

Nitrosamines and Cancer

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Nitrosamines are a class of chemical compounds that were first described in the chemical literature over 100 years ago, but not until 1956 did they receive much attention. In that year two British scientists, John Barnes and Peter Magee, reported that dimethylnitrosamine produced liver tumors in rats. This discovery was made during a routine screening of chemicals that were being proposed for use as solvents in the dry cleaning industry.

Magee and Barnes' landmark discovery caused scientists around the world to investigate the carcinogenic properties of other nitrosamines and N-nitroso compounds. Approximately 300 of these compounds have been tested, and 90% of them have been found to be carcinogenic in a wide variety of experimental animals. Most nitrosamines are mutagens and a number are transplacental carcinogens. Most are organ specific. For instance, dimethylnitrosamine causes liver cancer in experimental animals, whereas some of the tobacco specific nitrosamines cause lung cancer. Since nitrosamines are metabolized the same in human and animal tissues, it seems highly likely that humans are susceptible to the carcinogenic properties of nitrosamines.

In the early 1970s, there were outbreaks of liver disorders, including cancer, in various farm animals in Norway. Intensive investigations revealed that all of the affected animals had consumed rations containing herring meal, which had been preserved by the addition of relatively large amounts of sodium nitrite. Further investigation showed that the herring meal contained dimethylnitrosamine, the same compound that Magee

and Barnes had reported as a strong liver carcinogen nearly a decade earlier. Dimethylnitrosamine was formed in the fish meal as a result of a chemical reaction between dimethylamine, a commonly occurring amine in fish meal, and a nitrosating agent that formed from the sodium nitrite. This observation caused scientists to begin asking serious questions about the occurrence of nitrosamines. If dimethylnitrosamine could form from a commonly occurring amine and sodium nitrite in fish meal, could nitrosamines be formed in human foods? Amines occur commonly, and sodium nitrite is added to cured meats to prevent toxin production by *Clostridium botulinum*, the microorganism responsible for botulism. When these questions were raised in the late 1960s, they couldn't be answered because reliable analytical methods did not exist for detecting low levels of nitrosamines in foods. During the 1970s and 1980s, reliable analytical methods to determine nitrosamine levels in foods and beverages were developed and later applied to a variety of other consumer products, occupational settings, and body fluids (see table).

Nitrosamines occur commonly because their chemical precursors--amines and nitrosating agents--occur commonly, and the chemical reaction for nitrosamine formation is quite facile. Research on the prevention or reduction of nitrosamine formation has been productive, and most of the items shown in the table contain considerably lower amounts of nitrosamines than they did a few decades ago.

Nitrosamines in Food, Body Fluids, and Occupational Exposure

- Fried bacon
- Cured meats
- Beer
- Nonfat dry milk
- Tobacco products
- Gastric juices
- Rubber products
- Rubber manufacturing
- Metal industries
- Pesticide production and use
- Certain cosmetics
- Certain chemical manufacturing