Industry Activities in Response to the Heavy Metals Problem in Seafoods

LEE J. WEDDIG
Executive Director
National Fisheries Institute, Inc.
Washington, D.C.

Just a year ago at this meeting, I was of the very premature opinion that the "mercury in fish" problem was solved. The summer months of 1970 had seen a series of discoveries in various fresh water fish of mercury presence above the Food and Drug Administration (FDA) guideline of 0.5 ppm. In each case, the action step had been the same — close the offending body of water. Simultaneously, or later in some cases, officials took action to shut off the sources of mercury.

We had a pollyanna attitude that mercury in fish was an isolated problem caused by nasty industrial polluters. We believed that the impact on the fish industry would be minimal, causing loss of a few fish temporarily. Victims would be a few score of individual fishermen who were unfortunate to have selected Lake Erie, Pickwick Reservoir, Brunswick estuary or some similar spot, as the location to attempt to earn a living by catching fish. We calculated the damage from the fresh water mercury discoveries and determined it meant loss of only a small percentage of our supply — a percentage that could be written off on an industry-wide basis without too much difficulty.

These ostrich-like attitudes were shattered rather abruptly in early December (1970) with the disclosures to the press by chemist McDuffy that his analyses of commercial canned tuna fish and frozen swordfish showed over the guideline.

The industry belatedly realized that the mercury problem was for real — now that it involved one of our very largest volume fish products, and one of the staples in the frozen fish trade.

The tuna industry, through efforts of the individual packers, the Tuna Research Foundation and the National Canners Association, established testing procedures to check out all lots in inventory, with the intent of segregating those fish which could not meet the guideline. The FDA, of course, was working overtime also, to monitor activity by the domestic packers and to directly handle the imported pack. The end result was the loss of only a very small percentage of the inventory.

The swordfish problem was not as easily salvaged. Upon notification that swordfish sampled by the FDA showed approximately 50% to be over the guideline of 0.5 ppm, with some reaching levels three and four times the guideline, the industry members through NFI, to which most major swordfish dealers belong, took several immediate steps.

The *first,* and perhaps most effective action, was notification of overseas producers that all new shipments should cease. Since 95% of the swordfish was imported, this action was of great significance.

Second, shipments already on the water were either returned to home ports or held at the port-of-entry for testing. I might add, FDA would have seen to that even if the industry hadn't agreed to it.

Third, testing began on the cold storage inventory, estimated to be anywhere from 2 to 4 million pounds. This step proceeded slowly because of lack of

laboratory facilities. Further disillusion occurred when analyses revealed that the mercury levels were too high. There was no way of segregating under guideline from over guideline fish, since almost all were over the guideline. Trade was essentially shut off.

The FDA then began the task of sampling and testing warehouse stock. The FDA tests very rapidly confirmed the reluctant decision that virtually the entire inventory was unacceptable. The total known inventory was almost completely accounted for. It was either seized, embargoed or voluntarily kept from the market.

A very small amount of trade evidently continued, since the FDA found some stock in the stores and restaurants. This resulted in the FDA public recommendation that the public not eat any swordfish. This was a disastrous announcement, whose reason still escapes me.

In the meantime, however, other problems remained. For example, what to do with several million pounds of frozen swordfish that the nation's health authority said was unsuitable for sale? The product could not be fed to animals, since that use was also forbidden by the FDA. It was not legal to attempt any sort of blending operation, that is, to mix a product with little or no mercury content with the high analyses fish in an effort to reduce the average. Even just dumping the product was a problem since anti-pollution laws prevented burning it or dumping it into the sea. A few companies decided the easiest way out was to let the FDA seize the product, since the courts then had the problem of disposal. However, this step was not acceptable, for economic reasons, to any firm with any quantity of product. Several companies had inventories in excess of $250,000. The end result was organization of a swordfish negotiating committee within the NFI, which carried on a short-term exchange of correspondence with the Frozen Fish Export Association of Japan. The exchange boiled down to a single issue—who was going to bear the brunt of the costs involved in shipping millions of pounds of swordfish back to Japan? The product could be remarketed in that country, which does not agree with the FDA as to the significance of mercury in fish. However, normal marketing channels did not exist.

