Customer Cravings

VOLUME 7

Maximizing Pet Food Nutrition with Proteins

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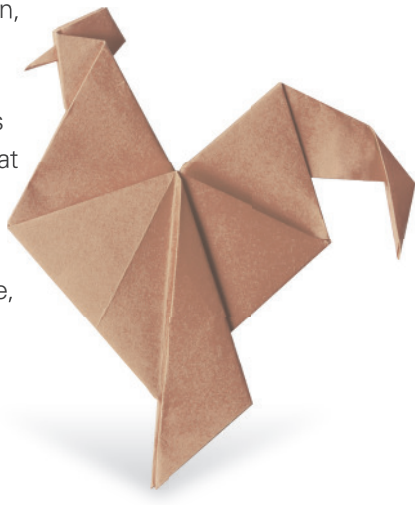
Welcome

Once upon a time, pet owners would grab a one-size-fits-all bag of food from the store and fill up their pets' bowls with the same food, every day, for the rest of their lives. But modern pets are members of the family, and as we become more attentive to our own health and wellbeing, we want the best for them too.

We strive to provide the healthiest lifestyle for our pets not only to improve their quality of life, but to prolong their lives with us. Although food only plays one part in a healthy pet lifestyle – alongside getting enough exercise and regular vet checkups – feeding them the best in nutrition is a good place to start.

At Kemin, we know pet food formulators are seeking to create brands that address individual pets and their health concerns. To help promote better nutrition for all pets, Kemin is advancing its PROSURANCE™ line of Specialty Proteins for pet nutrition. Our thoughtfully crafted proteins are designed with pets and their individual nutritional needs in mind.

Kemin's Specialty Proteins are available in a range of sources – including chicken, pork, whitefish and duck – and suitable for limited ingredient and clean-label diets. Our hydrolyzed proteins are highly digestible and hypoallergenic, making them ideal for pets with food sensitivities like itching or diarrhea. Some sources also promote functional benefits, like our PROSURANCE WF.90, an ultra-low-fat formulation containing beneficial peptides that may support cognition.



We hope this issue will help educate formulators on how impactful protein can be for pet nutrition and health, and help guide you in selecting a responsible, quality protein supplier.

Yannick Riou

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KEMIN

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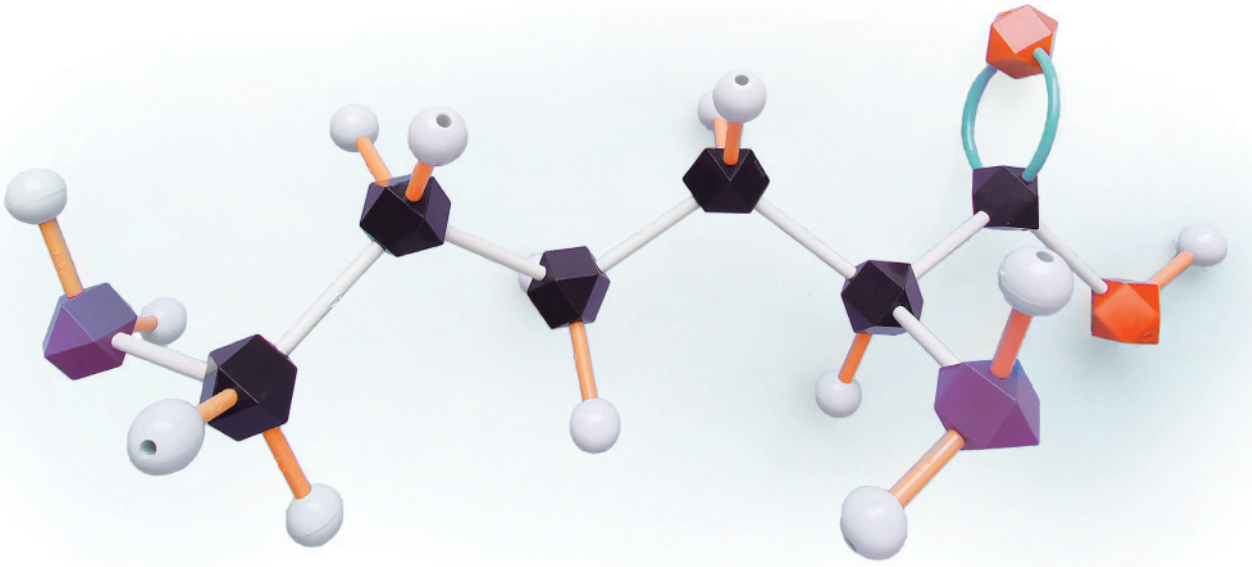
LYSINE CHEMICAL STRUCTURE
Ideal protein concept: The balance of essential amino acids using lysine as a reference.



