CORRESPONDENCE

Ingestion of herring leads to absorption of pristane in humans

Editor—Pristane (2,6,10,14-tetramethylpentadecane) is a branched chain hydrocarbon which is thought to be derived from the phytol moiety of chlorophyll. This compound has been associated with several biological effects. Pristane can induce plasmacytomas,¹ and together with some polycyclic aromatic hydrocarbons, act as promoters in the development of B-lymphoid malignancies and skin tumours in animals.^{2,3} Intraperitoneal injections have induced arthritis in mice.⁴

Pristane occurs in rather high concentrations, 1% to 3% of the body fat, in certain zooplankton and these plankton are assumed to be the primary source of the pristane found in liver oils of sharks and whales.⁵ Pristane is also found in herring and the concentration in flesh is about 370 µg/g of wet weight.⁶ Other fish species such as cod have much lower concentrations of pristane in their flesh, most often < 1 µg/g of wet weight.⁶

One of us (BS) volunteered to ingest Atlantic herring as lunch at 11 00 am. Four different meals contained 125, 140, 250, and 310 g of cured herring. A reference meal was composed of chicken with potatoes, hard bread, and water.

The quantitative analysis of pristane was performed with gas chromatography equipped with a flame ionisation detector. Pristane was also identified with gas chromatography-mass spectrometry, operated in electron impact mode. The recovery of the complete clean up method was >90% for pristane and the internal standard (dodecylcyclohexane). The detection limit of the method was 300 pg.

The serum concentration of pristane increased to 20–3000 ng/g serum 2–4 hours after ingestion of herring. Pristane was not detected before and 24 hours after ingestion of herring and it was not detected after the reference meal.

This experiment showed that pristane is clearly absorbed after the ingestion of Atlantic herring.

Pristane injected intraperitoneally into mice induces seropositive arthritis in susceptible strains. This agent has been proposed as an experimental model for rheumatoid arthritis.⁴ Swedish fishermen eat more herring than the general population⁷ and it is an interesting finding that fishermen had a high prevalence of rheumatoid arthritis when this disease was investigated in 66 large occupational groups in Sweden.⁸

It is also interesting that pristane is absorbed after ingestion of herring and this absorption should be studied in larger groups of humans after ingestion of herring and other species of fat fish. Further work is also needed to scrutinise the possible link between pristane exposure and the occurrence of multiple myeloma and diseases affecting the joints.

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Digestive tract neoplasms among employees with past exposure to brominated dioxins

Previously, we reported biomonitoring, immunological, and other clinical findings for a group of 42 employees potentially exposed to polybrominated dibenzo-p-dioxins (PBDDs) and furans (PBDFs) during extrusion blending of resins containing polybrominated diphenyl ether (PBDE) flame retardants.^{1,2}

In the five years since the clinical study was completed, two cases of digestive tract neoplasms have come to our attention within this group of employees and an additional digestive neoplasm was reported in a technician who performed analyses in support of the production operation including testing by pyrolytic methods. The two cases in the earlier study group had the highest observed 2,3,7,8-tetrabromodibenzo-p-dioxin (2,3,7,8-TBDD) concentrations in blood lipids among the 42 persons surveyed.

Case 1 was diagnosed to have squamous cell carcinoma of the oesophagus in January 1994 at the age of 57 and died nine months later. This person worked as an extruder operator throughout the period when PBDEs were used in the extruding operations (1977–89). He had the highest recorded 2,3,7,8-TBDD concentration (527 parts per trillion (ppt) measured in 1989) of any person in the study population. Other dioxin and furan congeners were increased as well with a 2,3,7,8-TBDF concentration of 176 ppt and total hepta- plus octa-TBDD concentrations of 10 000 ppt. Other factors potentially relevant to his diagnosis included

a history of smoking about one pack of cigarettes a day for 40 years and consumption of two to three bottles of beer a day.

Case 2 was diagnosed to have adenocarcinoma of the duodenum, a relatively rare type of cancer, in April 1994 at the age of 49 and died in July 1994. He had performed laboratory support work since 1974. Potential contact with PBDDs and PBDFs would have occurred between 1977 and 1989. Postmortem measurement of dioxins and furans in blood lipids showed a non-detectable 2,3,7,8-TBDD concentration, and a 2,3,7,8-TBDF concentration of 10 ppt. Marginally higher concentrations of the measured congeners were obtained in a fat sample as well as detectable concentrations of both 2,3,7,8-TBDD (0.8 ppt) and 1,2,3,7,8-penta-BDD (2.3 ppt).

Case 3 was diagnosed to have tubular adenoma of the rectum in September 1995 at the age of 48. He had also been employed as an extruder operator during the entire period of PBDE use. His initial 2,3,7,8-TBDD blood lipid concentration in 1989 was 425 ppt.

Case 1 is of particular interest because of our earlier findings of increased digestive and respiratory cancer among people with high chlorinated dioxin exposures who were also cigarette smokers.³ The remaining two cases represent contrasting occurrences where dioxin concentrations were less clearly higher than background (case 2) or where the tumour diagnosed was a relatively common benign neoplasm (case 3).

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Factors affecting recognition of cancer risks of nuclear workers

Editor—I have a problem with Kneale and Stewart's approach to statistical analysis and that is the fact that the more statistical tests they run on the same data, the more likelihood there is of encountering spurious or artefactual associations. For this reason the more nested tests, correction factors, and optimised values introduced into tests, the more likely the results will be significant but of no practical consequence. Surely the Hanford data have now been worked to death.

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Author's reply—Both the analyses of Hanford data which O'Donnell finds so unnecessary, and the 1991 analysis of Oak Ridge data by Wing *et al.*¹ have produced evidence of incompatibility between the records of nuclear workers recently released by the