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Query: Records containing the term 1667

1
NAME: N-NITROSODIMETHYLAMINE

RN: 62-75-9

PROBABLE ROUTES OF HUMAN EXPOSURE:

Inhalation of vapor and possibly percutaneous absorption.[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 1985. 2nd ed. Park Ridge, NJ: Noyes Data Corporation, 1985., p. 669] **PEER REVIEWED**

N-Nitrosodimethylamine was identified as an air pollutant near /a factory/ using the amine as a raw material. ... Typical daily human exposures were calculated to be 39 ug on site, 10 ug in the adjacent residential neighborhood, and 0.3 ug two miles away.[Fine DH et al; Human Exposure to N-nitroso Compounds in the Environment, Origins of Human Cancer (1977a) as cited in USEPA; Ambient Water Quality Criteria Doc: Nitrosamines p.C-12 (1980) EPA-440/5-80-064] **PEER REVIEWED**

Air, diet, and smoking all play a roughly equivalent role in direct human exposure to preformed N-nitrosamine contributing a few micrograms per day, with direct intake from drinking water probably much less than 1 ug/day. /Nitrosamines/[USEPA; Ambient Water Quality Criteria Doc: Nitrosamines p.C-14 (1980) EPA 440/5-80-064] **PEER REVIEWED**

The extent of exposure to the general population of N-Nitrosamines and N-Nitrosamides is unknown. ... exposures, resulting from anthropogenic sources, are probably restricted to limited industrial areas. /N-Nitrosamines and N-Nitrosamides/[USEPA; Ambient Water Quality Criteria Doc: Nitrosamines p.A-2 (1980) EPA-440/5-80-064] **PEER REVIEWED**

NIOSH (NOES Survey 1981-1983) has statistically estimated that 747 workers (299 of these were female) were potentially exposed to N-nitrosodimethylamine in the US(1); all workers were classified in the Biological and Life Scientist occupation description(1). N-Nitrosodimethylamine air concentrations at occupational settings were: less than or equal to 47 ug/cu m at a leather tannery(2), 0.1 ug/cu m at a foundry(3), 29 to 212 ppt in the compression molding department at Rubbermaid, Inc, Wooster, OH(4); 0.5 ug/cu m at a tire chemical factory(5), 0.14 ug/cu m at an industrial rubber products factory(5), 160 ng/cu m at an amine plant area in Belle, WV(6), 91 ng/cu m at a DuPont plant in Belle, WV(6), 4.4 ug/cu m at a hot process area tire manufacturing plant(7), 0.16 to 0.49 ug/cu m (time weighted avg breathing - zone concentration) at a tire manufacturing plant(7), 1.02 ug/c u m at Firestone Tire and Rubber Co, Akron, OH(7), and 11,600 ng/cu m (avg) at a chemical factory in Baltimore(8). Other N-nitrosodimethylamine air concentrations and the associated industry were, ug/cu m: 0.01 to 0.06 (0.03 avg) fish processing, < 0.03 to 0.01 (0.03 avg) dye, < 0.05 to 47 (3.4 avg) leather, 0.02 to 5.5 (0.6 avg) rubber, and 0.03 to 0.8(0.2 avg) surfactant(9). All 28 personal breathing zone samples collected at a rubber vehicle sealing plant contained detectable levels of N-nitrosodimethylamine at concentrations ranging from 0.47 to 11.44 ug/cu m(10). Airborne levels of N-nitrosodimethylamine in factories using metal-working fluids ranged from not detected to 0.102 ug/cu m(11). Personal breathing zone samples collected in a tire manufacturing plant contained N-nitrosodimethylamine at the following average concentrations, ug/cu m: 0.1 to 0.3 in the feed mill and calendar and 0.1 to 0.4 in the

