Hazard Analysis at Critical Control Points (HACCP)

HACCP is a concept in which the human visual inspection of animals being processed into food is replaced with an integrated program which looks at the points in the process which are most likely to contribute to contamination or adulteration of processed foods. The U.S. Food and Drug Administration adopted regulations in 1995 mandating application of HACCP principles for safe and sanitary processing of seafood. By focusing on these critical points with documented record keeping, the processor and the inspectors can be more efficient and improve food safety. HACCP is a planning procedure for documenting good production and processing practices. Participants operate under an approved plan with audits at random frequency. These plans help guide the operations in processing plants and back to the production of the fish. Focus is on documentation of proper activities at important stages rather than stationing a permanent inspector at farm or processing plant. Personal hygiene at the processor is evident at most modern plants which include multiple hand washing, clean uniforms, hair and face coverings, boot washes, and gloves. Many processors now also include a chlorination or ozonated water dip for fillets before packaging. Ozonated water dips especially have been found to reduce surface bacterial counts on fillets (Kim et al., 1999; Restaino *et al*., 1995).

Other examples of parts of a HACCP plan:

1. Document feed source and use, farm water quality, testing for off-flavor

2. Document source, arrival time, temperature and condition of fish as they arrive at process plant
3. Provide footbaths, hand washes and protective clothing for processing workers, document usage by having employees sign daily log
4. Measure and record bacterial numbers on fillets during quality control

The first step is to write the plan. This is typically done with a consultant or experienced government advisor. The second step is plan review by authorities. These are normally from a health inspection agency from a national or regional government. The third step is to train all employees in HACCP plan procedures and documentation. This is a critical aspect as the farm and processor want to ensure product quality, but also to have the staff able to gather the data and complete the required paperwork. The fourth step is to operate the farm and/or plant according to the approved plan. Again the supervisors and the working staff must understand the plan, be capable of conducting tests and collecting data and recording them correctly. Fifth step is to maintain paperwork documenting all stages until inspection. A perfectly run farm or plant that fails to document the facts, will fail the inspection and all that entails (Cato, 1998; Miget, 2004).

F. SUSTAINABLE AQUACULTURE

Operating aquaculture farms in a sustainable manner is the goal of every farmer and investor. Sustainability entails environmental, social and economic aspects as the operation must achieve all three to be successful. Today there are a plethora of descriptions: corporate social responsibility, triple bottom line, win-win-win, etc., that each point to the need to address all aspects of aquaculture and seafood processing and delivery for operations to be sustainable for an extended period. Consideration of reuse of aquaculture effluents,

processing by-products, carbon footprint, food miles, and product life cycle each contribute to the consideration that farmers and processors now must consider. We are lucky that aquaculture as an industry has embraced these topics and researchers and innovative farmers are constantly developing answers and improvements that quickly spread through the industry (Costa-Pierce 2008).

References

Cato, J. C., 1998. Seafood safety: Economics of hazard analysis and critical control point (HACCP) programmes (No. 381). UN Food and Agriculture Organization.

Costa-Pierce, B. A. (Ed.), 2008. Ecological aquaculture: the evolution of the blue revolution. John Wiley & Sons.

Kim, J. G., Yousef, A. E., and Dave, S., 1999. Application of ozone for enhancing the microbiological safety and quality of foods: a review. Journal of Food Protection, 62(9), 1071-1087.

Miget, R. J., 2004. The HACCP seafood program and aquaculture. Southern Regional Aquaculture Center.

Restaino, L., Frampton, E. W., Hemphill, J. B., and Palnikar, P., 1995. Efficacy of ozonated water against various food-related microorganisms. Applied and Environmental Microbiology, 61(9), 3471-3475.

