Rendered Animal By-Products:

A Necessity in Aquafeeds for the New Millennium

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Rendered animal by-products include a variety of fats, oils, and meals.

Aquaculture currently consumes about 35% of the world fishmeal supply. The International Fishmeal and Oil Manufacturers Association expects aquaculture to consume 56% of the fishmeal supply by the year 2010.

The mechanism by which aquaculture gains an increasing share of the fishmeal supply is to outbid traditional users such as poultry and swine feed manufacturers. In other words, fishmeal prices are expected to rise as aquaculture continues to grow. This trend is the driving force behind research to reduce dependence on fishmeal.

Rendered Animal By-Products

Of all the different sources of animal protein and energy available for use within compound aquafeeds, the largest in terms of quantities available are rendered animal by-products, including animal protein meals and fats. The former includes meat and bone meal, meat meal, hydrolyzed feather meal, poultry by-product meal, blood meal, dried meat solubles, bone meal, animal plasma, and miscellaneous animal products (i.e., liver meal, lung meal, hide fleshings, animal digest). Fats include industrial tallows, edible beef tallow, lard, yellow grease, and feed-grade fats.

Availability and Cost

According to James Rudbeck, director of international affairs for the National Renderers Association, Inc., renderers within the U.S. process over 20 million metric tons (mmt) of raw materials each year. In 1999 they produced over 8 mmt of by-products valued at almost $3 billion U.S. These figures included 3.31 mmt of inedible tallow and greases, 2.6 mmt of meat and bone meal, 1.12 mmt of other inedible products, .38 mmt of feather meal, 0.78 mmt of edible tallow, and .236 mmt of lard.

Although no precise statistical information exists concerning the global production and availability of the above animal by-product meals and energy sources, it is estimated that the total global production of rendered animal by-products is currently between 18 and 25 mmt, or about three times that of total global fishmeal and fish oil production (6 to 7 mmt). Table 1 shows recent reported ingredient trading values ($ U.S. per ton) for selected rendered animal by-products and other key feed ingredients.

Despite their ready market availability and generally lower cost compared to fishmeal, rendered animal by-product meals have not generally found widespread use within aquafeeds. By-product meals generally are being used as lower-cost secondary sources of animal protein rather than as primary high-quality animal protein sources within aquafeeds. This has been largely due to their perceived variable composition (especially within products tested in the 1970s and '80s) and generally lower quality compared to fishmeal.

Processing and Nutritional Quality

The poorer nutritional values ascribed to these by-product meals have generally been related to specific essential amino acid imbalances (particularly for blood and feather meals), high ash content (meat and bone meals), reduced nutrient digestibility (inadequate processing/rendering techniques), variable nutrient content and quality (depending on the origin and composition of raw materials used), and possible microbial contamination (inade-

Table 1. Reported ingredient trading values for selected rendered animal by-products and other key feed ingredients (Feedstuffs, June 26, 2000).

Ingredient	Trading Value ($ U.S./Ton)
Meat and Bone Meal (Ruminant)	173-225
Meat and Bone Meal (Porcine)	205-243
Flash-Dried Blood Meal	365-395
Poultry By-Product Meal	210-303
Hydrolyzed Feather Meal	187-215
Menhaden Fishmeal	310-410
Anchovy Meal	435
Soybean Meal (High-Protein)	169-214
Cottonseed Meal	132-183
Canola Meal	106-134
Corn Gluten Meal	235-265
Prime Tallow	8-10 (Cents/Pound)
Yellow Grease	6-10.75 (Cents/Pound)
Choice White Grease	10-11.25 (Cents/Pound)
Poultry Grease	8-9 (Cents/Pound)

Table 2. Results of OI feeding trials with juvenile *Litopenaeus vannamei* reared within outdoor, biosecure zero-exchange culture systems.