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warm-up mills(12). The general population may be exposed to N-nitrosodimethylamine via inhalation of ambient air and cigarette smoke and ingestion of contaminated food and drinking water(SRC).[(1) NIOSH; NOES. National Occupational Exposure Survey conducted from 1981-1983. Estimated numbers of employees potentially exposed to specific agents by 2-digit standard industrial classification (SIC). Available from, as of May 29, 2012: <http://www.cdc.gov/noes/> (2) Rounbehler DP et al; Food Cosmet Toxicol 17: 487-91 (1979) (3) IARC; N-nitroso Compd: Occurrence Biol Eff 41: 223-9 (1982) (4) Albrecht WN; Gov Rep Announce Index 83: 757 (1983) (5) Fajen JM et al; Sci 205: 1262-4 (1979) (6) Fine DH et al; Spec Conf Toxic Subst Air Environ (Proc) Meet Date 1976 p 168-81 (1977) (7) McGlothlin JD et al; ACS Symp Ser 149: 283-99 (1981) (8) Fine DH et al; Environ Sci Technol 11: 581-4 (1977) (9) Fajen JM et al; IARC Sci Publ 41: 223-9 (1982) (10) Reh BD, Fajen JM; Amer Indust Hyg Assoc J 57: 918-23 (1996) (11) Fadlallah S et al; Bull Environ Contam Toxicol 57: 867-74 (1996) (12) McGlothlin JD et al; ACS Symp Ser 169: 283-99 (1981)] **PEER REVIEWED**

BODY BURDEN:

More N-nitrosodimethylamine was detected in human blood immediately after ingestion of a meal containing spinach, bacon, tomato, bread and beer than was present before(1). In 175 samples of human milk collected from 16 nursing women, 76.5% of the samples contained less than 0.2 ppb N-nitrosodimethylamine (minimum level of reliable measurement)(2). In 54 human milk samples from 54 healthy nursing women, trace amounts of N-nitrosodimethylamine (below detection limit of 0.5 ug/L) were detected in the milk of 10 mothers and two other samples contained levels of 1.1 and 1.2 ug/L(3).[(1) IARC; IARC Monographs on the Evaluation of Carcinogenic Risks to Humans 17: 125-76 (1978) (2) Lakritz L, Pensabene; Food Chem Toxicol 22: 721-724 (1984) (3) Uibu J et al; Acta Paediatr 85: 1140-1142 (1996)] **PEER REVIEWED**

ENVIRONMENTAL FATE & EXPOSURE:

ENVIRONMENTAL FATE/EXPOSURE SUMMARY:

No evidence was found that N-nitrosodimethylamine is currently used, except for research purposes and may be released to the environment with laboratory waste. N-Nitrosodimethylamine's former production and use in the production of rocket fuels; antioxidant; additive for lubricants; and as a softener of copolymers may have resulted in its release to the environment through various waste streams. N-Nitrosodimethylamine is formed as a byproduct during disinfection processes used at wastewater treatment facilities. If released to air, a measured vapor pressure of 2.7 mm Hg at 20 deg C indicates N-nitrosodimethylamine is expected to exist solely as a vapor in the ambient atmosphere. Vapor-phase N-nitrosodimethylamine will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals with an estimated half-life of 6.3 days. N-Nitrosodimethylamine absorbs light in the environmental spectrum indicating a potential for direct photolysis in sunlight. If released to soil, observed Koc values of 68-118 indicate N-nitrosodimethylamine is expected to have high mobility. Low adsorption to soils and ready leaching have been observed in several studies. Volatilization from wet soil surfaces may be an important fate process based upon a measured Henry's Law constant of 1.08×10^{-6} atm-cu m/mole at 20 deg C. Under laboratory conditions, greater than 70% of N-nitrosodimethylamine applied to the surface of a moist, warm soil (12% moisture content, 22 deg C) volatilized in 10 hours. N-Nitrosodimethylamine may potentially volatilize from dry soil surfaces based upon its measured vapor pressure. A half-life of about three weeks was reported for N-nitrosodimethylamine in aerobic soil under laboratory conditions; the primary removal processes were volatilization and