The Ideal Protein Balance

Current pet food nutrient guidelines include crude protein and essential amino acid requirements, but do not address amino acid ratios, a key proponent of pet nutrition. Learn how to achieve the ideal protein balance in pet food formations.

What is the ideal protein balance?

The "ideal protein" can be defined as one that provides an exact balance of amino acids, without deficiencies or excess, to meet the requirements for optimum animal performance, maintenance and maximum protein deposition.[1]

This concept is widely used to formulate poultry and swine diets and has been shown to improve body composition and yields while reducing production costs. Beyond economic benefits, this concept is also believed to benefit the environment by reducing excess nitrogen excretion from protein formulation.[2]

The ideal protein concept uses lysine as a reference amino acid, with the requirements for all other essential amino acids expressed as a percentage of lysine.

Current Pet Food Nutrient Guidelines:

- [x] Crude protein requirement
- [x] Amino acid requirement
- [ ] Amino acid balance ratio

There are several reasons for selecting lysine as the reference amino acid:

1 Lysine has only one major function in the animal body, which is protein tissue deposition, meaning lysine is not influenced by other metabolic roles.

2 Lysine is usually the most- or second-most limiting amino acid in the diet, meaning lysine requirement data for a variety of dietary, environmental, and body compositional circumstances are readily available.

3 Analysis of lysine in food is straightforward and easy to replicate.[2-4]

Protein Content in Dog and Cat Food

A major difference between pet food and livestock feed is protein content, since the purpose of the two diets are very different.[8] Unlike livestock feed, pet food is formulated to be "complete and balanced," meaning the pet's nutritional needs will be met if the proper amount of food and water is ingested.

Most pet food formulators use various nutrient guidelines, established by AAFCO, National Research Council and The European Pet Food Industry (FEDIAF),[5-7] to develop diets specific to each species and life stage. These guidelines help formulators choose the right amount of protein to include in their diet.

Formulators also choose protein levels for palatability reasons. Multiple trials have shown that dogs prefer a dietary profile of 25-30% metabolizable energy from protein,[9,10] while cats prefer one with 52% metabolizable energy from protein.[11]

Balancing the Pet Food Nutrient Guidelines

Current pet food nutrient guidelines include crude protein and essential amino acid requirements, but do not address amino acid ratios. The current essential amino acid requirements for dogs and cats are based on relatively short-term studies (less than 6 months) and use markers of animal growth or protein status, not markers of animal health or wellness.[8]

To achieve essential amino acid requirements, formulators often include high concentrations of crude protein, combine complementary

protein sources, or include synthetic amino acids. Consequently, most pet foods contain a surplus of protein but likely do not meet the ideal protein amino acid balance.[8] These diets are not only nutritionally unbalanced, they are also costly to formulators since protein ingredients can be expensive.

The Ideal Protein Concept for Balanced Nutrition

Amino acid requirements for pets should be based on criteria like optimal health and longevity. But establishing new requirements would require long-term trials. Nutritional guidelines aside, formulators should choose proteins with balanced amino acid profiles to meet the nutritional needs of dogs and cats throughout all stages of their lives.

PROSURANCE™: Specialty Proteins with Balanced Amino Acid Profiles

Kemin's range of specialty proteins provides solutions that add to the nutritional and flavor profile of dog and cat food, treats and other consumable pet products. Our focus on fresh raw ingredients and manufacturing expertise leads to products containing high-quality, digestible protein levels and balanced amino acid profiles that deliver functional benefits, all while being sustainably sourced. Click here to learn more about PROSURANCE specialty proteins.

