

OCCURRENCE OF AND EXPOSURE TO *N*-NITROSAMINES IN SWEDEN: A REVIEW

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During the last ten years, over 900 samples of foods, snuff and other products on the Swedish market were analysed for *N*-nitrosamines. The average daily intake of volatile *N*-nitrosamines from foods was estimated to be 0.29 µg/person, and the daily intake of tobacco-specific *N*-nitrosamines from snuff was calculated to be up to 110 µg/snuff user.

Research into the occurrence of and exposure to *N*-nitrosamines has been carried out in Sweden for about ten years. The present short review summarizes these results.

Foods

Volatile *N*-nitrosamines (VNA) have been detected in a wide variety of foods (Josefsson & Nygren, 1981; Österdahl, 1988a; Table 1). *N*-Nitrosodimethylamine was the VNA occurring most frequently. The highest levels of VNA were found in fried bacon. The formation of *N*-nitrosopyrrolidine in fried bacon depends on a number of factors; we found that soaking of bacon in water before frying (Österdahl, 1988b) and microwave-cooking as compared to pan-frying (Österdahl & Alrikson, 1989) significantly lowered the levels. The average per-caput daily intake of VNA has been calculated to be 0.29 µg (Österdahl, 1988a). It is not possible at present to estimate reliably the carcinogenic risk for man of exposure to such very low levels of VNA.

Snuff

All samples of snuff tested have been found to contain detectable levels of both VNA and tobacco-specific *N*-nitrosamines (TSNA) (Österdahl & Slorach, 1983, 1984; Table 2). The levels of VNA in Swedish snuff have decreased considerably since 1979 (mean, 110 µg/kg) and are now normally less than 10 µg/kg; however, snuff contains much higher concentrations of TSNA. Total TSNA levels of 3.8–11 mg/kg were found. Considerable amounts of TSNA (up to 240 µg/g) have also been detected in the saliva of habitual snuff users (Österdahl & Slorach, 1988). The daily intakes of VNA and TSNA were calculated to be 0.22 and up to 110 µg per snuff user, respectively. The association between oral cancer and snuff dipping could well be due to the presence of TSNA in the saliva. Snuff users should therefore be warned about the possible carcinogenic risk involved in their habit.

Table 1. Volatile *N*-nitrosamines in foods on the Swedish market, 1979-88

Food	No. of samples	No. positive ^a	Mean level (µg/kg) ^b			
			NDMA	NDBA	NPIP	NPYR
Bacon and pork, fried	152	146	1.2	ND	0.1	6.1
Other meat products	68	28	0.4	Trace	0.3	Trace
Smoked fish	76	63	1.2	ND	ND	ND
Other fish and seafood	33	14	0.6	ND	ND	Trace
Beer	291	165	0.3	ND	Trace	ND
Whiskey	15	11	1.2	ND	ND	ND
Other spirits and wine	73	2	Trace	ND	ND	ND
Dried milk	27	3	Trace	ND	ND	ND
Other dried products	38	27	0.9	ND	0.1	0.1
Cocoa	12	11	0.5	ND	ND	1.0
Chocolate products	17	12	0.1	ND	ND	0.1
Tea and coffee	22	18	0.2	ND	ND	0.1
Cheese	26	8	ND	ND	0.1	ND
Miscellaneous products	25	4	Trace	ND	Trace	ND

^a > 0.1-0.3 µg/kg^b NDMA, *N*-nitrosodimethylamine; NDBA, *N*-nitrosodibutylamine; NPIP, *N*-nitrosopiperidine; NPYR, *N*-nitrosopyrrolidine; ND, not detectedTable 2. Volatile and tobacco-specific *N*-nitrosamines in snuff and chewing tobacco on the Swedish market, 1983-86

Product	Country of origin	No. of samples ^a	Mean level (µg/kg wet weight) ^b							
			NNN	NAT	NAB	NNK	NDMA	NPIP	NPYR	NMOR
Snuff	Sweden	67 (32)	4000	2700	170	770	0.7	Trace	5.1	Trace
	USA	11 (5)	15 000	18 000	150	7400	27	ND	31	ND
	Norway	2 (2)	21 000	12 000	1700	3300	130	8.9	180	32
Dried snuff	UK	2 (0)	1800	850 ^c		260				
	Germany	4 (0)	680	310 ^c		100				
Chewing tobacco	Sweden	6 (4)	1200	1200	ND	160	0.2	ND	0.8	0.4
	USA	9 (6)	820	670	20	100	64	ND	0.8	0.6
	Denmark	16 (8)	430	690	30	20	5.5	ND	16	ND

^a Numbers in parentheses, numbers of samples analysed^b NNN, *N*'-nitrosoanabine; NAT, *N*-nitrosoanabine; NAB, *N*-nitrosoanabine; NNK,4-(*N*-nitrosomethylamino)-1-(3-pyridyl)-1-butanone; NDMA, *N*-nitrosodimethylamine; NPIP, *N*-nitrosopiperidine;NPYR, *N*-nitrosopyrrolidine; NMOR, *N*-nitrosomorpholine^c NAT and NAB

ND, not detected

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