In the end, the product was disposed of mostly by returning it to Japan. Some was shipped to other nations with similar attitudes to mercury. In no case did the U.S. company recover all its costs. Several firms are still attempting to recover from their losses which exceeded $100,000. All told, we estimate losses from the swordfish inventory disposal to exceed $1-million.

What I've described thus far has been the "bail out" action taken by the industry. Concurrent with these actions were many meetings, discussions and finally, decisions. Initial attitudes of people in the swordfish business were not very peaceful. Several firms felt the Association, or individuals, should challenge the FDA guideline in court. This move was discarded as being impractical and unnecessary. We felt that if the evidence could be produced that would convince a judge that the guideline was wrong, then that same evidence would convince the FDA to reevaluate the guideline, without the need for court action.

While the details of the swordfish problem consumed a great deal of time and effort on the part of the industry, their resolution does nothing to solve the more deep rooted difficulties, that of heavy metals in fish generally. Concurrent with the work described thus far, a more comprehensive, more important program was taking shape. This is a long-term program involving industry sponsored action and coordination with that under way by organizations outside the industry.

I think we can categorize the work in three distinct, but interrelated, fields: (1) *Assessment* — projects aimed at determining the extent of metal presence in fishery products; (2) *Investigative* — projects seeking an understanding of the true nature of the problem; i.e., what is the relationship of heavy metals in fish to health of fish consumers and (3) *Public Relations* — communications action designed to convey better understanding of the actual situation and solicit appropriate government response.

The assessment concern, of course, was immediate. Did we have another swordfish problem on our hands? Immediately after the swordfish difficulty emerged, NFI commissioned a rapid, superficial survey of all key fish products to see which other species might be affected by presence of mercury at levels near or over the guideline. The survey also covered five other metals (arsenic, silver, cadmium, selenium and lead).

The findings did not cause any alarm since none of the species tested showed consistent over guideline results for mercury. For other metals, we decided there would not be any major problems. However, less than 75 samples were tested so the results are not conclusive. The project served to point out several less important species which would be borderline for mercury, and that other metals had not reached generally alarming stages.

Concurrent with the industry surveys were more comprehensive product samplings by the FDA, the National Marine Fisheries Service (NMFS), state governments and several overseas governments.

The FDA surveyed about 20 major products at the wholesale level. From this came seizures of imported snapper. As of this time, no further action has been taken. In fact, Commissioner Edwards released a statement through the NMFS recently in which he reaffirmed that there were no problems with any marine fish other than swordfish.

NMFS has two major surveys under way: (1) a survey of 34 processed fishery products for the presence of mercury, lead, arsenic, cadmium and chromium and (2) a survey of approximately 100 species of commercial and recreational fish and shellfish taken from all U.S. fisheries, for mercury and other heavy metals.

The processed product survey is 90% completed. It is expected that full results will be in before the end of the calendar year (1971). The 100-species survey, overall is only about 10% completed. However, the completed segments of this survey include in-depth analyses of species and products of high commercial and recreational importance.

The in-depth studies turned up various problems. Generally, there was an association between size of individual fish within a species group and the degree of mercury presence. Also, there were geographical variances, such as found in halibut where the fish being caught immediately in the coastal areas of Alaska and Washington showed some problems, with the rest of the species being generally clear.

All of these surveys, plus those conducted by the state governments and foreign governments, from time to time generated flurries of activity in other species. I've mentioned seizures of imported snapper. There were problems with large northern lobsters until the procedure was established to analyze all meat, rather than just a portion of it. The most significant problem was in the halibut industry. This was solved by an industry testing program and rejection of very large fish from certain areas. We may still run into a few problems with several other species, but hopefully the investigative activities of the research have flushed out all potential problems.

The second area of research is investigation. With the knowledge that the present 0.5 ppm guideline presents serious problems to the tuna industry, wipes out swordfish and certain fresh water species businesses, complicates halibut production and sales and could be serious for certain other species, it is essential that the relationship of mercury in fish to the health of fish consumers be determined.