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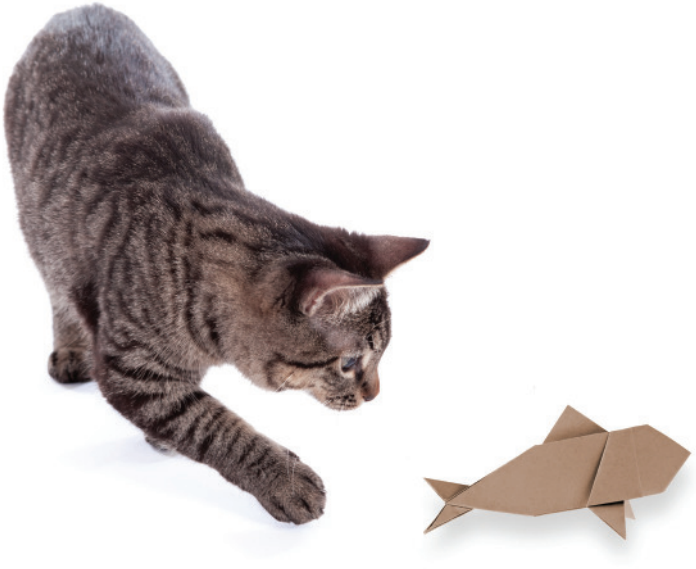
How Protein Hydrolysates Can Prevent Adverse Food Reactions in Pets

Just as in humans, pets can develop food allergies and sensitivities. Learn how formulating with protein hydrolysates can help prevent adversefood reactions in pets.



Protein is an essential nutrient in pet food that supports numerous functions in companion animals. Proteins help to build skin, hair, nails, tendons, cartilage, ligaments, muscles, and play key roles in the production of enzymes and hormones.[1]

As variety in pet foods continues to grow, some animals may develop adverse food reactions to certain diets, just as in people. An adverse food reaction is an undesirable response by the body to a food type and may or may not be linked to an immunological response. Immunologic responses result from food hypersensitivity (allergic response), where non-immunologic responses result from food intolerances.[2]

Food Intolerance vs. Food Allergy

Symptoms of food intolerances may be acute or chronic and are generally limited to gastrointestinal signs such as vomiting, diarrhea, borborygmus, flatulence, maldigestion/malabsorption, or delayed gastric emptying. **Food intolerances may be related to any aspect of the diet, not just proteins.**

A food allergy is defined as "an adverse health effect arising from a specific immune response that occurs reproducibly on exposure to a given food." [3] Clinical signs of food allergies in dogs and cats may manifest in the following ways:

- Dermatologic signs such as dermatitis, with symptoms like itchy, dry skin, or rashes, or bacterial and/or yeast infection amongst others
- Gastrointestinal signs including chronic vomiting, chronic diarrhea
- Or a combination of both.[4]

