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Mercury In Fish: Cause For Concern?

Swordfish and shark taste great--especially grilled or broiled. But reports that these and some other large predatory fish may contain methyl mercury levels in excess of the Food and Drug Administration's 1 part per million (ppm) limit has dampened some fish lovers' appetites.

FDA scientists responsible for seafood safety are also concerned about the safety of the eating these types of fish, but they agree that the fish are safe, provided they are eaten infrequently (no more than once a week) as part of a balanced diet.

Mercury Is Everywhere

Mercury occurs naturally in the environment. According to FDA toxicologist Mike Bolger, Ph.D., approximately 2,700 to 6,000 tons of mercury are released annually into the atmosphere naturally by degassing from the Earth's crust and oceans. Another 2,000 to 3,000 tons are released annually into the atmosphere by human activities, primarily from burning household and industrial wastes, and especially from fossil fuels such as coal.

Mercury vapor is easily transported in the atmosphere, deposited on land and water, and then, in part, released again to the atmosphere. trace amounts of mercury are soluble in bodies of water, where bacteria can cause chemical changes that transform mercury to methyl mercury, a more toxic form.

Fish absorb methyl mercury from water as it passes over their gills and as they feed on aquatic organisms. Larger predator fish are exposed to higher levels of methyl mercury from their prey.

Methyl mercury binds tightly to the proteins in fish tissue, including muscle. Cooking does not appreciably reduce the methyl mercury content of the fish.

Nearly all fish contain trace amounts of methyl mercury, some more than others. In areas where there is industrial mercury pollution, the levels in the fish can be quite elevated. In general, however, methyl mercury levels for most fish range from less than 0.01 ppm to 0.5 ppm. It's only in a few species of fish that

methyl mercury levels reach FDA limit for human consumption of 1 ppm. This most frequently occurs in some large predator fish, such as shark and swordfish. Certain species of very large tuna, typically sold as fresh steaks or sushi, can have levels over 1 ppm. (Canned tuna, composed of smaller species of tuna such as skipjack and albacore, has much lower levels of methyl mercury, averaging only about 0.17 ppm.) The average concentration of methyl mercury for commercially important species (mostly marine in origin) is less than 0.3 ppm.

FDA works with state regulators when commercial fish, caught and sold locally, are found to contain methyl mercury levels exceeding 1 ppm. The agency also checks imported fish at ports and refuses entry if methyl mercury levels exceed the FDA limit.

Spot-caught predator fresh-water species like pike and walleye sometimes have methyl mercury levels in the 1 ppm range. Other fresh-water species also have elevated levels, particularly in areas where mercury levels in the local environment are elevated.

FDA suggests sports fishers check with state or local governments for advisories about water bodies or fish species. These advisories provide up-to-date public health information on local areas and warn of areas or species where mercury (or other contamination) is of concern.

Safety Studies

Eating commercially available fish should not be a problem, day FDA toxicologists. The 1 ppm limit FDA had set for commercial fish is considerably lower than levels of methyl mercury in fish that have caused illness.

For information about the likely outcome of eating fish with low levels of methyl mercury, scientists look to studies of persons exposed to high levels; in particular, studies of two poisoning episodes from highly contaminated fish in Japan in the 1960's, and another poisoning incident in Iraq in the 1970's involving contaminated grain.

In the first episode, which occurred in Minimata, Japan, 111 people died or became very ill (mostly from nervous system damage) from eating fish (often daily over extended periods) from waters that were severely polluted with mercury from local industrial discharge.

Following a similar incident in Nigata, Japan, where 120 person were poisoned, studies showed that the harm caused by methyl mercury poisoning, particularly the neurological symptoms, can progress over a period of years after exposure has ended. The average mercury content of fish samples from both areas ranged from 9 to 24 ppm, though in Minimata, some fish were found to have levels as high as 40 ppm. Fortunately, no similar incidents have occurred in the

United States.

The best indexes of exposure to methyl mercury are concentrations in hair and blood. The average concentrations of total mercury in non-exposed people is about 8 parts per billion (ppb) in blood and 2 ppm in hair. From the Japanese studies, toxicologists have learned that the lowest mercury level in adults associated with toxic effects (paresthesia) was 200 ppb in blood and 50 ppm in hair, accumulated over months to years of eating contaminated food.

