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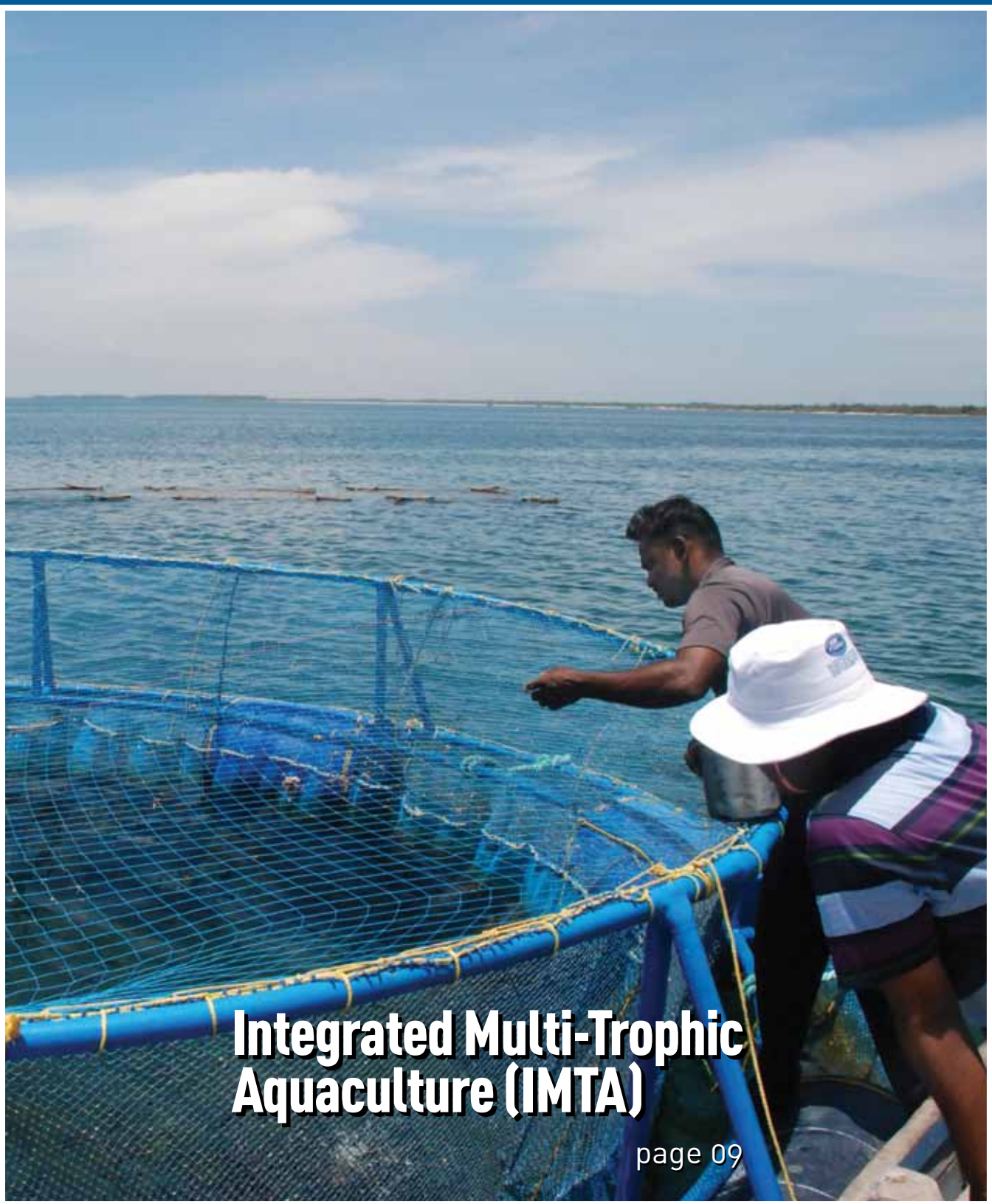

Integrated Multi-Trophic Aquaculture (IMTA)

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Aquaculture produces the Lowest levels of mercury in seafood

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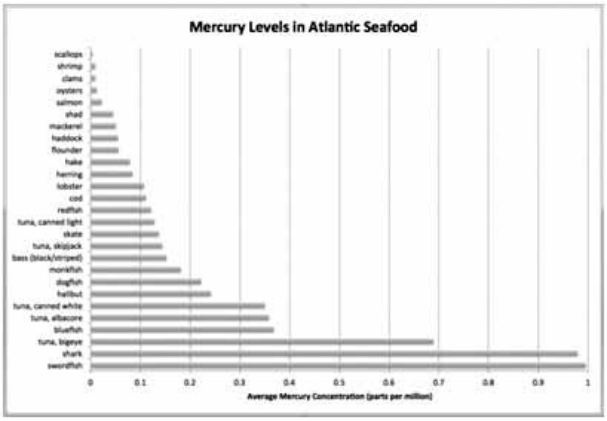
There are guidelines one can follow that help people avoid mercury by eating fish grown in tanks, ponds, and cages in the ocean. On a worldwide basis, about ⅔ of the fish we eat comes from saline water, with ½ actually farmed instead of harvested from the wild.