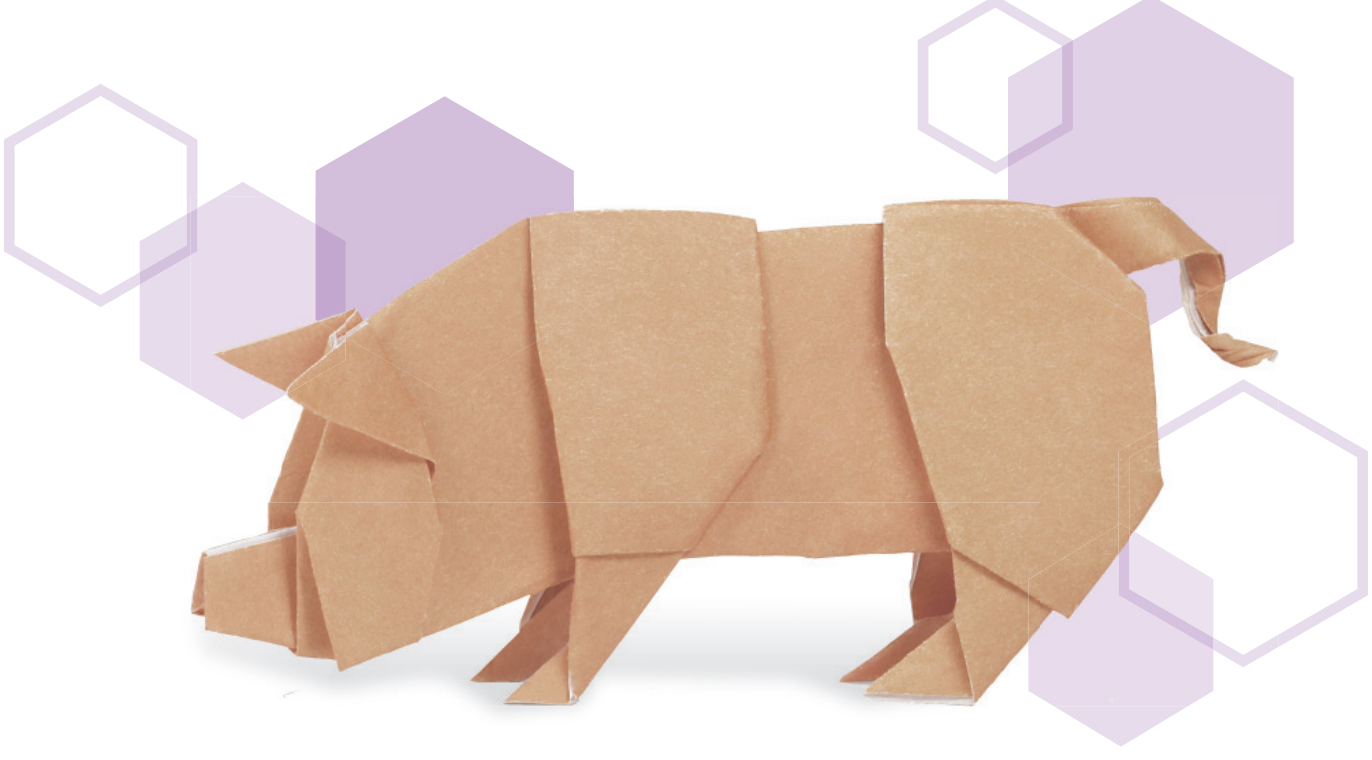
Allergic responses are the result of food hypersensitivity. Hypersensitivity reactions are inappropriate overreactions by an immune system to a foreign antigen. The most common types of hypersensitivities are: [5]

- **Type I hypersensitivity:** This type results in an immediate reaction that involves the degranulation of mast cells. In other words, an immunogenic response is released from mast cells. For mast cell degranulation to occur, the allergen present must be the appropriate size and large enough to cross-link two or more Immunoglobulin R (IgE) antibodies located on the mast cell membrane. A common example of a type I hypersensitivity in humans is peanut allergy.
- **Type III hypersensitivity:** This type results in localized inflammation, loss of blood flow, and damage to surrounding tissues.[6] This hypersensitivity is caused by a buildup of antigen-antibody complexes that are soluble and travel through the bloodstream until they accumulate in capillaries and surrounding tissues. These reactions are commonly linked to vaccinations, chronic diseases, and autoimmune diseases.
- **Type IV hypersensitivity:** This type is known as the "delayed-type hypersensitivity" as it is a cell-mediated response, and thus the onset is days after exposure to an antigen.[6] In humans, a common type IV hypersensitivity is the rash obtained from poison ivy.

Allergic responses are often a combination of several hypersensitivities. Proteins may stimulate both mast cell degranulation (Type I) and T-lymphocyte stimulation (Type-IV) pathways. Methods for managing these hypersensitivities may include pharmaceutical management, desensitization via administration of micro dosages too small to trigger a complete reaction (allergen injections), and/or avoidance or alteration of allergens.

