



Nitrosamines

Fish, Meat, Drinks, Malting Barley & Roasted Malt in the Spotlight

Nitrosamines are a class of nitrogen-containing organic compounds with the general structural formula R_1R_2N-O , whereby R_1 and R_2 are alkyl or aryl radicals. Accordingly, a large number of different nitrosamine derivatives are possible. Nitrosamines are found in many different foods, however, also in tobacco, cosmetics and consumer goods. Unprocessed plant-based foods are generally considered to be nitrosamine-free.

In addition to teratogenic and mutagenic properties, nitrosamine compounds are especially attributed to act carcinogenic.

Occurrence and Formation

Nitrosamines are formed by the reaction of nitrite with secondary amines. Small amounts of amines are found in fruit, higher amounts in meat or sausages and very high amounts in cheese as well as fish. Since food can also additionally contain nitrite the exogenous formation of nitrosamines is always possible, which is further promoted by an acidic environment and heat exposure.

Beer and malt coffee in particular may contain high levels of nitrosamine due to

an improper malt production. Other potentially highly contaminated foods include cured meat and fish products due to the processing with nitrate or nitrite-based salts. By further heating processes, e.g. roasting, the level increases again significantly.

By means of suitable measures, such as lowering the nitrite and nitrate content in cured foods, adding antioxidants (ascorbic acid or tocopherols) and reducing nitrate content in vegetables, a substantial reduction of the nitrosamine concentration in foods is possible.

Toxicology

90% of nitrosamines examined in animal experiments caused a carcinogenic effect. Resulting tumours appear preferentially in the esophagus, stomach, liver, kidney and urinary tract. It is assumed that the endogenous rearrangement of nitrosamines to diazoalkanes which lead to an alkylation of the DNA, RNA and/or proteins promotes the tumorigenic process. In March 2023, the European Food Safety Authority (EFSA) published a Scientific Opinion on the Risk Assessment of nitrosamines. Out of 32 substances

studied, EFSA considers 10 substances to be of particular relevance.

Legal Background

Nitrosamines belong to the most carcinogenic substances in animal experiments. Therefore, no limit values can be set below which the nitrosamines are considered harmless. The minimisation principle applies. Guideline values for nitrosamines (NDMA) were only established for malt and beer (malt: 2.5 µg/kg; beer: 0.5 µg/kg; guideline values from Bavarian State Office for Health and Food Safety, LGL).

Analysis

The Eurofins experts for organic contaminants offer the analysis of the most important nitrosamines using the LC-APCI-MS/MS-technology.

The currently available nitrosamines as well as six others whose analysis is currently being implemented can be found in table 1.

Analysis of nitrosamines is currently available in the matrices fish, meat, beverages (alcohol-free and up to an alcohol content of 5%) and malting barley/roasted malt. Further matrices are being planned.

Nitrosamine	Abbr.	CAS-No.	Particularly relevant (EFSA)	Implemented at Eurofins
N-Nitrosodimethylamine	NDMA	62-75-9	yes	yes
N- Nitrosomethylethylamine	NMEA	10595-95-6	yes	yes
N-Nitrosodiethylamine	NDEA	55-18-5	yes	yes
N-Nitrosomorpholine	NMOR	59-89-2	yes	yes
N-Nitrosodipropylamine	NDPA	621-64-7	yes	yes
N-Nitrosodibutylamine	NDBA	924-16-3	yes	yes
N-Nitrosomethylaniline	NMA	614-00-6	yes	no – planned
N-Nitrososarcosine	NSAR	13256-22-9	yes	no – planned
N-Nitrosopyrrolidine	NPYR	930-55-2	yes	yes
N-Nitrosopiperidine	NPIP	100-75-4	yes	yes
N-Nitrosodiisobutylamine	NDIBA	997-95-5	no	yes
N-Nitrosodiphenylamine	NDPhA	930-55-2	no	yes
N-Nitrosoethylisopropylamine	NEIPA	16339-04-1	no	no – planned
N-Nitrosodiisopropylamine	DIPNA	601-77-4	no	no – planned
N-Nitroso-N-methyl-4-aminobutyric acid	NMBA	61445-55-4	no	no – planned
1-Methyl-4-nitroso-piperazine	MeNP	16339-07-4	no	no – planned

Tab 1: Overview of nitrosamines