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biodegradation. At 21 deg C, observed half-lives in ground cover soil, turfgrass soil and tree soil were 4.1, 5.6 and 22.5 days respectively. The rates and extent of N-nitrosodimethylamine biodegradation in natural environments, including surface waters, sludges and soils have been observed to be highly variable. If released into water, N-nitrosodimethylamine is not expected to adsorb to suspended solids and sediment in the water column based upon its Koc values. Volatilization from water surfaces is expected to occur based upon this compound's Henry's Law constant. Estimated volatilization half-lives for a model river and model lake are 29 and 215 days, respectively. The potential for bioconcentration in aquatic organisms is low based upon an estimated BCF of 3. Hydrolysis is not expected to be an important process. A photodegradation half-life of 79 hours was measured in distilled water exposed to fluorescent light through a pyrex filter (wavelength > 280 nm). The direct photolysis rate constant for N-nitrosodimethylamine in aqueous solution exposed to irradiation representing Southern California midsummer, midday sun was observed to be 0.040/min with a half-life of 16 minutes. Occupational exposure to N-nitrosodimethylamine may occur through inhalation of air at workplaces involved in rubber processing or tire manufacturing or where metal-working fluids are used. The general population may be exposed to N-nitrosodimethylamine via inhalation of ambient air and cigarette smoke and ingestion of contaminated food and drinking water. (SRC) **PEER REVIEWED**

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NATURAL POLLUTION SOURCES:

Formation of DMN ... can occur by reaction of nitrites with dimethylamine produced by intestinal bacteria.[Haddad, L.M. and Winchester, J.F. Clinical Management of Poisoning and Drug Overdosage. Philadelphia, PA: W.B. Saunders Co., 1983., p. 227] **PEER REVIEWED**

Formed by the interaction of nitrite with dimethylamine and by the action of nitrate-reducing bacteria(1). One group that found N-nitrosodimethylamine in tap water (3 to 6 ng/L) concluded that the N-nitrosodimethylamine may have formed from the reaction of low concentrations of nitrite, an oxidizing agent (possibly chlorine), and secondary amines(2). Another researcher concluded that extensive nitrosamine formation in natural waters is not likely because of low nitrite concentrations, low levels of nitrosatable amines, and expected third order kinetics(3). N-Nitrosodimethylamine has been identified as a chemical component in tobacco(4).[(1) O'Neil MJ, ed; The Merck Index. 14th ed., Whitehouse Station, NJ: Merck and Co., Inc., p. 1147 (2006) (2) Kimoto WI et al; Water Res 15: 1099-1106 (1981) (3) Oliver JE; Agric Symp Ser 174: 349-62 (1981) (4) Rodgman A, Perfetti TA; The Chemical Components

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of Tobacco and Tobacco Smoke. Boca Raton, FL: CRC Press (Taylor & Francis Group), p. 715 (2009)] **PEER REVIEWED**

ARTIFICIAL POLLUTION SOURCES:

The mainstream smoke from an 85 mm US blended cigarette without a filter-tip has been found to contain 0.084 ug N-nitrosodimethylamine.[USEPA; Ambient Water Quality Criteria Doc: Nitrosamines p.C-12 (1980) EPA-440/5-80-064] **PEER REVIEWED**

Emitted during the compounding, forming & curing operations of elastomeric parts by reaction of accelerators/stabilizers used such as tetramethylthiuram disulfide, tetramethylthiuram monosulfide & tetraethylthiuram disulfide.[Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983., p. 558] **PEER REVIEWED**

There is some evidence that N-nitrosodimethylamine might be formed during the burning of dimethylhydrazine as a rocket fuel.[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: <http://monographs.iarc.fr/index.php>, p. V1: 97 (1972)] **PEER REVIEWED**