HARVEST, STORAGE AND PROCESSING

A. Pre-Harvest and Harvest

B. Processing and packaging

C. Value chain models

D. Quality Control, and Traceability

E. Markets and Market Development

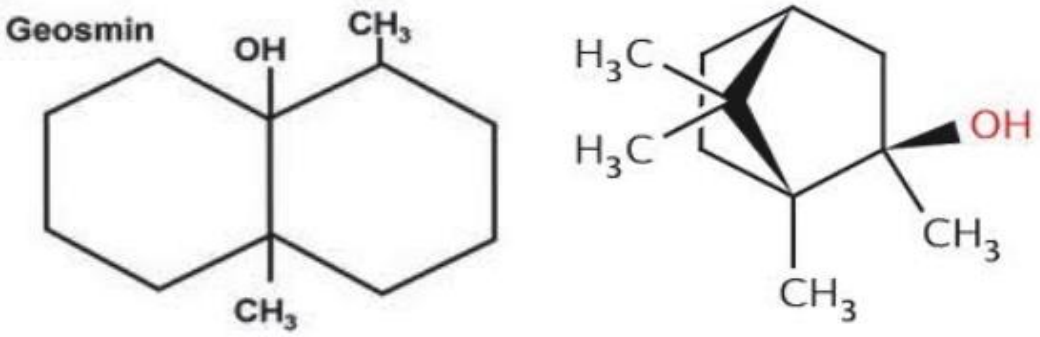
A. PRE-HARVEST AND HARVEST

Quality control of aquaculture products has been one of the most critical aspects to the success of the industry. Maintaining and improving the quality of the various product forms has been a central part of the rapid growth of demand for farmed fish products in the market. This attention to detail starts while the fish are still growing in their various production systems. Processors, haulers and farmers work together to ensure that fish are not contaminated by chemical pollutants, parasites or by spoilage during transport. Virtually all farms check their water sources on a regular basis to ensure high quality. Many farms now use bird nets or greenhouse covers to keep birds and other sources of potential contamination

out. In Pakistan, the use of groundwater is one method to maintain quality control and avoid complications that might come with use of canal water or reservoirs.

Off-flavor - The objectionable taste and smells commonly referred to as off-flavor is one of the most important quality factors. Any fish can be affected by off-flavors, but tilapia, carps and catfishes are especially susceptible. Cyanobacteria, also called blue-green algae, are responsible for most off-flavor in farmed fishes. Monitoring for off-flavor is a process that begins before harvest and continues throughout processing. Fish from ponds are most likely to have accumulated the compounds geosmin and/or methyl-isoborneol

Methyl-isoborneol



(MIB), produced by the algae, at levels that would impart objectionable tastes and/or odors. However, intensive recirculating systems have also been known to develop off-flavors. The most common method for determining if fish is off-flavor is to cook a whole fish or a freshly cut fillet in a microwave oven. Most testers will cook the fish or fillet inside a paper bag to concentrate any odors. (Note: plastic bags are not good as they can emit their own odor when heated in a microwave.) The odor may be obvious just by smelling the contents of the bag. Otherwise the taste tester will eat some of the fish to detect off-flavor. Some testers have the

ability to detect geosmin and MIB at levels of 4 or 5 parts per billion.

Fish are normally sampled a week before a tentative harvest. Sampling is a relatively simple process. A few fish are harvested from the pond and filleted. The fillets are placed in a small paper bag (lunch bag style). The top is rolled or folded down and placed in a microwave oven. After cooking for thirty to sixty seconds, the bag is opened and the sampler will quickly smell the air in the bag. If the fish has accumulated geosmin or MIB, the sampler should smell it immediately. If the level is low, the sampler may eat a mouthful of the product to confirm. Most people can detect levels of geosmin or MIB at levels of 5 to 10 ppb. Experienced samplers can detect down to levels of 2 or 3 ppb. If detected, the standard method to eliminate off-flavor is to place the fish in clean flowing water for several days. This is normally sufficient to allow for elimination of the offending compounds. Taste testing will be repeated to ensure the fish is free of off-flavors. Most processors will repeat testing at several points in processing as part of their quality control.

Harvest techniques – In Pakistan, harvesting varies considerably depending upon the culture system. Ponds are normally partially drained and then harvested by use of a seine and hand nets or buckets. The fish are typically brought to one side or corner with the seine and then may be lifted out by hand or with a large scoop net or sometimes placed in large bags. The largest farms may utilize a net with a quick release bottom latch suspended from a crane or back-hoe.

Bringing net full of fish to shore

Harvesting fish by hand

More sophisticated ponds and raceways that can be gravity drained may utilize a harvest box that concentrates fish for removal using nets or baskets. Harvest boxes may be built inside the pond or outside in the drain channel.

Cage culture, where fish are reared in net lined enclosures in ponds or lakes, typically uses a large bar placed across the top of the cage to concentrate fish for harvest. One side of the net cage will be pulled up and over the bar, concentrating the fish in the increasingly smaller part of the net. The process continues until the fish are concentrated into one corner where they can be lifted out by hand or scoop net. The largest farms may use fish pumps, fish escalators or other mechanical means to remove fish. Many farms will use graders to separate harvest size fish and either leave small fish in the production system, or remove them to another production unit.

Floating cage culture in large water reservoir

Floating cage culture in canal