HOW FACTORY FISH FARMS MISUSE ANTIBIOTICS

food&waterwatch

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The frightening public health impacts of the overuse of antibiotics to raise animals for food are becoming clear. The Centers for Disease Control and Prevention (CDC) estimate that over 2 million Americans contract an antibiotic-resistant infection each year, leading to at least 23,000 deaths.[1]

But fewer people realize that the aquaculture industry also has an antibiotics problem. Just like raising livestock and poultry, many large-scale fish farming operations rely on the misuse and overuse of antibiotics to compensate for crowded, stressful conditions.

Many fish and other seafood are given low doses of antibiotics in feed over long periods of time to try to prevent the spread of illness.[2] These practices lead to the development and spread of antibiotic-resistant bacteria. Imagine taking a low dose of antibiotics every day to prevent getting sick, rather than going to the doctor to get a prescription or antibiotics when you actually are sick.[3]

Aquaculture production has grown substantially over the last several decades. According to the United Nations Food and Agriculture Organization (FAO), total global aquaculture production has reached nearly 67 billion tons.[4] Aquaculture has risen from just over 13 percent of total global fish production to 42 percent since 1990.[5]

The use of antibiotics in aquaculture varies widely around the world.[6] Since most of the seafood that we eat in the United States is imported, practices used around the world have the potential to affect anyone who consumes seafood.[7] The risks from this poorly regulated industry include residues of antibiotics and other drugs that remain in the products that we eat, as well as antibiotic-resistant bacteria created by the overuse of antibiotics.[8]

Factory Fish Farms

Like factory farms on land, large-scale factory fish farms in the oceans are generally big, dirty and dangerous. Marine fish are grown in cages or net pens that allow uneaten fish feed, fish waste and any antibiotics or chemicals used in the operation to flow through the cages directly into the ocean.[9] Pesticides and the other drugs or chemicals used in these operations can also be damaging to the surrounding aquatic ecosystem.[10] Caged fish can escape and compete for resources or interbreed with wild fish and weaken important genetic traits, and farmed fish can also spread disease to wild fish.[11]

Factory fish farms also tend to grow top-of-the-food-chain carnivorous fish that require large amounts of protein in their diet.[12] That protein generally comes from small wild fish — like herring and sardines — that are extracted in large quantities

from the ocean and processed into feed.[13] In some cases it can take over six pounds of wild fish to produce one pound of farmed fish.[14] Taking wild fish out of the ocean to feed farmed fish can undermine the marine food chain by reducing a food source for other wild fish.[15] Soy is also being extensively added to feed, yielding excess waste and pollution.[16] Fish raised in freshwater ponds in Asia are often fed "homemade" feed, consisting of kitchen scraps and chicken parts, which may increase the risk of *Salmonella*.[17]

Uninspected Imports

Currently, more than 9 out of 10 fish that Americans eat are imported, and about half of all imported fish and seafood are raised on fish farms.[18] In the developing world, fish farmers often use veterinary drugs and fungicides that are unapproved in the United States in order to combat disease in overcrowded fish pens. The U.S. Food and Drug Administration (FDA) is increasingly concerned that U.S. fish imports contain residues of these drugs and chemicals, some of which can cause cancer and allergic reactions and contribute to the development of antibiotic-resistant bacteria.[19]

U.S. government inspectors do not examine enough imports to find all of the unapproved and dangerous chemicals in imported fish. About 2 percent of imported fish and seafood shipments is physically inspected or tested in laboratories.[20] The low level of inspection leaves consumers vulnerable to foodborne illnesses and to exposure to common chemicals and drugs used in overseas aquaculture operations that are illegal in the United States. In 2012, the CDC found that imported fish were the most common source of foodborne illness outbreaks from imported foods between 2005 and 2010.[21]

The European Union (EU) found four times more veterinary drug violations on imported seafood annually than the United States did because the EU inspected a vastly higher percentage of imports, between 20 and 50 percent.[22]

How Antibiotic Misuse Leads to Antibiotic Resistance

All species evolve in response to their environment, including bacteria. Antibiotics kill bacteria, but if a few bacteria withstand the treatment, these bacteria will not only survive, but reproduce and pass on the genetic traits that allow them to resist exposure to antibiotics.[23] Even more troubling, most antibiotic-resistance genes occur on mobile pieces of DNA that can be shared among bacteria, a process known as horizontal gene transfer.[24]

