Older cats with existing kidney disease may be negatively affected by a diet excessively high in protein. However, older cats have higher protein requirements due to their reduced ability to digest and assimilate

protein, which emphasises the importance of protein digestibility in cat foods.

Current dietary protein recommendations for cats are based on age, obese or overweight status, and presence of kidney disease. This research will help to better understand how protein levels improve the recommendations for cats.

Behind the Research



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Research Objectives

Dayakar Badri, Matthew Jackson, and Dennis Jewell research the effects of varying dietary protein levels on healthy adult cats.

Detail

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Bio

Dayakar V Badri, PhD is a senior scientist in the Nutrition Innovation group at Hill's Pet Nutrition Inc, Topeka, USA. He is a reviewer for *Frontiers in Plant Sciences* and *Frontiers in Microbiology*, and an author of more than 100 peer reviewed journal articles, patents, and scientific abstracts. His research interests mainly focus on the host-microbiome interactions

and harnessing the microbiome through nutrition to improve pet health.

Matthew I Jackson, PhD is a principal scientist in the Nutrition Innovation group at Hill's Pet Nutrition Inc, Topeka. His research focuses on macronutrient and energy metabolism, and the interaction of the gut microbiome with host physiology. He reviews for journals including *The American Journal of Clinical Nutrition*, *Frontiers in Nutrition*, and *Frontiers in Cellular and Infection Microbiology*. Matthew is an author or inventor on

over 60 peer reviewed publications, conference abstracts, book chapters, and granted patents.

Dennis E Jewell, PhD is an adjunct faculty member at Kansas State University, USA. His research interest is the nutritional influence of health, longevity, and disease in dogs and cats. He is author of more than 250 book chapters, patents, peer reviewed journal articles, and scientific abstracts.

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Personal Response

Your research suggests that finding the right diet for some cats could be quite complex. What are the most important things owners should consider when choosing cat food?

It's important to know how to choose cat food with dietary protein levels appropriate for their age, body condition, and any other disease conditions, in consultation with clinical veterinarians. Our study showed that the quality of the protein is important as well. Quality means both the amino acid levels in the protein and the protein's digestibility. Pet parents should also look to see that the food contains an adequate amount of carbohydrates for healthy microbial metabolism.



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