

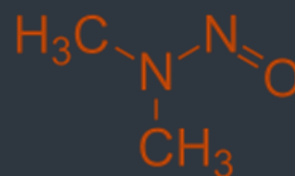
## The proposal to designate "Nitrosamines" as this month's toxin...

...came from the Carcinogenesis Working Group of the GT, which focuses on the research and evaluation of carcinogenic substances and processes that can lead to cancer development. The central focus of the Working Group is on investigating the molecular mechanisms of carcinogenesis to better understand how carcinogenic substances act and how the risk of cancer development can be minimized. The group promotes scientific exchange and collaboration between toxicologists and scientists from other disciplines.

Nitrosamines are found in certain foods and are also significantly formed and increased by food preparation techniques. Therefore, proper handling during frying and grilling can minimize the formation of hazardous contaminants. Just in time for the barbecue season, the goal of this article is to raise awareness about nitrosamines and thus increase sensitivity for healthier barbecue events.

## Reducing Nitrosamine Formation

To prevent increased nitrosamine formation, it is advisable to avoid smoked fish or cheese as well as grilled, smoked, and cured meat. Since nitrosamine formation is increased with higher heat and smoke production, grilling should not be done for extended periods over high flames. Short intense heat and then further cooking at the outer part of the barbecue or wrapped in aluminium foil is recommended. Water-soluble antioxidants like ascorbic acid (vitamin C) can inhibit nitrosamine formation. When grilling, it can be advantageous to simultaneously grill vegetables rich in vitamin C. Suitable water based marinades containing spices with high antioxidant content (such as rosemary, oregano, or thyme) can also reduce nitrosamine formation.



*N*-Nitrosodimethylamine

## Grilling and Barbecues – Healthier with Awareness of Nitrosamine Formation

Nitrosamines can be found in cured meat products, processed fish products, beer, cheese, soy sauce, oils, but also in processed vegetables, breast milk and much more foodstuff. Heat treatment can lead to the formation but can also increase the levels of nitrosamines in food. Consequently, the contamination is particularly high in heavily heated or partly burned meat and fish products, which especially happens when barbecuing. The European Food Safety Authority (EFSA) considers the average daily exposure to nitrosamines via food in the European population as concerning. Therefore, it is important to take precautions to minimize the exposure to nitrosamines during barbecue events to protect oneself and others.

Nitrosamines are formed through the nitrosation of secondary amines, a reaction taking place in presence of nitrite under acidic conditions. Typical sources of nitrites are preservatives in cured. Secondary amines are commonly found in proteins and other nitrogen compounds that naturally occur in food. Under thermal treatment such as grilling, roasting, or frying, the formation of nitrosamines can increase up to threefold. Therefore, cured meat products such as ham, bacon, and sausages often possess high concentrations of nitrosamines. Smoked fish and certain cheese products contain also increased nitrosamine concentrations.

Ingested nitrosamines are activated during metabolism by cytochrome P450-dependent monooxygenases. Aiming to enable excretion of xenobiotic compounds, in this case the body forms reactive intermediates which are far more toxic than their parent compounds. For some nitrosamines, these intermediates can bind to DNA bases. The resulting DNA adducts can cause the DNA being read incorrectly which consequently may induce cancer. The carcinogenicity of nitrosamines is

### **N-Nitrosodimethylamine**

NDMA belongs to the group of volatile nitrosamines and is considered the most important structure for nitrosamines found in food. At the same time, NDMA is the best-studied nitrosamine and, based on current knowledge, possesses the highest tumorigenic potential.

### **Influence of Alcohol Consumption**

There are currently few studies examining the impact of concomitant alcohol consumption on nitrosamine uptake. Existing human data suggest that simultaneous ethanol consumption leads to increased nitrosamine uptake. When consuming dishes with a known N-nitrosamine (NDMA) content, only small amounts of the ingested NDMA dose was found in biological fluids, except in cases of concurrent ethanol intake. This suggests that ethanol may reduce hepatic clearance of NDMA in humans, i.e., the liver's ability to remove and metabolize NDMA from the blood. This effect of ethanol on nitrosamine metabolism has already been demonstrated in animal studies with rodents.

### **Clean Labeling**

Investigations by CVUA Stuttgart, Germany, have shown that some manufacturers have tried to bypass the labeling requirement of cured products in the past. "Clean Label" indicates that no artificial curing product has been added.

Yet, as part of "Clean Labeling" technologically processed plant raw materials from sources such as beetroot or parsley are used, which have very high nitrate levels due to processing. When added to food and processed accordingly, the risk of nitrosamine formation increases. Since these products are only added to the food for curing purposes and are not approved as corresponding food additives, their use is not permitted.

well documented. Studies have shown that chronic exposure can lead to various cancers, particularly of the gastrointestinal tract. The International Agency for Research on Cancer (IARC) has classified several nitrosamines as probably (Group 2A) or possibly (Group 2B) carcinogenic to humans. Ten nitrosamines identified in food are considered critical and potentially contribute to cancer development in humans. Currently, the average daily exposure of the European population to these critical nitrosamines is too high to exclude a health risk and is therefore concerning. Particularly at risk are individuals with a high consumption of cured meat or smoked fish products.

Therefore, it is necessary to minimize the overall intake of nitrosamines through food. An important measure is to urge manufacturers to reduce the nitrite and nitrate content in food. Nitrite can be used for curing meat products in the form of curing salt and/or nitrate in specific amounts, as it is advantageous in food technology. However, the use must be indicated on the product so that consumers are informed and can choose to avoid such products.

*By Ute Haßmann*

### **Literature and links:**

- [Risk assessment of N-nitrosamines in food | EFSA \(europa.eu\)](#)
- <https://www.ua-bw.de/pub/beitrag.asp?subid=1&ID=1828&Pdf=NoAm#:~:text=Die%20Nitritp%C3%B6kelung,zu%20dem%20reaktiven%20Stickoxid%20reduziert>
- [N-Nitrosamine und N-Nitrosoamino-säuren in Lebensmitteln \(bayern.de\)](#)
- [LexUriServ.do \(europa.eu\)](#)
- [Andrew Valdivia auf Unsplash](#)