The present U.S. guideline is based on the history of illnesses and deaths caused by presence of methyl mercury in fish and shellfish consumed by people in Minimata and Niigata, Japan. The best available data indicates two or three of the symptomatic cases in Niigata had mercury levels of 0.2 ppm in their blood. Using a no-effect safety factor of 10, it was determined that mercury levels should be held below 0.02 ppm. Swedish data indicate a 70 day half-life of mercury in humans. This was translated by some to an acceptable daily intake (ADI) of 0.03 mg for a 150 pound person. In the course of a year, this amounts to .03 mg x 365 or 11 mg. Forty-eight pounds of fish with a mercury level of 0.5 ppm will contain 11 mg of mercury. At a third of a pound per serving, this means 144 meals, all of fish containing maximum guideline levels of mercury.

Several very important questions remain unanswered.

(1) Will mercury-blood levels in excess of 0.2 ppm indeed cause symptoms? The three reported cases of Niigata seem to be exceptions. Other cases there showed considerably higher levels. Further, in our opinion, the method of analysis used at Niigata is suspect. This could explain why symptoms have not been detected in persons whose mercury-blood level exceeded 0.2 ppm, such as was the case in Sweden.

(2) Will consumption of fish as part of a balanced adequate diet, as opposed to an all fish subsistence diet, such as occurred in Japan, cause the same build up of mercury in the human system?

(3) Does the consumption of fish whose mercury level is relatively low — 0.2-1.0 ppm — result in mercury build up in the system in the same relationship as that caused by very heavily contaminated fish (5-20 ppm) as was the case in Japan? Reports of the Anti-Coronary Club analyses by the New York Health Department raise questions of this kind.

(4) Is the mercury found in deep water marine species identical in toxicity and availability to that found in areas where pollution by industrial discharge is the cause?

(5) Could the Japanese cases have been caused by more than methyl mercury? The bodies of water were polluted by other chemicals as well. Is there perhaps a synergistic effect yet undiscovered?

Lack of answers to the above and other questions is the reason why the ADI of 0.3 mg must be considered as an interim judgment. In addition to questions relating to the ADI, there is also a serious question as to relationship of the guideline to the ADI, i.e., what is the likelihood of exceeding the ADI when the guideline is 0.5 ppm as opposed to 0.7 ppm, 1.0 ppm, etc.? As has been pointed out, a consumer of 48 pounds of fish annually, all of which contained 0.5 ppm mercury, would reach the ADI. However, all fish do not contain 0.5 ppm, and relatively few people consume 48 pounds of fish annually. In other words, what is the relative risk of exceeding the ADI if the guideline were 1 ppm? To answer the question, one must know consumption patterns and levels of mercury in various species. The NMFS is constructing a computer program that analyzes the mercury exposure in a 1,500 household sample. Total fish consumed by

household is tabulated by variety. Typical mercury levels are assigned to each variety. The result should provide some indication of risk at various guideline levels. The report is expected within 6 months.

The answers to the earlier questions require longer term research. We are attempting to remain informed as to projects under way at universities and government labs. A survey has been conducted which produced considerable data.

Some of the more pertinent projects include: (1) Work by Dr. A. J. Liston, Food and Drug Directorate of Canada, who is conducting chronic studies with rats, cats and guinea pigs to determine an ADI for both mercury and cadmium. (2) Work at the Medical Research Council Laboratories, Carshalton, Surrey, England, where Dr. L. Magos is determining the highest daily dose of methyl mercury which at steady state is not toxic to the brain. (3) New York Health Department study of anti-coronary club consumers which showed no difference in mercury-blood levels between this group, which has a long time fish eating history, and others in the population. (4) Dr. Hochberg at the National Institute of Health in Atlanta studied mercury levels in the hair and blood of Pribiloff Island Indians who consume large quantities of seal liver and meat. (Seal liver has a very high mercury content.) Even though mercury-blood levels were reported above those which supposedly would accompany symptoms, no clinical symptoms were detected. (5) Likewise, a study directed by Dr. Morrison of the Food and Drug Directorate of Canada, has been unable to detect symptoms in natives of north central Canada who eat large quantities of fish from lakes with a high mercury content. This is a rather extensive study of more than 10,000 individuals which is not completed. (6) A most unusual study is that reported October 13 at the American Public Health Association convention. Michigan medical researchers tested tissues from cadavers dating back to 1900. Their conclusions were that mercury levels in Americans have decreased since 1913.