The Japanese studies did not, however, provide information on what levels of methyl mercury might adversely affect the fetus and infant.

"There is no doubt that when humans are exposed to high levels of methyl mercury, poisoning and problems in the nervous system can occur," Bolger says.

The types of symptoms reflect the degree of exposure. Paresthesia (numbness and tingling sensations around the lips, fingers and toes) usually is the first symptom. A stumbling gait and difficulty in articulating words is the next progressive symptom, along with a constriction of the visual fields, ultimately leading to tunnel vision and impaired hearing. Generalized muscle weakness, fatigue, headache, irritability, and inability to concentrate often occur. In severe cases, tremors or jerks are present. These neurological problems frequently lead to coma and death.

"During prenatal life, human are susceptible to the toxic effects of high methyl mercury exposure levels because of the sensitivity of the developing nervous system," Bolger explains. Methyl mercury easily crosses the placenta, and the mercury concentration rises to 30 percent higher in fetal red blood cells than in those of the mother.

"But none of the studies of methyl mercury poisoning victims have clearly shown the level at which newborns can tolerate exposure," Bolger says. "It is clear that at exposure levels that affect the fetus, adults are also susceptible to adverse effects. What is not clear the effect, if any, on fetuses at much lower levels--those that approach current exposure levels through normal fish consumption."

Studies of the poisoning incident in Iraq have provided limited data about what effects low levels of methyl mercury exposures to the fetus have on the infant. One possible effect, for example, is lateness in walking. In the fall and winter of 1971-72, wheat seed intended for planting--and which had therefore been treated with an alkyl mercury fungicide--was mistakenly used to prepare bread; more than 6,500 Iraqis were hospitalized with neurological symptoms and 459 died. The vast majority of the mothers experienced exposures that resulted in hair levels greater then the lowest levels associated with effects in adults. But there was no clear evidence that the fetus was more sensitive that the adult to

methyl mercury.

Another study on methyl mercury toxicity was published by the World Health Organization in 1990. It concluded, "the general population does not face a significant health risk from methyl mercury." Bolger says there is a consensus among scientists on all the results of this study except for the findings related to the relationship between low exposure levels and fetal toxicity.

Searching for More Information

FDA and the National Institute of Environmental Health Sciences are supporting a study by the University of Rochester to gather conclusive data on the effects of long-term exposure to low levels of methyl mercury in the fetus and infant. The study is being conducted in the Seychelles Islands, off the coast of East Africa in the Indian Ocean.

Fish is the major source of protein for people in the Seychelles Islands,. Begun about 10 years ago, the study focuses on the approximately 700 pregnancies that occur on the islands each year.

"That's more significant database than we had in the Iraqi study," says Bolger. "Also, the population is mostly Muslim," he says, a religion that prohibits smoking and drinking, behaviors that could affect the prenatal health of fetuses (and interfere with efforts to understand the subtle effects of methyl mercury).

The study tracks women from pregnancy to childbirth, and monitors the babies' consumption of breast milk. As children grow older, they are followed for any signs of nervous system disorders. Reports from the Seychelles study are not ready for publication, but Bolger expects the results to make a significant contribution to the consideration of whether further controls or other actions may be needed.

FDA Advice for Consumers

Fish is an important source of high-quality protein, vitamins and minerals. FDA seafood specialists say that eating a variety of types of fish, the normal pattern of consumption, does not put any one in danger of mercury poisoning. It is when people eat fad diets - frequently eating only one type of food or a particular species of fish - that they put themselves at risk.

Pregnant women and women of childbearing age, who may become pregnant, however, are advised by FDA experts, to limit their consumption of shark and swordfish to no more than once a month. These fish have much higher levels of methyl mercury than other commonly consumed fish. Since the fetus may be more susceptible than the mother to the adverse effects of methyl mercury, FDA

experts say that it is prudent to minimize the consumption of fish that have higher levels of methyl mercury, like shark and swordfish. This advice covers both pregnant women and women of childbearing age who might become pregnant, since the first trimester of pregnancy appears to be the critical period of exposure for the fetus. Dietary practices immediately before pregnancy would have a direct bearing on fetal exposure during the first trimester, the period of greatest concern.