The gene sharing can occur among the bacteria in animal digestive tracts and then continue as bacteria from the animal spread via waste into the environment.[25] The resistance gene, in a way, takes on a life of its own, no longer tied to a specific species of bacteria but persisting in the larger microbial environment. The collective effect is known as "reservoirs of resistance," in which resistance genes are widespread in the environment and can be acquired by other bacteria.[26] The routine use of antibiotics over long periods of time creates the ideal conditions for creating antibiotic-resistant bacteria.

Antibiotic Use in Aquaculture

Raising many animals in close quarters poses challenges to maintaining good health, and fish are no exception. Bacterial diseases — and antibiotic use to manage those diseases — are very common due to stress and hygiene issues in these artificially crowded conditions. Better sanitation and vaccines make it possible to use far fewer antibiotics in certain parts of the aquaculture industry, but those practices are not widely used, especially in developing countries.[27] Aquaculture uses large amounts of a wide variety of antibiotics, including those important to human medicine.[28]

So what happens when antibiotics are used in aquaculture? Treating the fish with medicated feed creates conditions in which antibiotic-resistant bacteria can spread within the fish. This treatment also creates the possibility of drug residues in seafood (see specific cases below).[29]

But the fish do not eat all of the medicated feed, and most of the antibiotics pass through the digestive system and are released into the environment in animal waste. Antibiotics that remain in the water place selective pressure on bacteria living in it, leading to the development and spread of antibiotic resistance near aquaculture facilities. Prophylactic use of antibiotics in shrimp and salmon aquaculture has led to higher rates of resistance in bacteria in the surrounding waters. Additionally, antibiotics in the water affect other marine life nearby.[30]

Evidence suggests that these antibiotic-resistant bacteria can, in turn, pass on their antibiotic resistance genes to other bacteria, including human and animal pathogens, through hori-

zontal gene transfer.[31] An increasing number of studies have documented elevated levels of bacterial antibiotic resistance in and around aquaculture sites. For example, before 1990 in the United Kingdom, the disease-causing bacteria *Aeromonas salmonicida* were sensitive to amoxicillin. But after the antibiotic was introduced to fish farms, amoxicillin-resistant strains began to appear.[32] Evidence of antibiotic-resistant bacteria also has been reported in the Mediterranean Sea, where a study found a high percentage of resistant strains, indicating a widespread antibiotic resistance in the bacterial populations surrounding fish farms.[33]

Case Study: Salmon Farms in Norway and Chile

The world's top two salmon-producing countries, Norway and Chile, use vastly different amounts of antibiotics. Incredibly, Chilean salmon producers use *840 times* more antibiotics per ton of fish than Norwegian salmon producers. Norwegian salmon producers use only very small amounts of antibiotics, less than a gram of antibiotics per ton of salmon produced, compared to over half a kilogram of antibiotics per ton of salmon in Chile.[34] What can explain this glaring disparity?

In Norway, producers transitioned to vaccines and hygiene management practices, reserving antibiotics only for emergencies.[35] The Norwegian Veterinary Institute developed a vaccine against the disease furunculosis, which came into common use during the 1990s through collaboration between the government and industry.[36]

Industrial salmon farming in Chile has grown rapidly into a robust export industry, making Chile the top supplier of salmon to the United States.[37] Heavy antibiotic use has fueled that growth at every step of the way.[38] Chilean salmon producers have struggled with diseases for which there are no vaccines.[39] Chile permits the use of several classes of antibiotics in salmon production that are banned for such uses in Norway, the United States and Canada,[40] including substantial use of quinolones, a class of antibiotics unapproved for such uses in the United States. The FDA has cited three companies operating in Chile for using unapproved antibiotics and other drugs.[41] Researchers have further analyzed antibiotic sales data, determining that Chile effectively neither regulates nor tracks antibiotic use in the salmon industry.[42]

The heavy use of antibiotics in Chilean salmon facilities has lead to an increase of antibiotic-resistant bacteria there.[43] Moving young salmon from freshwater hatcheries to marine facilities further spreads antibiotic-resistant bacteria around the environment.[44] Antibiotic-resistance genes that emerged in aquatic bacteria have been found in human and animal pathogens nearby.[45] For example, some antibiotic-resistant urinary tract infections in Chilean people have been linked to antibiotic misuse in salmon aquaculture.[46] Research suggests that aquaculture workers may be at risk as well.[47]

Case Study: Aquaculture in Asia

Asia dominates global aquaculture production, producing nearly 90 percent of the world's total.

