

SELENIUM'S ROLE IN THE SEAFOOD SAFETY ISSUE

BACKGROUND

The reason why high doses of methylmercury cause harm in the body appears to be because mercury interferes with normal metabolic activities of selenium, an essential dietary nutrient. Supplementation with additional selenium has long been known to protect the body from adverse effects of mercury exposure. It now appears that this occurs because the additional selenium replaces the selenium that becomes unusable because of mercury binding. Selenium is a required component of a number of different types of enzymes that perform important functions in the body. These enzymes are normally present in all cells of all animal life, but they perform especially important functions in pituitary, thyroid, and adrenal glands as well as in brain tissues.

Since selenium's protective effect against mercury toxicity was discovered in 1967, it has been demonstrated in all species that have been studied. It is increasingly clear that mercury's high affinity for selenium results in complexes where mercury and selenium become bound together, making the selenium unavailable for making the enzymes that perform necessary functions required to maintain health. If there is enough additional selenium available in the cells to keep the supply of these enzymes maintained at a steady rate, these functions will be performed, and health will be maintained. This is a particularly important aspect of the seafood safety issue since ocean fish are among the richest sources of dietary selenium. The issue of mercury in ocean fish consumption comes down to a the question: "Does the amount of selenium present in ocean fish provide partial protection from the mercury that is also present, or does it provide complete protection?"

Recent research indicates that exposure to large amounts of methylmercury results in diminished selenium-dependent enzyme activities in brain tissues because when mercury outnumbers the selenium it can capture too large a fraction of what the tissues need. Excessively high mercury exposure can stop selenium-dependent physiological processes in the brain and glands, but this cannot happen if there is enough selenium available to offset these losses. Therefore, the small amounts of mercury present in ocean fish would not be expected to cause harm. Instead, the rich amount of selenium that is abundantly present in ocean fish is more than enough to be effective in protecting against mercury exposure. This is not true of pilot whale meat, which is virtually unique among seafoods in that it contains far more mercury than selenium.

It has been difficult for regulatory agencies responsible for protecting public health to determine how much mercury is safe for human consumption. Because of this, regulatory agencies have found it necessary to be extra cautious when suggesting safe limits for human mercury exposure. However, recent animal studies demonstrate that dietary selenium's protective effects against methylmercury toxicity are far more potent than previously expected. The results of these studies strongly support the concept that the selenium present in ocean fish is sufficient to completely protect against the small amounts of mercury that are also present. In order to prove this hypothesis, it will be necessary to perform direct assessments of mercury and selenium interactions through use of more refined experimental models to evaluate the details of this process.

The health effects research team of the U.S. Environmental Protection Agency (EPA)- sponsored Center for Air Toxic Metals® (CATM®) at the Energy & Environmental Research Center (EERC) of the University of North Dakota has been intensely examining mercury-selenium interactions for the past 5 years. The following studies have been specifically designed to accomplish the goal of defining the way mercury causes harm in the body so that future regulatory decisions can be made with proper information. This coincides with our goal of defining the multiple health benefits of the nutritionally essential selenium that is naturally abundant in seafood.