Altering Protein to Reduce Allergenicity

Degrading a protein's structure may reduce its allergenic potential. This can be accomplished through heat, chemical hydrolysis via acidification/alkalization, the addition of denaturation products such as urea, and/or enzymatic hydrolysis.[6] The use of heat alone is often not enough to reduce allergenicity of a food, as evident in allergic responses to cooked and/or processed foods. However, the addition of heat can increase the rate of other reactions by causing the protein to unfold, exposing hydrophobic side chains and potential enzyme binding sites.[7]



Protein Hydrolysis

One method of altering protein is to reduce its size through hydrolysis. The primary purpose of hydrolysis is to generate smaller peptide fragments, measured as molecular weight, by breaking peptide bonds in amino acid chains, further disrupting the structure of proteins.[8] The formation of peptides and amino acids may lead to reduced allergenicity, improved digestibility, flavor alteration, and the formation of bioactive peptides.[9]

While protein hydrolysis reduces the size of proteins and peptides, the limits of molecular weight required to eliminate or reduce allergenicity are not yet fully known.[3] The peptides formed from different protein sources may have different effects and activities, depending upon peptide size, amino residues and remaining structure.

Key Considerations When Choosing Hydrolyzed Proteins:

- Too little hydrolysis may expose more allergen site than in the natural protein.[10,11]
- While excessive bitterness has been reported for hydrolyzed peptides with 1-4 kDa sizes,[10] the bitterness of the smaller peptides is related to the exposure of the hydrophobic side chains of the amino acids present in the peptide, such as Proline.[12] Therefore, not all peptides of these lengths are bitter. Methods for eliminating the bitterness of a hydrolysate include:
  - Removal of the bitter peptides via filtration or carbon-binding, or plastein reactions through transpeptidation.[12] However, these methods can be costly and reduce the mass of available amino acids in a food.
  - The addition of protease enzymes with specificity for cleaving the hydrophobic amino residues can reduce the bitterness while preserving the amino acid profile.[12]

Enzymatic vs. Chemical Hydrolysis

While most hydrolysates utilized in food processing and biotechnology are processed via enzymatic hydrolysis, chemical hydrolysis with acids or bases may also be utilized to break down proteins for those that need strong acids or bases to break down certain types of raw materials.[13]

Enzymatic Hydrolysis	Chemical Hydrolysis
Controlled and predictable outcome	Difficult to control
Preserves valuable nutrients	Potential destruction of essential amino acids
Gentle processing	Racemization from L to D-rom amino acids

Chemical acid hydrolysates can be used as flavor enhancers in foods, but some essential amino acids such as tryptophan, methionine, cystine, and cysteine can be destroyed. Chemical alkaline hydrolysis can result in the racemization of free amino acids and peptide residues.[14] Racemization is the conversion from L-amino acids to D- form amino acids, which may be toxic in some species.[18]

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Introducing the PROSURANCE™ line of Specialty Proteins products

Kemin's line of PROSURANCE Specialty Proteins contains a wide range of hypoallergenic, digestible protein sources equipped with unique functional benefits. Learn about all of Kemin's PROSURANCE brand products below.

Hydrolyzed Protein Products:

Adverse food reactions in dogs typically manifest as diarrhea, vomiting or nonseasonal pruritus (itching.) The severity and duration of the allergic response can also negatively impact skin and coat health over time.[1]

To eliminate these adverse reactions, pet owners are increasingly looking to address pet digestive sensitivities with hypoallergenic petfood diets. As a result, petfood manufacturers are incorporating ingredients that are easily digestible, like hydrolyzed protein.

At Kemin, we use our expertise in hydrolysis to formulate the PROSURANCE.HD line of high quality, spray-dried protein hydrolysates. The PROSURANCE.HD product line was designed with pets and formulators in mind, making it ideal for use in specialty and hypoallergenic diets.

PROSURANCE WF (Whitefish)

- Hypoallergenic, low-molecular-weight protein
- 90% crude protein
- Ultra low fat
- Water soluble

PROSURANCE CHX Blend.HD 75 (Chicken blend)

- Hypoallergenic, low-molecular-weight protein
- 75% crude protein
- High digestibility
- High palatability

PROSURANCE CHX.HD (Chicken)

- Hypoallergenic, low-molecular-weight protein
- Label friendly

PROSURANCE CHX Liver.HD (Chicken Liver)

- Hypoallergenic, low-molecular-weight protein
- 58% crude protein
- High digestibility
- High palatability

PROSURANCE PRK Liver.HD (Pork Liver)

- Hypoallergenic, low-molecular-weight protein
- 65% crude protein

Non-Hydrolyzed Protein Products:

Kemin's non-hydrolyzed proteins are processed via a gentle drying process, resulting in palatable, high-quality proteins with balanced amino acid profiles. The PROSURANCE line of spray-dried proteins provides petfood manufacturers with label-friendly ingredients that pet parents can understand and trust. Non-hydrolyzed products include: PROSURANCE PRK Liver (Pork Liver), PROSURANCE CHX Liver (Chicken Liver) and PROSURANCE Duck and Pea.