Most Asian aquaculture occurs in freshwater or brackish ponds, which release water into nearby water bodies, allowing chemical use to degrade the local aquatic ecosystem. Not just antibiotics, but many other veterinary medicines, are commonly used.[48] Antibiotics have been used in low doses, such that some of the treatments are no longer effective.[49]

Catfish

Imported catfish from Vietnam has undercut a substantial U.S. catfish farming industry over the last several years. To level the playing field, the 2008 U.S. Farm Bill required that imported catfish undergo the same level of inspection as domestic catfish. This change was highly controversial, with much debate about whether such measures are necessary.[50]

But a risk assessment of chemical use in Asian aquaculture found catfish farming in Vietnam to be among the worst possible "hot spots" due to its intensive production practices and heavy chemical use.[51] Vietnamese catfish production uses relatively higher levels of antibiotics than other forms of aquaculture in Asia.[52] A limited study of antibiotic use in Asian aquaculture found 17 different antibiotics being used in surveyed Vietnamese catfish farms, including several antibiotics used in human medicine.[53] One class of medically important antibiotics, fluoroquinolones, was recently banned in aquaculture in Vietnam after several drug-residue violations were found by countries such as the United States and Canada, where fluoroquinolones may not be used in aquaculture.[54] There is ongoing research on vaccines to use instead of antibiotics in Vietnamese catfish production, with few effective results thus far.[55]

The high use of antibiotics in intensive catfish production in Vietnam has lead to a reservoir of antibiotic-resistance genes that can spread between species in the Mekong River

Delta.[56] A recent study found multi-drug resistance in nearly all the samples tested of *Pseudomonas*, a common aquatic bacteria on Vietnamese catfish farms. Stunningly, one sample of *Aeromonas*, another fish pathogen, was resistant to all 13 antibiotics tested.[57] These types of bacteria are "ubiquitous" in the aquatic environment and include both fish and human pathogens.[58]

Currently, the FDA has an Import Alert in place that orders all shipments from 13 Vietnamese seafood exporters to be seized for the illegal use of enrofloxacin, an antibiotic in the fluoroquinolones class, for violations dating back to 2009.[59] The FDA banned the use of fluoroquinolones in fish and other food animals "based on evidence" that widespread use "would promote the evolution of drug-resistant pathogens" and that consumers could be exposed to this risk on their food because the drug-resistant bacteria would remain on the fish after they were processed.[60]

Shrimp

As with catfish, antibiotic misuse in shrimp production in Asia has fostered multi-drug-resistant bacteria.[61] Vietnamese shrimp farms have used as many as 30 different antibiotics, including those important in human medicine.[62] In Vietnam, researchers found the presence of bacteria resistant to antibiotics used in shrimp farming in coastal areas to be relatively common. Antibiotic residues in water and mud near the shrimp facilities are a problem as well.[63]

Tests of shrimp imports offer a window into the impacts of antibiotic use in production. A study comparing imported shrimp with wild shrimp from South Carolina found antibiotic resistance to be more common in some imports. Patterns of resistance in samples from Ecuador, India and Thailand reflected antibiotics that are heavily used in those countries' shrimp industries.[64]

A 2015 *Consumer Reports* survey found that 80 percent of the bacteria commonly found on shrimp from Vietnam were resistant to one or more classes of antibiotics, suggesting that the shrimp were exposed to these antibiotics in their environment.[65] The survey also found residues of several classes of antibiotics on shrimp from Vietnam, and 72 percent of the shrimp with antibiotic residues in the study were from Vietnam.[66]

The Trans-Pacific Partnership

The Trans-Pacific Partnership (TPP) trade deal is a 12-nation trade pact being considered by Congress in 2016. The deal covers 40 percent of the global economy and significant agriculture-, food- and fish-producing countries in the Pacific Rim. Agribusiness and food companies demanded that the TPP include provisions to allow corporations to attack food safety laws as illegal trade barriers.

