

Antique Whale Oil Provides Insights to Origin of Pre-Industrial Chemicals

October 12 2006

One of the last remaining New England whaling ships has provided unexpected insights into the origin of halogenated organic compounds (HOCs) that have chemical and physical properties similar to toxic PCBs and the pesticide DDT. HOCs are found everywhere and degrade slowly, but some are naturally produced and others are produced by humans.

While large scale industrial production of HOCs did not begin until the late 1920s, scientists from the Woods Hole Oceanographic Institution (WHOI) in Massachusetts say naturally produced HOCs were bioaccumulating in marine mammals before major chemical companies like Monsanto, Dupont, and 3M were making HOCs for industrial uses. Their findings are reported in the online version of the journal *Environmental Pollution*.

In the past decade, scientists conducting routine analyses of animal and food samples began to discover unknown HOCs in their samples. Detective work led to their identities, but where these compounds were coming from has been a mystery. While some of these "unknown" compounds can be loosely traced to a possible industrial or natural source, the majority of these compounds have no known industrial or natural sources.

Study authors Emma Teuten and Christopher Reddy found their pre-industrial HOC samples in a most unlikely place: whale oil from the Charles W. Morgan, one of the last whaling ships operating during the 19th and early 20th century. Built in 1841 in New Bedford, Mass., the

ship traveled the world looking for whales, often on voyages of three years or more. The ship is now preserved and on public display at Mystic Seaport in Mystic, Conn. The researchers received the whale oil sample from the New Bedford Whaling Museum.

Teuten and Reddy studied one sample of antique whale oil and found 11 HOCs. The results provide further evidence that naturally produced HOCs were accumulating in marine mammals long before the human-produced varieties.

“What is most interesting to us is that our colleagues still find these ‘natural’ compounds in recent samples from marine mammals, human breast milk, and commercially available fish in Canada,” said study co-author Christopher Reddy, an associate scientist in the WHOI Marine Chemistry and Geochemistry Department. With co-author Emma Teuten, now at the University of Plymouth, England but previously at WHOI, Reddy studied one of the previously unknown HOCs and determined that it was from a natural source, not industrial pollution. The approach was time consuming, taking more than six months of lab work to complete, and required more than ten pounds of whale blubber.

“Our main goal now is to identify who is making them, why, and how toxic they are,” said Teuten. “We suspect that many of these compounds were and are made by bacteria, plants, animals as chemical defense mechanisms.”

Reddy says the properties of these natural compounds he and Teuten found in the archived whale oil are similar to those of industrial HOCs. “Most industrial HOCs do degrade in the environment, although very slowly. With adequate regulations regarding the manufacture and release of the industrial versions, we expect in the future that natural HOCs, rather than industrial ones, will again be the only HOCs found in animal and human tissue.”

Reddy says these results should motivate science to consider the ecological role and bioactivity of these natural HOCs and how pre-exposure to these compounds prepared bacteria, plants, animals, and humans for industrial HOCs introduced during the past century. It is well known that organisms have evolved defensive mechanisms against chemicals in their environment, and until recently the sources of these chemicals were primarily natural. The importance of HOCs like those identified by Teuten and Reddy in the evolution of these defenses is not yet understood.

Industrial HOCs have been accumulating in the environment since the 1930's. Production of PCBs began in 1929, DDT in the late 1930s. "Knowing that the natural compounds have been produced for much longer times, we can use the natural sources as tools in studying the industrial ones," Teuten said. "For example, we may be able to use these natural HOCs as chemical tracers, just like dyes are used in medicine."

Source: Woods Hole Oceanographic Institution

Citation: Antique Whale Oil Provides Insights to Origin of Pre-Industrial Chemicals (2006, October 12) retrieved 28 March 2023 from <https://phys.org/news/2006-10-antique-whale-oil-insights-pre-industrial.html>

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