A short list of these and other projects under way is appended to this paper.

The third major industry work area has been in public relations. The press treatment during the first quarter of 1971 was devastating. Unfortunately, the coverage very often was sensational and inaccurate, painting all fish with the same broad brush. The need for counter public relations was evident.

The basic tool in our work to change opinions of key members of the public has been an "influentials" mailing program. A list of 2,400 editors, consumer group leaders, educators and others has been receiving on a monthly basis, brief memos covering news clippings that report a more comprehensive view of the problem. This program was initiated in January, and we think it has been quite beneficial. Our strategy was to give the widest circulation possible to positive authoritative statements from others, rather than to attempt to be information sources ourselves. The October 1971 mailing, for example, included a clipping on the American Public Health Association's report of declining mercury levels.

Other aspects of the program included a series of network and syndicated radio interviews; and most importantly, a spirit of full cooperation with the press. We answered questions as completely as we knew how and tried to show that our industry was facing a problem in a public minded manner, to assure the consumer that his welfare was being protected.

There is no doubt the industry was damaged by the mercury incidents. We lost a sales volume of $25 million a year in swordfish. Individual swordfishermen lost their livelihood. Some food chains, depending heavily on swordfish, lost sales volume of 20-25% that have not yet recovered.

The overall impact is greater than swordfish, however. Retail fish sales generally remain sluggish, almost a year after the problem broke. Of course, prices and short supplies contribute to this. However, the steady increase in per capita consumption enjoyed during the past 3 years will be reversed this year.

Sales, of course, are only part of the story. There's a feeling of uncertainty that cautions against major investments in inventories. This, in turn, prohibits concentrated promotions and other volume activities, which are the only means of achieving overall industry growth. Hopefully, we can regain industry progression during 1972, if we aren't beset by other problems.

My final point is to touch briefly on legislative needs. Very simply, I don't believe the discovery of a potential hazard, such as mercury in swordfish, should have cost the industry the millions it did. Somehow, precipitous action, of the type we experienced, should be avoided. We are relying on the Fishery Product Inspection legislation to avoid abrupt actions, but rather to allow timely discovery of potential problems and to find solutions prior to reaching the precipice.

We also feel that some form of compensation program is needed to protect the fisherman and others in the industry against bankrupting losses. Finally, the water quality laws need strengthening. Hopefully, the current congressional work in this area will bear fruit.

From these experiences I have drawn several conclusions. They serve only to show we are headed in a single direction. (1) The accumulation of research results should continue. At some point, if results continue to be favorable, FDA should be informally approached to discuss a guideline modification or a change in its interpretation. (2) If research appears lacking in any key area, industry should either sponsor same or find a sponsor. (3) Pressure on NMFS should be continued and increased to accelerate its research. (4) Favorable results should continue to be circulated to influentials. (5) Compensation legislation attempts should be continued. (6) The Hart Bill should be supported.

We would hope that the end result of these experiences will enable our society to benefit in the future. Humans, swordfish, metals are all part of nature. New facets of our interrelationships will continue to be found. Our need is to gain true understanding in a more sophisticated, less frightened manner.

