food&watch

Fact Sheet

Open Ocean Aquaculture: Chemicals of Concern to Human Health and the Environment

The Bush administration promotes the development of a $1 billion offshore aquaculture industry as a way to provide U.S. consumers with a healthy supply of seafood.[1] However, fish production on an industrial scale, in which mass quantities of fish are raised in submerged cages that are up to 80 feet in diameter, would require heavy use of chemicals, such as hormones and antibiotics.

The 2007 National Offshore Aquaculture Act would allow open ocean aquaculture, or fish farming, from three to 200 miles off of U.S. coasts. Below is a list of chemicals that are already approved for use in the production of fish raised in offshore cages. If the industry develops, pharmaceutical and aquaculture companies can be expected to petition federal agencies to approve a broader range of chemicals, creating additional concerns for consumer health and the environment.

In the Hatchery

Before farm-raised fish grow large enough to survive in offshore cages, they are raised onshore in tanks or canals made of concrete. A variety of chemicals are approved for use in fish hatcheries.

Spawning Hormones

What are they?

In captivity, most fish do not reproduce successfully.[2] Fish hatchery operators inject hormones into male and female fish so that they breed. Chorionic gonadotropin, a human hormone, can be injected into fish destined for human consumption. Luteinizing hormone releasing hormone (LHRH) can also be used to induce spawning, but while the offspring can go to market, the parent fish cannot.[3]

Chorionic gonadatropin and LHRH have been used in hatcheries to spawn fish destined for offshore aquaculture. The Atlantic Marine Aquaculture Center in New Hampshire has used the hormone to induce haddock and cod reproduction.[4] The Aquaculture Center of the Florida Keys injected cobia and snapper with chorionic gonadatropin to induce spawning and shipped the offspring to Snapperfarm, Inc., an offshore aquaculture company in Puerto Rico.[5]

What are the concerns?

When humans use chorionic gonadotropin as a fertility drug (or for other uses), it can increase the risk of multiple pregnancy, premature puberty, and ovarian enlargement and cysts.[6,7]

In 1991, the U.S. Food & Drug Administration approved Chorionic gonadotropin for use in cows without an investigation into the potential human health effects of consuming meat injected with the hormone. When petitioning for approval for use of the hormone in fish, the pharmaceutical company submitted only one study to establish the threshold at which rats did not experience increased uterine and testicular weight after consuming the hormone.[8]

The highest legal cumulative dose of chorionic gonadotropin in fish destined for human consumption is 25 ml.[9] However, the FDA does not test fish for residues of the hormone, nor does it take any other regulatory action to enforce this limit.[10,11]

Hatchery Drugs

Fish hatchery operators use formalin, a solution of the carcinogen formaldehyde, or potassium permanganate to treat fungal infections in fish eggs.[12,13,14] Additionally, aquaculturists can put fish in baths of copper sulfate to treat bacterial skin and fin diseases.[15] (Please see below for risks of using copper compounds in aquaculture.) FDA does not regulate the use of potassium permanganate and copper sulfate in aquaculture.[16] However, these chemicals are designated as hazardous substances, and their discharge from hatcheries is regulated through state-level permitting under the Clean Water Act.[17,18,19]

Hatchery Pesticides

Hatcheries can also use bleach (sodium hypochlorite and calcium hypochlorite) to kill small fish and algae in hatcheries. These chemicals are designated as hazardous substances, and their discharge from hatcheries is regulated through state-level permitting under the Clean Water Act.[20,21] Aquaculturists can also control algal growth with a variety of copper compounds (copper carbonate, copper hydroxide, and copper sulfate pentahydrate), the concerns with which are described in the second half of this document.

Tagging Antibiotic

What is it?
Aquaculture operators use oxytetracycline hydrochloride (OTC) to mark the bones of young fish. The fish are placed in a solution of the antibiotic for two to six hours. This creates a calcium-bound tetracycline deposit in the bone, which is visible under ultraviolet light.[22]

Aquaculturists often use OTC to mark farm-raised fish that will be released into the wild in stock enhancement programs.[23] It is possible that OTC marking will be proposed as a way to tag fish raised in offshore cages.