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Pet Food Quality: Understanding Biogenic Amines

The quality of a pet food product is reflected in its freshness and palatability. The formation of biogenic amines can greatly affect both freshness and flavor, so it's important for manufacturers to understand how to control their formation.

What Are Biogenic Amines?

Biogenic amines are compounds formed during the normal metabolic functions of plants and animals.[1] Many amines play important roles in human and animal physiological functions,[2,3] but a high accumulation of biogenic amines ingested from food can become a health hazard.[4]

Biogenic Amine Formation in Food

Not all biogenic amines have toxic effects and toxicity can vary based on the person or animal affected. Some amines are found naturally in human foods, including meat, fish, cheese, wine, beer and fermented foods.[1] However, high levels of biogenic amines in food can indicate microbial spoilage.[5]

Once biogenic amines are formed, they are heat stable and cannot be destroyed by processing methods such as cooking, baking or canning.[6] Histamine, tyramine, cadaverine, putrescine, spermine and spermidine are biogenic amines with potential toxicity effects in animals when ingested at high levels.

Amine Toxicity in Dogs and Cats

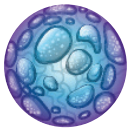
Even after centuries of domestication, dogs and cats maintain similar genetic profiles to their wild canid and feline ancestors. It's not uncommon for wild canids and felines to scavenge decomposed or spoiled carcass. Due to this, it appears they have developed adaptive mechanisms to metabolize and detoxify biogenic amines, and domestic dogs and cats may still maintain some of these mechanisms.[7]

There is a shortage of literature evaluating the precise effect of biogenic amines on dogs and cats due to ethical reasons. However, studies have shown elevated levels of biogenic amines can cause food poisoning and detrimental effects on palatability and nutrition.[1, 4] Pet food manufacturers

HOW BIOGENIC AMINES ARE FORMED:

Free Amino Acids

+



Bacteria & Fungi

+

Time & Temperature

= Biogenic Amine Formation

should control biogenic amine formation in raw materials and finished products to avoid detrimental effects to the food or pet consuming it.

Pet Food Safety: How to Control Biogenic Amines

To evaluate product freshness, pet food manufacturers can use the Biogenic Amine Index.[8] This index shows biogenic amine content in a food product and can be used to indicate freshness or spoilage.

$$\text{BIOGENIC AMINE INDEX} = \frac{\text{Histamine + Putrescine + Cadaverine}}{\text{1 + Spermine + Spermidine}}$$

Kemin recommends the methods below to avoid biogenic amine formation and promote pet food product freshness:

- Use quality ingredients: The quality of an animal meal, or other animal protein source, largely depends on the freshness of animal by-product before rendering. The time between collection and rendering should be as short as possible.
- Use cold storage to prevent microbial growth: Cold storage can prevent microbial growth in products that are fresh, but if a product endures high temperatures before freezing, amines can form and continue to form once cooled.
- Practice good hygiene: Ensure transfer and processing equipment is kept sanitary to reduce microbial load.
- Use freshness control treatments to prevent microbial deterioration: ALLINSUR™ FS has been shown to effectively control biogenic amine formation in raw materials.

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Specialty Proteins:

Thoughtfully crafted proteins

At Kemin, we know protein plays an essential role in the nutritional quality of pet food. Our PROSURANCE™ Specialty Proteins are crafted to address the distinct nutritional needs of dogs and cats. Made with protein derived from high-quality sources, our hydrolyzed and non-hydrolyzed proteins are ideal for hypoallergenic, highly-digestible pet diets and equipped with unique functional benefits.

Learn more at **kemin.com/craft**.

PROSURANCE™

SPECIALTY PROTEINS

DUCK CHICKEN PORK WHITEFISH

KEMIN IS ASSURANCE