APPENDIX

A Partial Listing of Current Mercury Research

Absorption and Elimination of Dietary Mercury. . . .
Dr. J. K. Miettinen - University of Helsinki, Helsinki, Finland

Automated Methodology for Mercury Analysis. . . .
Dr. Roger G. Herdman - New York State Department of Health, 84 Holland Avenue, Albany, NY 12206
Dr. A. B. Morrison - Food and Drug Directorate, Tunneys Pasture, Ottawa, Canada

Biotransformation of 203 Labled Mercury. . . .
Dr. Thomas W. Clarkson - University of Rochester, Rochester, NY
Dr. T. Norseth - Institute of Occupational Health, Oslo, Norway

Distribution of Mercury and Cadmium in Estuarine Environment. . . .
Dr. Theodore J. Kneip - New York University Medical Center, 550 First Avenue, New York, NY 10016

Determination of A.D.I. for Mercury and Cadmium. . . .
Dr. A. J. Liston - Food and Drug Directorate, Tunneys Pasture, Ottawa, Canada
Dr. L. Magos - Medical Research Council Laboratories, Carshalton, Surrey, England

Distribution of Mercury and Cadmium in Plants Algae and Bacteria. . . .
Dr. J. Barber - Imperial College of Science and Technology, London, England

Embrionic Toxicology of Mercury. . . .
Dr. Robert W. Miller - National Cancer Institute, Bethesda, Maryland 20014

General Investigation of Mercury. . . .
Dr. D. C. Fang - Oregon State University, Corvallis, Oregon
Dr. J. B. Hook - Michigan State University, East Lansing, Michigan
Dr. T. T. Kurland - Mayo Clinic, Rochester, Minnesota
Dr. Bernard Weiss - University of Rochester, Rochester, NY 14602

Mercury in Birds — Predatory, Fish Eating, and Waterfowl. . . .
Mr. J. A. Keith - Canadian Wildlife Service, Ottawa, Canada

Mercury and Cadmium Brain, Liver and Kidney Damage, and Recovery. . . .
Dr. Bernard Weiss - University of Rochester, Rochester, New York

Monitoring Body Burden of Mercury in Populations. . . .
Dr. T. B. Eyl, 3227 Mayer Drive, St. Clair, Michigan 48079
Dr. Hochberg - Center for Disease Control, Atlanta, Georgia 30333
Dr. A. B. Morrison - Food and Drug Directorate, Tunneys Pasture, Ottawa, Canada

Natriuretic Effect on Kidneys Caused by Mercury. . . .
Dr. B. R. Neckay - University of Texas, Galveston, Texas

Neutron Activation Analysis for Mercury and Other Heavy Metals. . . .
Dr. Theodore J. Kneip - New York University Medical Center, 550 First Avenue, New York, NY 10016

Protein (Enzyme Synthesizing Systems) Effect of Mercury on Liver, Kidney and Brain. . . .
Dr. Paul Brubaker (NIEHS) P. O. Box 12233, Research Triangle Park, North Carolina 27709

Renal Regeneration After Toxic Dose of Mercury and Effects of Acute and Chronic Loading of Mercury. . . .
Dr. Wallace G. Campbell, Jr. - Emory University, Woodruff Building, Atlanta, Georgia 30322
Dr. Francis Binkley - Emory University, Woodruff Building, Atlanta, Georgia 30322

Renal Toxicity of Heavy Metals — Mercury and Cadmium. . . .
Dr. E. C. Faulks - University of Cincinnati, Cincinnati, Ohio

Restoration of Mercury Contaminated Lakes and Rivers. . . .

Dr. A. Jernelov - Institute for Air & Water Pollution, Stockholm, Sweden

Dr. Lars Landler - Swedish Water & Air Pollution Laboratory, Stockholm, Sweden

Teratological Effects of Mercury. . . .

Dr. Richard Doherty - University of Rochester, Rochester, New York

Toxicity of Mercury — Gross and Subcellular. . . .

Dr. Bertram D. Dinman - University of Michigan, Ann Arbor, Michigan 48104

Dr. T. Norseth - Institute of Occupational Health, Oslo, Norway

Dr. Ronald Klein - National Institute of Environmental Health, Research Triangle Park, North Carolina 27709

Turnover of Mercury in Aquatic Systems. . . .

Dr. A. Jernelov - Institute for Air & Water Pollution, Stockholm, Sweden