Parameter	Trial 1	Trial 2	Trial 3
Fishmeal Inclusion Level (%)	22.0	–	–
Meat and Bone Meal (%)	–	31.0	–
Poultry By-Product Meal (%)	–	–	23.0
Initial Body Weight (g, Week 0):	1.85	1.88	1.88
Final Body Weight (g, Week 8)	13.40	12.28	12.39
Average Weekly Growth (g per Week)	1.44	1.30	1.31
Shrimp FCR	1.68	1.76	1.78
Survival (%)	94.3	95.0	95.0

quate heat processing and poor storage).

However, it is generally accepted that the processing methods currently employed by the modern rendering industry have been greatly improved, with a consequent improvement in the nutritional quality and feed value of animal by-product meals (Bureau and Cho 1999; Shepherd 1998).

Improving Formulations

In addition to improving processing methods within the rendering industry, the increased use of animal by-product meals within aquafeeds can be facilitated through the use of improved formulation techniques (by blending complementary protein sources to obtain the desired overall dietary nutrient profile), dietary supplementation with limiting free amino acids and minerals, dietary enzyme cocktails that improve nutrient availability and digestibility, and dietary feeding stimulants so as to improve palatability and consequent feed intake.

Shrimp Feeding Trials

Feeding trials recently completed at OI with juvenile shrimp (*Litopenaeus vannamei*) reared within experimental outdoor, biosecure zero-exchange culture systems have shown that high-quality fishmeal (72.3% crude protein, 10.86% lipid) could be totally replaced with either meat and bone meal (55.61% crude protein, 10.61% lipid) or poultry by-product meal (69.15% crude protein, 15.67% lipid) with little or no significant loss in growth performance, food conversion efficiency, or survival (Table 2). These trials were conducted using pelleted rations formulated to contain approximately 35% crude protein and 9% lipid, with no added dietary vitamins or trace element premix. Clearly, the road is open to make significant cost savings.

Conclusion

A recent feeding trial at the Oceanic Institute demonstrated that high-quality fishmeal could be completely replaced with either meat and bone meal or poultry by-product meal with little or no loss in performance. The increased use of adequately processed terrestrial animal by-product meals within compound aquafeeds is a means of safely recycling animal by-products from terrestrial, warm-blooded farm animals through a completely different animal food chain, cold-blooded aquatic animals – farmed fish and shrimp.

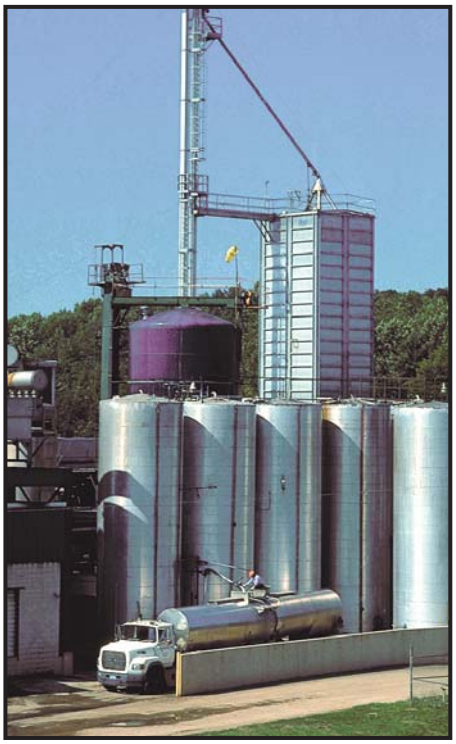
This has the advantage of converting non-food-grade products with potentially negative environmental effects (i.e., disposal through dumping or incineration) into high-quality, nutritious, and safe foods. Moreover, the dietary replacement of fishmeal and other marine resources within aquafeeds will reduce the cost and improve the profitability of aquaculture ventures.

References

Bureau, D.F. and C.Y. Cho. 1999. Nutritive value of rendered animal protein ingredients for fish: outline of recent research - http://www.uoguelph.co/fishnutrition/.

Shepherd, T. 1998. Rendered products in aquaculture feeds. *International Aquafeed*, 4: 13-16.

Some diets mentioned in this article were tested in this tank field at Oceanic Institute.



Storage and transport of products at a rendering plant.