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Aquafeeds

Animal co-product hydrolysates sources of key molecules in aquafeeds

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Hydrolysis improves nutritive value of feed ingredients from processing

Hydrolysis improves the nutritional value of various rendered animal by-products.

The supply of fishmeal from wild-capture fisheries, long the staple protein ingredient for high-quality aquaculture feeds, cannot expand further and is insufficient to meet the growing feed protein needs of the global aquaculture industry. Additional renewable and sustainable protein alternatives are needed.

Animal co-product hydrolysates (ACPHs) can meet many nutritional needs of aquaculture worldwide as a protein alternative in aquafeeds. ACPHs can help reduce pressure on natural fisheries stocks and provide sustainability in the growing demand for aquatic products.

Animal co-product hydrolysates

Animal hydrolysates result from controlled enzymatic digestion of by-products from the meat-processing industry. Technically, it is feasible to generate ACPHs from most kinds of slaughterhouse waste, such as scrap meat, offal, feathers and blood, as well as rendered animal by-products like meat and bone meal, poultry meal, feathers and blood meal.

Unique value

Hydrolysis improves the nutritive value of feed ingredients that are produced from slaughterhouse waste (Table 1). Enzymatic digestion of the raw material breaks the protein chains into peptides that are better absorbed in the gut.

Nates, Effects of hydrolysis, Table 1

Effects Of Hydrolysis	Resulting Benefit
Digestion of protein	Improved digestibility, absorption and assimilation of peptides
Increase in the proportion of low-molecular compounds like short-chain peptides, free amino acids and nucleotides	Enhanced attractability and palatability
Production of bioactive peptides	Antioxidant and antimicrobial activities

Table 1. Effects of hydrolysis on animal by-products.

Enzymatic hydrolysis of poultry meal with endo- and exopeptidases shows the feasibility of hydrolyzing poultry by-products so significant amounts of short-chain peptides and free amino acids can be produced. High levels of digestible protein characterize poultry protein hydrolysates with a digestibility index above 95 percent.

Feather hydrolysates produced by bacterial keratinases have been tested as additives in aquaculture feeds, and several species of bacteria with high keratinolytic activity have been isolated from feather meal broth. Recent studies have established that the pepsin digestibility and amino acid content of fermented feather meal can be far better than those of commercial feather meal. The microbial cells could also potentially supply carotenoid pigments to fermented feather meal, whereby the ingredient may be useful in animal feeding not just as a source of protein but also that of pigments.

Attractability, palatability

The short-chain peptides and free amino acids produced as a result of hydrolysis along with nucleotides that are rich in meats confer excellent attractability and palatability properties to ACPHs. Poultry liver hydrolysates added to animal feeds at levels as high as 6 percent have been found to enhance palatability. Spray-dried hydrolysates produced from poultry by-product meal can contain up to 70 percent protein.

The authors found that inosine is the dominant nucleotide in poultry meal. The molecule is believed to enhance diet attractability in several fish species, including largemouth bass, turbot and mackerel. Among monophosphate forms, adenosine monophosphate dominated, and similar trends have been seen in fishmeal hydrolysates.

Antioxidant properties

Alkali hydrolysates and enzyme hydrolysates from meat and bone meal, blood meal and feather meal have ash and protein content similar to the parent materials, but with concomitant liberation of bioactive peptides that are encoded within the protein. ACPH prepared under alkaline hydrolysis can be a source of antioxidants with activities comparable to butylated hydroxytoluene. Results from studies have also shown the presence of the antioxidant carnosine, a histidine-containing dipeptide, in poultry by-products.

Carnosine levels in poultry products ranged 0.95-102.3 mg/g (wet basis). Carnosine levels in meat and bone meal ranged from 500 to 1,800 ppm, while in fishmeal, they can be as low as 5 ppm. Soy and other plant proteins do not contain carnosine.

In research, Nile tilapia whose diets contained added carnosine showed higher body weight and body length than fish in the control group. Diets supplemented with carnosine could increase the levels of growth hormone, insulin-like growth factor 1 and triiodothyronine in serum, indicating that diets supplemented with carnosine could improve antioxidation in muscle.

Hydrolysates from the large volumes of rendered animal by-products available can provide protein as well as antioxidant properties in feed.

Antimicrobial peptides

Antimicrobial peptides have also been identified in poultry bone meal and feather meal hydrolysates. These include cysteine-rich antimicrobial peptides. Other potential molecules found in cattle, chickens and turkeys include galanin, which has been reported to elicit feeding in satiated animals, and “defensins” that show antimicrobial activity against bacteria and fungi. At this point, we don’t know if these molecules are present in animal by-products. Other properties Compared with fishmeal, dried porcine blood co-products and bone protein hydrolysates are poor in methionine and lysine. However, blood by-products are rich in microelements, which can improve calcium and copper retention in aquaculture species. This is especially true for shrimp, in which inadequate supplementary dietary copper level can reportedly result in significant growth depression. Porcine plasma hydrolysates are also effective inhibitors of lipid oxidation, as well as metal-chelating and reducing agents.

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