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Aquafeeds

Feed management for RAS, part 2

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Improving feed utilization, disease resistance and immune response

Improved feed management in RAS can offset the cost of the quality feeds required.

The potentially higher cost of the complete feeds needed for recirculating aquaculture systems (RAS) can be offset by improved feed management, since it is easier to feed frequently, place feed in the proximity of aquatic animals, and monitor uneaten or wasted feed in RAS. If such improved management is realized, the overall costs of feeding can actually decrease.

Overfeeding

Overfeeding is one of the major causes of environmental pollution resulting from aquaculture. This is a more significant problem for aquatic animals that require sinking feeds, such as shrimp, versus most fish, which need floating feeds. With shrimp, pond managers must estimate the correct amount of feed to deliver, since they cannot directly observe feed being consumed.

An increase in feeding frequency and reduction in volume per feeding is usually associated with a decrease in feed conversion ratios (FCR) or improvement in feed utilization. This is one of the major advantages associated with intensive RAS, since automatic feeders can be programmed to optimize feed utilization and reduce waste, improving on manual techniques. A parallel example from pond aquaculture is the use of feeding trays to quantify daily feeding behavior, adjust feeding rate and frequency, and minimize wasted feed.

Automated feeding systems

Many automated feeding systems for RAS and intensive cage systems that result in cost savings to producers have been developed in recent years. Improvements in feed use are associated with a subsequent reduction in feed waste and nutrient leaching.

Feed waste has been estimated at 25-75 percent, depending on the farming method. This waste should be drastically reduced in an RAS, since feeding behavior can be more easily assessed, the solids created by wasted food can be visually or automatically monitored, and the addition of food can be controlled by automated feeding systems.

A similar savings will be associated with leaching, since shorter but more frequent feeding periods result in shorter exposure of the feed to water before consumption, improving the nutrient availability. Finally, there are some reports that adding saponin compounds to the feed will actually result in reduced levels of ammonia in the culture water.

Attractants, incitants, and stimulants

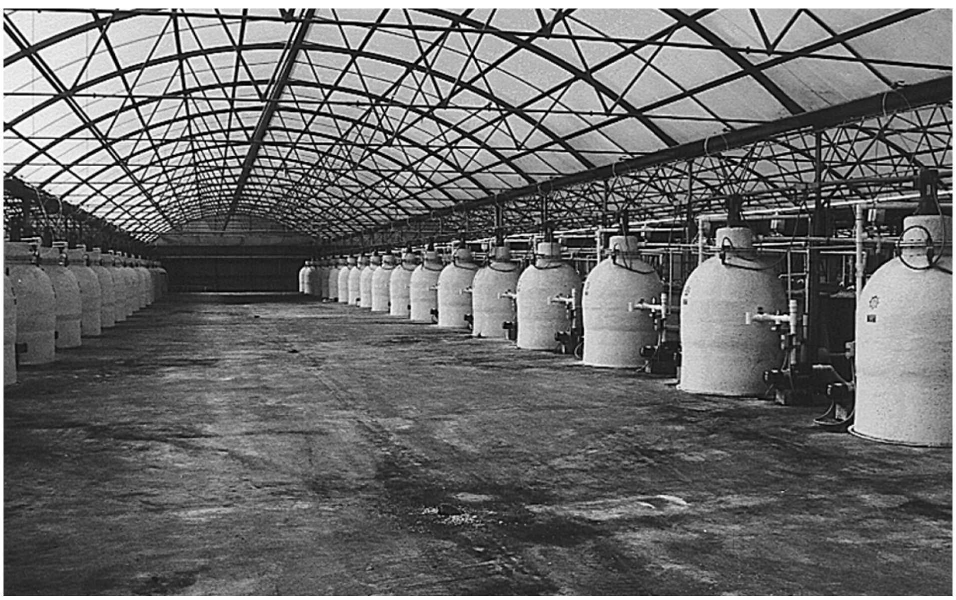
Effective use of feeding attractants, incitants, or stimulants in RAS feeds may help reduce the use of expensive animal meals currently used, allow the reduction in protein level proposed in **Part 1** (https://www.aquaculturealliance.org/advocate/feed-management-for-ras-part-1/) of this article, by standardizing palatability and reduce leaching and uneaten feed. These factors would subsequently further increase feed utilization and reduce feed waste.

Palatability

Differences in feed palatability have been demonstrated using different feed ingredients. For example, the protein requirement for L. vannamei was determined to be 15 percent in the presence of 2 percent artemia meal, but over 30 percent in the absence of artemia meal, emphasizing the need for adequate feed palatability.

Presently, many commercial feeds depend upon expensive squid meal, krill meal, fish solubles, and/or fishmeal to serve as “attractants.” Applied research is needed to assay aquatic chemoreception and develop cost-effective attractants for commercial feeds. These attractants should allow feed manufacturers to standardize palatability from one feed batch to another, without the market price of a single ingredient adversely affecting the selling price.

Improving disease resistance and immune response



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Crowding has been shown to have a major correlation to disease outbreaks in aquatic animals, and RAS lead to much higher densities than traditional pond culture. Research suggests the addition of probiotics (e.g., carotenoids, nucleotides, vitamins, and ß-glucans) can decrease such losses.

Probiotics

Vitamins E and C, selenium, and carotenoids increase disease resistance and/or immune response in several aquatic species. The use of docosahexaenoic acids and phospholipids for increased stress resistance, and dietary vitamin C for increased resistance to *Vibrio sp*. infections have been reported for aquatic animals.

Recently, the feed industry has begun to investigate the addition of ß-glucans and various pigments to feed for the purpose of protecting aquatic animals from disease. The potential use of ß-glucans has been established, but questions remain. When should they be used? How much should be used per treatment? How many treatments are required per crop? What is the best treatment mode? Answers are needed before ß-glucans can be added to feed cost-effectively.

Antibiotics

The addition of antibiotics to feed is a common practice that requires further research. The extended need for antibiotic treatment may be reduced in RAS, since acute treatment can more easily be accomplished due to the greater control and monitoring capabilities available in tanks versus ponds. Some antibiotics have also been found to act as growth enhancers, and are added as routine components of feed.

However, a significant consideration must be the effect of the antibiotics leaching from the feed on the biological filter bacteria. The nitrifying bacteria in these biological filters are susceptible to many common antibiotics. Misapplication of antibiotics can result in the loss of complete ammonia oxidation, leading to an acute rapid increase in total ammonia nitrogen and nitrite concentrations. The reestablishment of nitrifying bacteria can take several weeks; the added stress of increasing dissolved nitrogen concentrations on already diseased aquatic animals can be fatal.

This problem can be avoided by taking the filtration off-line during exposure to the medicated feed, and subsequently pumping the culture tank water back into the filtration system. The water can pass through a bed of activated carbon to absorb the antibiotic, and/or through an oxidizing environment like an ozone column to destroy the antibiotic. It is relatively easy to bioassay the effects of feed antibiotics on biological filter bacteria before adding the feed to large production systems.

Conclusion

The elements of feed management presented here include the most economically significant factors influencing the development and use of RAS feeds. However, research must be continued in many areas for truly cost-effective feeds and feed management strategies to be developed.

Future goals for feeds used in RAS should include:

- Lower feed ingredient costs (as a percentage of operating costs) due to improved species-specific formulations (i.e., improved assimilation and palatability).
- FCR as close to 1.0 as possible.
- Reduced environmental impact through better feed management and significantly reduced effluent discharge.
- Increased survival and disease resistance from improved feeds.
- Improved biosecurity of all production.

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