N-Nitrosodimethylamine's former production and use in the production of rocket fuels; antioxidant; additive for lubricants; and as a softener of copolymers(1) may have resulted in its release to the environment through various waste streams(SRC). No evidence was found that N-nitrosodimethylamine is currently used, except for research purposes(2). Two studies have demonstrated N-nitrosodimethylamine formation in both sterile and non-sterile soils to which nitrite and dimethylamine were added(3,4). Another study demonstrated N-nitrosodimethylamine formation when sewage, dimethylamine and nitrite were continuously percolated through a soil(3). It was also demonstrated that N-nitrosodimethylamine may form from fertilized and polluted areas when dimethylamine was added(5). There is some evidence that N-nitrosodimethylamine might be formed during the burning of dimethylhydrazine as a rocket fuel(6). N-Nitrosodimethylamine is formed as a byproduct during disinfection processes used at wastewater treatment facilities(7).[(1) O'Neil MJ, ed; The Merck Index. 14th ed., Whitehouse Station, NJ: Merck and Co., Inc., p. 1147 (2006) (2) IARC; IARC Monographs on the Evaluation of Carcinogenic Risks to Humans 17: 125-76 (1978) (3) Pancholy SK; Soil Biol Biochem 10: 27-32 (1978) (4) Mills AL, Alexander M; J Environ Qual 5: 437-40 (1976) (5) Greene S et al; J Environ Qual 10: 416-21 (1981) (6) IARC; IARC Monographs on the Evaluation of Carcinogenic Risks to Humans 1: 97 (1972) (7) Siddiqui M, Atasi KZ; Water Environ Res 76: 316-326 (2004)] **PEER REVIEWED**

ENVIRONMENTAL FATE:

TERRESTRIAL FATE: Based on a recommended classification scheme(1), observed Koc values of 68-118(2) indicate that N-nitrosodimethylamine is expected to have high mobility in soil(SRC). Low adsorption to soils and ready leaching have been observed in other studies(3,4). Volatilization of N-nitrosodimethylamine from moist soil surfaces may be an important fate process(SRC) given a Henry's Law constant of 1.08×10^{-6} atm-cu m/mole at 20 deg C(5). Under laboratory conditions, greater than 70% of N-nitrosodimethylamine applied to the surface of a moist, warm soil (12% moisture content, 22 deg C) volatilized in 10 hours(6). The potential for volatilization of N-nitrosodimethylamine from dry soil surfaces may exist(SRC) based on a measured vapor pressure of 2.7 mm Hg at 20 deg C(5). A half-life of about three weeks was reported for N-nitrosodimethylamine in aerobic soil under laboratory conditions; the primary removal processes were volatilization and biodegradation(6). 17% of the added N-nitrosodimethylamine (132 ug/g soil) was lost from sandy loam soil after

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10 days incubation at 30 deg C; no further loss was noted during the next 30 days incubation(7). However, when the organic matter content was increased from 2.16% to 17.5%, over 60% of the added N-nitrosodimethylamine was lost by day 15 of the incubation period(7). At 21 deg C, observed half-lives in ground cover soil, turfgrass soil and tree soil were 4.1, 5.6 and 22.5 days respectively(8). The rates and extent of N-nitrosodimethylamine biodegradation in natural environments, including surface waters, sludges and soils have been observed to be highly variable(9).[(1) Swann RL et al; Res Rev 85: 23 (1983) (2) Yang WC et al; J Environ Qual 34: 336-341 (2005) (3) Gunnison D et al; J Hazard Mater 73: 179-197 (2000) (4) Greene S et al; J Environ Qual 10: 416-21 (1981) (5) Klein RG; Toxicology 23: 135-47 (1982) (6) Oliver JE et al; J Agric Food Chem 27: 887-91 (1979) (7) Malik MAB, Tesfai K; Bull Environ Contam Toxicol 27: 115-21 (1981) (8) Yang WC et al; J Environ Qual 34: 336-341 (2005) (9) Fournier D et al; Appl Environ Microbiol 75: 5088-5093 (2009)] **PEER REVIEWED**

