Translation

Article dated 20 June 2001, found on NyTeknik website.

New environmental toxin destroys the liver.

Joe DePierre's studies on mice will give the answer to why liver cancer occurs.

Worldwide, researchers are warning for a new organic environmental toxin, PFOS.

- Rats and mice that eat PFOS develop enlarged livers and the animals lose weight. If the animals eat the related substance, PFOA, during a long period they develop liver cancer [the authors have missed the pancreatic acinar cell tumors and testicular Leydig cell tumors seen in rats in the DuPont study]. It's likely that the same is true for PFOS. So says Joe DePierre, professor in biochemistry at Stockholm's University. He is researching the mechanisms that cause liver cancer in mice and rats.

PFOS, perfluorooctane sulphonate, is not a new substance. It, and other fluorinated substances have been used in industry since the 1950's. Water and grease repellent, temperature resistant, and extremely stable, they have been perfect in everything from fire fighting foam, paper and textiles, to materials used in metal treatment. But the stable chemical structure is a drawback now when the substance has been found in the environment and tests on animals show cancer risks. Suddenly the western world faces a new environmental toxin that is even more difficult to breakdown than PCB and DDT.

It was when researchers at the university of Michigan, USA, [actually ENTRIX, Inc., a private consulting group staffed, in part, by MICHIGAN STATE academics working under contract for 3M, whose (3M's) Environmental Lab did most of the analytical] got access to a new method of analysis that the truth was discovered. 2000 blood or tissue samples from mammals, birds and reptiles were all found to contain PFOS. Researchers found the highest levels in animals near to urban areas. This was expected since that is where there are sources of emission. But even animals from remote locations, such as the arctic, contained the chemical. The highest levels, 6 ppm (millionths) were measured in north American mink and eagles. Even a seal from the Baltic sea hade high levels of the substance in its blood. In humans, levels of around 2 ppm have been measured [of course they fail to mention that this is the average in workers; although there was one general population sample at about 1.6 ppm, and that 3M Medical Dept has done all of this work - the general population 99th percentile value is about 0.2 ppm, ten times less, and the mean is around 0.03 - 0.04 ppm, about 50 times less].

- I would be worried about levels of 6 ppm and above [interestingly, although the question probably related to the mink values, we have said that we have no associations with health effects in workers up to 6 ppm (there are too few workers above 6 ppm)], says Joe DePierre.

- In our studies the animals get either 10 ppm or 100ppm PFOA or PFOS [in diet] in 4 to 5 days. If the animals eat PFOA during a long time they get cancer of the liver. They cannot take doses greater than 100 ppm without ceasing to look after their coats and losing their appetites. In the end they die.

- We have not done any long term studies with PFOS. But it is likely that even PFOS causes liver cancer.

Joe DePierre's theories have been confirmed by a research group at the university of Michigan. Their rats got cancer when they ate PFOS over a long period. [This is totally BOGUS. First, the University of Michigan has done nothing I am aware of. No work has been done on cancer at Michigan State. 3M did the cancer study. One reason that we found a slight but statistically significant increase in liver tumors in rats from our study is that most "excess" tumors were found at terminal necropsy, and these rats given PFOS lived longer (twice the survival rate to term as controls), and, in general, were healthier. The tumors did not "kill" them These were not metaplastic cancers.]

It is primarily the mechanisms behind effects of the fluorinated substances that Joe DePierre is trying to understand. One question is why do liver cells develop cancer.

- That toxic substances cause cancer just in the liver is not so strange. The liver is the body's cleansing organ, and has the task of taking care of toxic substances and making them soluble in water so that they can be transported out of the body via the urine.

But the liver can't cope against substances such as PFOS and PFOA, since they are so difficult to break down. They stay in the liver and are later stored in the body's fatty tissue in the same way as other organic environmental toxins [PFOS and PFOA do not accumulate in fatty tissue].

- In contrast to other organic toxins, PFOA causes cancer without damaging the cells' DNA, which is what normally causes cancer [actually, there are many cases of organic compounds that are not mutagenic yet can cause tumors to form].

Both PFOA and PFOS are similar to natural fatty acids which act as communicators for cells. Fatty acids link with receptors in the nucleus of the liver cells and send signals to the cells to perform different functions. It is probable that PFOS and PFOA link with the receptors and thus influence the function of the liver cells.

- PFOA increases the liver's breakdown of fat. One hypothesis as to why cancer occurs is that the hydrogen peroxide that is created when fat is broken down in the liver cells has something to do with the start of the cancer, says Joe DePierre.

Another hypothesis is that cancer starts because the cells can no longer cooperate with each other. The research group in Michigan has seen that communication between cells has been affected [this should read "can be affected" and depends on the concentration of PFOS - most detergents would have this kind of effect at a certain concentration].

- Whether fluorinated substances can cause liver cancer in humans remains to be seen, says DePierre.

- First we have understand the underlying molecular mechanisms that can explain why cancer occurs in mice and rats.

He means that it is important to be sensible when one talks about the effects of environmental toxins.

- There is reason to believe that nearly all chemicals that are fat-soluble, and alien-to-the-body can be carcinogenic in sufficiently high doses. The question is how carcinogenic and in what doses. Different species also react differently to different toxins. We know enough to know that we shall continue to do research on PFOS, but this is not the time for any alarm reports.

Authorities around the world believe however that the reports so far are enough for PFOS to be taken seriously. In Sweden the Environment Protection Agency (Naturvårdsverket) and the Chemical Inspectorate (Kemikalieinspektionen) have initiated an investigation of the subject. The investigation, which is being carried out by the Institute for Applied Environmental Research (ITM), is part of an international cooperation initiated by the OECD. The objective is to document the ways that the chemical spreads and the levels that have been reached in the environment.

- PFOS has a broad usage and we are investigating which industries use it in their production. Levels are measured in fish, sediment and water samples mainly from the Stockholm area. We are also investigating waste water cleaning plants and deposits, says Ulf Järnberg at ITM. In the beginning of next year ITM anticipates to have a good picture of the PFOS in Sweden.

Katarina Nordström

Text to picture:

Perceived as natural fatty acids

PFOS, $C_8F_{17}SO_3^-$

Receptors in the cell nucleus link with the PFOS which is perceived as belonging to the body [while this is likely, it has not been confirmed experimentally].

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Difficult to break down

PFOS belongs to a group of organic compounds that have in common the fact that they contain fluor. The group includes more than 100,000 substances. Researchers do not know how dangerous these are.

PFOS, which can react with both water and fat [it is slightly soluble in, not reacts with, water and fat], is comprised of a carbon chain with fluor atoms linked to it. The sulphonate group at the end of the chain is reactive and can link with free acids, metals and other charged groups [at best it would form ion pairs with

positively charged molecules, but will not react]. In common with PCB, DDT and other organic environmental toxins, PFOS is very difficult to break down and can remain in the environment for a long time during which they accumulate in animals and humans.

PFOS leaks out into the environment when products that contain the chemical break down. It is likely that PFOS spreads in the environment via other substances which later break down to PFOS [This is, of course, conjecture at this point].

Translated by David Williams for internal information within 3M.

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