The TPP could force the United States to accept inadequate food safety standards as "equivalent" to ours.[67] TPP countries that permit antibiotics use in aquaculture could use the TPP to attack U.S. food safety rules that block the import of seafood raised with banned antibiotics. The TPP even has provisions that could allow exporters to try and force U.S. border inspectors to allow seafood contaminated with antibiotics to be imported into the United States.

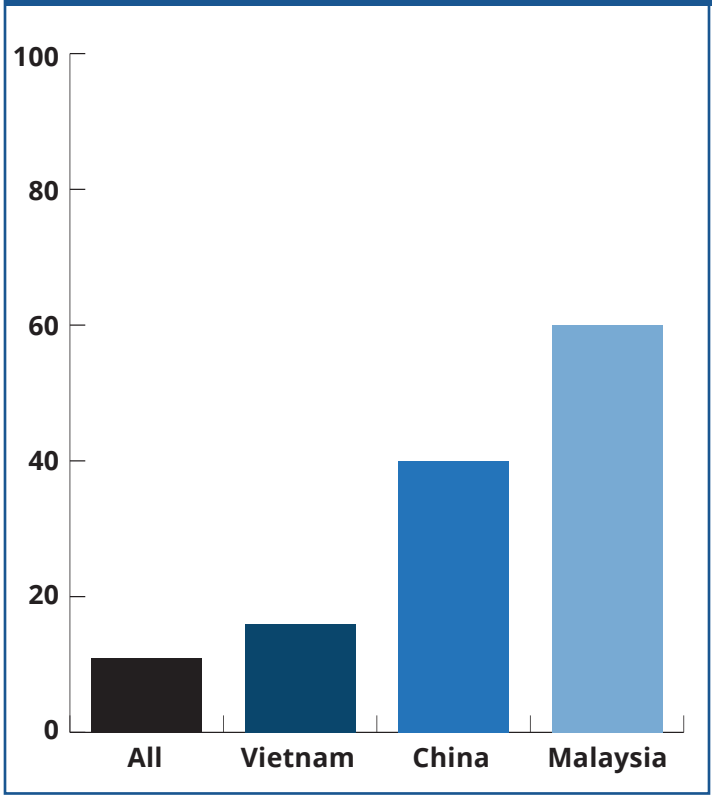
The FDA inspects only around 2 percent of imported seafood. But even this limited amount of sampling reveals problems. The FDA rejected one-fifth of seafood shipments from the TPP nations of Vietnam and Malaysia (23 percent and 20 percent, respectively) — about twice the overall refusal rate of 10 percent. Illegal antibiotics are a common reason that the FDA rejects imports from fish farming powerhouses like China, Vietnam and Malaysia — and is often the most common reason (see Figure 1).[68] Prioritizing trade with those countries rather than improving standards and increasing inspection of imports puts us all at risk.

What Can Consumers Do?

Choosing sustainably raised seafood takes work on the part of consumers. Food & Water Watch recommends that consumers read labels to see if seafood is from the United States and if it is wild-caught or farm-raised. For more information about choosing good seafood options, check out our seafood guide.

With so much imported seafood, however, we cannot shop our way out of this problem. Tell your elected officials to require more inspection of imported fish and to oppose new trade deals that increase unsafe imports.

FIGURE 1: Percent of FDA Import Refusals for Illegal Antibiotics *(2010–2014)*



SOURCE: Food & Water Watch analysis of FDA FOIA data and Import Refusal Report 2010 to 2014. Available at http://www.accessdata.fda.gov/scripts/ImportRefusals/index.cfm. Accessed December 2015.

Endnotes

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Food & Water Watch works to ensure the food, water and fish we consume is safe, accessible and sustainable. So we can all enjoy and trust in what we eat and drink, we help people take charge of where their food comes from, keep clean, affordable, public tap water flowing freely to our homes, protect the environmental quality of oceans, force government to do its job protecting citizens, and educate about the importance of keeping shared resources under public control.