AQUATIC FATE: Based on a recommended classification scheme(1), observed Koc values of 68-118(2) indicate that N-nitrosodimethylamine is not expected to adsorb to suspended solids and sediment in water(SRC). Volatilization from water surfaces is expected to occur(3) based upon a Henry's Law constant of 1.08×10^{-6} atm-cu m/mole at 20 deg C(4). Using this Henry's Law constant and an estimation method(3), volatilization half-lives for a model river and model lake are 29 days and 215 days, respectively(SRC). According to a classification scheme(5), an estimated BCF of 3(SRC), from a measured log Kow of -0.57(6) and a regression-derived equation(7), suggests the potential for bioconcentration in aquatic organisms is low(SRC). A photodegradation half-life of 79 hours was measured in distilled water following exposure to fluorescent light through a Pyrex filter(8). The direct photolysis rate constant for N-nitrosodimethylamine in aqueous solution exposed to irradiation representing Southern California midsummer, midday sun was observed to be 0.040/min with a half-life of 16 minutes(9). Hydrolysis is probably not an important removal process since the N-nitrosodimethylamine concentration in lake water essentially did not change after 3.5 months incubation at 30 deg C in the dark(10). No biodegradation of N-nitrosodimethylamine was observed in lake water samples during an observation period of 3.5 months(11). Static and continuous biodegradation tests on N-nitrosodimethylamine using seed from an activated sludge plant and feed that contained a nutrient solution based on yeast extract resulted in 47 to 72% degradation of the N-nitrosodimethylamine in 7 days(12). The rates and extent of N-nitrosodimethylamine biodegradation in natural environments, including surface waters, sludges and soils have been observed to be highly variable(13). N-Nitrosodimethylamine disappeared rapidly from aqueous solution due to evaporation and photolysis, with acidic solutions giving a somewhat higher removal than basic solutions or water, half-life of 0.8 hours versus 0.9 and 1.6 hours, respectively(14).[(1) Swann RL et al; Res Rev 85: 23 (1983) (2) Yang WC et al; J Environ Qual 34: 336-341 (2005) (3) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 15-1 to 15-29 (1990) (4) Klein RG; Toxicology 23: 135-47 (1982) (5) Franke C et al; Chemosphere 29: 1501-14 (1994) (6) Hansch C et al; Exploring QSAR. Hydrophobic, Electronic, and Steric Constants. ACS Prof Ref Book. Heller SR (consult ed) Washington, DC: Amer Chem Soc p. 5 (1995) (7) US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.1. Jan, 2011. Available from, as of May 11, 2012: <http://www.epa.gov/oppt/exposure/pubs/episuite1.htm> (8) Polo J, Chow YL; J Natl Cancer Inst 56: 997-1001 (1976) (9) Plumlee MH, Reinhard M; Environ Sci Technol 41: 6170-6176 (2007) (10) Tate RL, Alexander M; J Natl Cancer Inst 54: 327-30 (1975) (11) Callahan MA et al; Water-Rel Environ Fate Priority Pollut Vol 1 (1979) (12) Fochtman EG, Eisenberg W; Treatability of Carcinogenic and Other Hazardous Organic Compounds USEPA-600/2-79-097 (1979) (13) Fournier D et al; Appl Environ Microbiol 75: 5088-5093 (2009)

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(14) MacNaughton MC, Stauffer TB; Air Force Civil Eng Cen Environ Dir. (AFCEC-TR-75-9) (1975)] **PEER REVIEWED**

ATMOSPHERIC FATE: According to a model of gas/particle partitioning of semivolatile organic compounds in the atmosphere(1), N-nitrosodimethylamine, which has a measured vapor pressure of 2.7 mm Hg at 20 deg C(2), is expected to exist solely as a vapor in the ambient atmosphere. Vapor-phase N-nitrosodimethylamine is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals(SRC); the half-life for this reaction in air is estimated to be 6.3 days(SRC), calculated from its measured rate constant of 2.53×10^{-12} cu cm/molecule-sec at 25 deg C(3). N-Nitrosodimethylamine is susceptible to direct photolysis in sunlight(SRC) due to its strong absorption of UV light above 290 nm(4,5). The direct photolysis half-life in aqueous solution was observed to be 16 minutes using Southern California midday irradiation levels(5).[(1) Bidleman TF; Environ Sci Technol 22: 361-367 (1988) (2) Klein RG; Toxicology 23: 135-47 (1982) (3) Atkinson R; Journal of Physical and Chemical Reference Data. Monograph 1 (1989) (4) Polo J, Chow YL; J Natl Cancer Inst 56: 997-1001 (1976) (5) Plumlee MH, Reinhard M; Environ Sci Technol 41: 6170-6176 (2007)] **PEER REVIEWED**