The lowest levels of mercury in seafood are found in the commonly consumed species of tilapia, salmon, shrimp, pollock, and catfish. All of these fish except pollock are well known, short-lived aquaculture species that do not bio-accumulate mercury like large, carnivorous species harvested from the wild. Information regarding mercury levels in cultured seafood is available for those willing to venture into peer reviewed scientific literature, some of which is summarized below.
Carp

In China and worldwide, carp is the number one species cultured. Carp which are typically grown in dirt ponds and absorb mercury primarily through sediments rather than from processed feed. As the bacteria in sediments under water are methyl mercury creators, animals that feed in sediments have higher mercury content than those that swim in the water column. The organic form of mercury, methyl mercury, is more than 100 times more toxic than the elemental kind found in old thermometers.

Tilapia

Current worldwide tilapia consumption is over 4.2 million metric tons and it is the second most widely grown fish behind carp. As of 2013, 70 percent of all tilapia consumed in the US comes from China.



Graph by Maine Seafood Guide by Maine Sea Grant, based on data from the FDA (https://www.seagrant.umaine.edu/maine-seafood-guide/about)

Farmed tilapia do not generally consume animals that live in sediments in aquaculture systems nor are they exposed to mercury rich chemicals used primarily for docks, boats and other machinery found near seawater. Thus the primary source of mercury contamination for this fish would be from whatever it is fed. Feeding of agricultural wastes, raw and treated sewage, and manures is ubiquitous and intensively practiced in Asian countries. Moreover, fish can also ingest mercury by eating contaminated vegetation. Once aquatic plants absorb the elemental mercury or the more toxic form methyl mercury from an organic source, they "assimilate it" and the accumulation begins.

Mercury Absorption

Once fish are fed the feed (or waste), the next important question is how much of the mercury in the feed makes its way into the fish we eat? This necessary information is available but it has not been

Koi averaging 350 g and grown in a zero water exchange, bare bottom tank system at 11 kg/m³

investigated sufficiently for all prominent species consumed. However, there are some important studies that have been conducted. For example, salmon is the third most widely grown fish species in the world. All of these fish are grown in cages in the ocean and so there is no transfer of mercury from the bottom sediments, and any contaminants are from the feed offered to the fish. The amount of methyl mercury absorbed by Atlantic salmon from feed has been measured at only 40%, while 83% of that amount is in the form of methyl mercury found in the fillet. Research indicates that we will likely absorb 67% of that small amount.

Mercury is higher in Fish Meal than Fish Oil

Fish meal used in aquaculture feeds is the main ingredient that contains mercury and generally, fish meal contains more mercury than fish oil. An experiment feeding carp in ponds demonstrated that feeds supplemented with fish oil were preferentially fed upon compared to vegetable oil feeds or natural feed in the pond such as zooplankton. When fish were examined for mercury at the end of the experiment, fish that fed on feed with fish oil had less mercury than the fish eating only the live zooplankton in the pond, or fish eating vegetable oil based feeds and zooplankton. These results may be an indication of how mercury from a prepared source can be less in concentration than the typical bioaccumulation that occurs in wild fish eating live foods.

The Effect of Location on Mercury Content

Areas of water that have high a mercury level may result in marine life that also has high mercury content. This would be especially true of sedentary animals. Farmed Pacific oysters from the coast of Mexico, Sinaloa State, were found to be strong accumulators of cadmium compared to mercury which accumulated at ¼ of the concentration. Sewage disposal and fertilizers were listed as the main sources of cadmium. Yet in Northwest Mexico, further north of Sinaloa, wild shrimp had a mercury content from 0.31 to 0.46 ppm in muscle, with values in the hepatopancreas only slightly less. Mangrove oysters from the southern part of the Gulf of California were sampled at 0.38 ppm.

In a study of farmed shrimp from Northwestern Mexico mercury values tended to be higher as one proceeded south from the border of the US. The values of shrimp in the northwest part of the Gulf of California had a lower range with the highest measure at 0.5 ppm. Further south of that location in the area of Sinaloa, mercury measured higher at 0.8 ppm and at Nayarit which is south of Sinaloa, mercury measured even higher at 1.48 ppm. However, all shrimp were considered safe for continued consumption by the local authorities.

In a midway point of Guaymas Bay, a study from 2013 stated mercury input to sediments had increased from 2 to 15 times in recent years from agricultural waste and exhaust from coal-fired power plants. A trend was noted in turtles and birds in the area, their livers contained more mercury than body muscle. Hammerhead sharks from the adjacent coast measured the highest content of mercury which was 7 times that of the next highest mercury-containing marine species, the striped marlin.

Conclusion

In summary, fish grown in the water column in a controlled setting that are harvested at a young age and fed ingredients low on the food chain are naturally lower in mercury compared to other production systems. Thus aquaculture products can be an excellent choice for those wanting to avoid mercury accumulation and potential toxicity.

So much more can be learned about mercury from my recently published book: *Mercury, The Ultimate Truth and Chronic Disease*. It can be purchased in paperback, digital or borrowed from the Amazon Library here:

https://www.amazon.com/gp/product/B07Q52QG2J/ref=dbs_a_def_rwt_bibl_vppi_i0

References can be obtained on request from the Author