FDA toxicologists have determined that for persons other than pregnant women and women of childbearing age who may become pregnant, regular consumption of fish species with methyl mercury levels around 1 part per million (ppm)--such as shark and swordfish--should be limited to about 7 ounces per week (about one serving) to stay below the acceptable daily intake for methyl mercury. For fish with levels averaging 0.5 ppm, regular consumption should be limited to about 14 ounces per week. Current evidence indicates that nursing women who follow this advice do not expose their infants to increased risk from methyl mercury.

Consumption advice is unnecessary for the top 10 seafood species, making up about 80 percent of the seafood market--canned tuna, shrimp, pollock, salmon, cod, catfish, clams, flatfish, crabs, and scallops. This is because the methyl mercury levels in these species are all less than 0.2 ppm and few people eat more than the suggested weekly limit of fish (2.2 pounds) for this level of methyl mercury contamination.

FDA's action level of 1 ppm for methyl mercury in fish was established to limit consumers' methyl mercury exposure to levels 10 times lower than the lowest levels associated with adverse effects. (paresthesia) observed in the poisoning incidents. FDA based its action level on the lowest level at which adverse effects were found to occur in adults. This is because the level of exposure was actually lower than the lowest level found to affect fetuses, affording them greater protection.

FDA toxicologists are developing a more complete database for addressing low-level methyl mercury exposures from fish; however, they consider the 1 ppm limit to provide an adequate margin of safety. This doesn't mean that it is safe to regularly and frequently eat fish that contain 1 ppm methyl mercury. The limit was established taking into consideration the types of fish people eat, the levels of methyl mercury present in each species, and the amounts of fish that are normally consumed.

Not everyone agrees, however, about what advice to provide to consumers. This is particularly evident in sport fish advisories provided by states around the country. Because states often use different criteria for their fish advisories, adjoining states may provide different advice about fish from the same bodies of water. Some states have adopted a zero risk approach and have advised consumers not to eat certain species, while others have advocated a limit on

intake that is more consistent with the FDA approach.

Despite these differences, efforts by the states remain a valuable guide for alerting people to possible mercury contamination in certain fish species in particular bodies of water. Federal efforts are being made to increase uniformity in fishing advisories.

Sample Results

Results of FDA surveillance sampling for methyl mercury in fish from October 1992 through September 1994 are shown below. At least five samples of each species were analyzed. If a species was sampled in both fiscal years, only the FY 1994 results are shown. The limit of quantifiable detection is 0.10 part per million (ppm); therefore, any values less than 0.10 ppm are shown as ND (not detected). FDA's action level is 1 ppm.

Species	Range (ppm)	Average (ppm)
Domestic Samples		
Catfish	ND - 0.16	ND
Cod	ND-0.17	0.13
Crab	ND-0.27	0.13
Flounder	ND	ND
Hake	ND	ND
Halibut	0.12 - 0.63	0.24
Pollock	ND	ND
Salmon (canned)	ND	ND
Salmon (fresh or frozen)	ND	ND
Shark	0.30 - 3.52	0.84
Swordfish	0.36 - 1.68	0.88
Tuna (canned)	ND - 0.34	0.20
Tuna (fresh or frozen)	ND - 0.76	0.38

Import Samples		
Pollock	ND - 0.78	0.16
Shark	ND - 0.70	0.36
Swordfish	0.80 - 1.61	0.86
Tuna (canned)	ND - 0.39	0.14
Tuna (fresh of frozen)	ND - 0.75	0.27

Questions?

FDA invites consumers who have questions about methyl mercury in fish or other seafood concerns to telephone the 24-hour FDA Seafood Hotline at (1-800) FDA-4010 or (202) 205-4314 (in the Washington, D.C., area). The automated hot line and Flash Fax service are available 24 hours a day. Public affairs specialists can be reached at the same numbers from noon to 4 p.m. Eastern time, Monday through Friday.

by Judith E. Foulke

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