What are the concerns?
The use of oxytetracycline hydrochloride can spur the development of bacteria with resistance to oxytetracycline, which is an important drug in human medicine.[24] Antibiotic-resistant bacteria could be released into the environment during disposal of the antibiotic solution and the transfer of fish from the hatchery to ocean cages.

In the Open Ocean

While inland aquaculture facilities, such as hatchery tanks, are required by their permits to manage the release of chemicals and fish wastes into the environment, the permits for offshore aquaculture facilities do not have to mandate the treatment of discharged effluents.[25]

As of October 2007, no antibiotics have been approved to treat the adult fish typically raised in offshore cages. However, if offshore aquaculture operations are built at the scale predicted by the federal government, such intensive production would undoubtedly create the demand for drug companies to petition FDA to approve antibiotics for fish in offshore aquaculture.

Mercury

Why is it a concern?
Mercury is a toxic heavy metal that never breaks down completely. Fetuses, babies, and children can develop brain damage and learning disabilities with neurological symptoms similar to cerebral palsy if they or their mothers consume mercury-heavy diets.[26,27] In adults, high mercury intake can cause neurological problems, hearing loss, and blurred vision.[28]

How do farmed fish become contaminated?
Mercury is not intentionally used in offshore aquaculture. However, farmed fish consume fishmeal, fish oil, and other feed ingredients that can be contaminated with mercury. Studies on cod and salmon show that a large portion of the mercury in fish feed accumulates in the edible fillet of farmed fish.[29, 30] Although the legal limit for mercury concentration in animal feed is 20 ppb, FDA

testing of feed for mercury is very limited.[31,32] Researchers in the United States and Canada tested a variety of commercial fish feeds, and found levels of mercury with a mean Hg concentration of 51 ppb (ranging from 7 to 90 ppb).[33,34,35]

How do wild fish become contaminated?
Mercury in uneaten fish feed and feces is dispersed in aquatic environment, where wild fish can ingest it.[36] To make matters worse, the accumulation of feces on the ocean floor near fish farms accelerates the conversion of environmental inorganic mercury into its toxic form, methylmercury.[37]

Copper

How is copper used in fish farming?
Copper is a toxic substance that can be used in aquaculture in three ways: as an algaecide in the paint on cages, as a feed supplement, and to treat and prevent fungal and bacterial diseases in hatcheries, as described above. In coastal aquaculture, copper is used in paint on the nets to kill algae and plants. The copper leaches from the paint into the water and sea bottom, where it harms a variety of marine organisms.[38] Although copper has not yet been used on U.S. offshore cages, there are no regulations that restrict its use in the future.[39]

Copper is also added to aquaculture feed to meet dietary requirements of the fish. However, scientists have found that some feeds contain excessively high levels of copper.[40] Copper from fish feed can enter the marine environment in uneaten feed or fish feces.

What are the concerns?
Human consumption of too much or too little copper creates health problems. Although the majority of ingested copper is excreted, a small percent is bioaccumulated in the kidneys, liver, heart, and brain.[41] Chronic exposure to copper can cause liver and kidney damage.[42] Humans with Wilson's disease are especially at risk.[43]

An offshore fish farm. Photo courtesy of NOAA.

The water and ocean floor sediments near aquaculture cages have been found to have high levels of copper, even in areas with swift currents.[44,45,46,47] While copper is lethal to smaller organisms, such as brine shrimp larvae, it bioaccumulates in larger species that are destined for human consumption, such as fish and lobster.[48,49,50,51] This problem is exacerbated because lobster and other aquatic species are attracted to the uneaten fish feed and feces that accumulates under cages.[52]

Conclusion

The 2007 National Offshore Aquaculture Act does not include safeguards to mitigate the human health and environmental risks created by chemical use and contamination in offshore aquaculture. Members of Congress must oppose this and any aquaculture bill that does not protect consumers from unsafe levels of chemicals, hormones, antibiotics, and heavy metals that could accumulate in the flesh of farmed fish, and any dangerous substances used in or around fish farming operations that could contaminate wild seafood.

Endnotes

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