ENVIRONMENTAL BIODEGRADATION:

No biodegradation of dimethylnitrosamine was observed in lake water samples during an observation period of 3.5 months, and a lag of nearly 30 days occurred before its slow disappearance from soil. The nitrosamine appeared to be degraded very slowly in sewage, but it was not affected by the anaerobic organisms /found in collected bog sediments/. [Callahan, M.A., M.W. Slimak, N.W. Gabel, et al. Water-Related Environmental Fate of 129 Priority Pollutants. Volume I. EPA-440/4 79-029a. Washington, DC: U.S. Environmental Protection Agency, December 1979., p. 99-4] **PEER REVIEWED**

Type of biological degradation: P statzeri, P fragi, B mycoides, B cereus, B subtilis, C suboxydans, C Pasteurianum, A picolinophilus, A suboxydans and 4 unclassified strains of Arthrobacter were incubated for 72 hr with N-nitrosodimethylamine. No evidence of degradation. [Castegnaro, M., G. Eisenbrand, G. Ellen, L. Keefer, D. Klein, E.B. Sansone, D. Spincer, G. Telling, K. Webb, and W. Davis (eds.). Laboratory Decontamination and Destruction of Carcinogens in Laboratory Wastes: Some N-Nitrosamines. IARC Publications No. 43. Lyon, France: International Agency for Research on Cancer, 1982., p. 53] **PEER REVIEWED**

Degradation by Rhizopus orizae, Streptococcus cremoris, and Saccharomyces rouxii was found. [Castegnaro, M., G. Eisenbrand, G. Ellen, L. Keefer, D. Klein, E.B. Sansone, D. Spincer, G. Telling, K. Webb, and W. Davis (eds.). Laboratory Decontamination and Destruction of Carcinogens in Laboratory Wastes: Some N-Nitrosamines. IARC Publications No. 43. Lyon, France: International Agency for Research on Cancer, 1982., p. 53] **PEER REVIEWED**

AEROBIC: Static and continuous biodegradation tests on N-nitrosodimethylamine using seed from an activated sludge plant and feed that contained a nutrient solution based on yeast extract resulted in 47 to 72% degradation of the N-nitrosodimethylamine in 7 days. In a continuous biological reactor, N-nitrosodimethylamine at an initial concentration of 1.93 mg/L was reduced to < 0.01 mg/L in the effluent from the reactor (based on a 24 hour composite sample)(1). In an activated sludge treatment plant, $> 95\%$ of the approximately 2000 ug N-nitrosodimethylamine/L in the influent was removed(2). The rate of disappearance in raw sewage at pH 6.0 was nearly the same as that in sterile samples, indicating nonbiological factors were largely or entirely responsible for the N-nitrosodimethylamine disappearance(3). The rates and extent of N-nitrosodimethylamine biodegradation in natural environments,

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including surface waters, sludges and soils has been observed to be highly variable(4).[(1) Fochtman EG, Eisenberg W; Treatability of Carcinogenic and Other Hazardous Organic Compounds USEPA-600/2-79-097 (1979) (2) Patterson JW, Kodukala PS; Chem Eng Prog 77: 48-55 (1981)(3) Tate RL, Alexander M; J Natl Cancer Inst 54: 327-30 (1975) (4) Fournier D et al; Appl Environ Microbiol 75: 5088-5093 (2009)] **PEER REVIEWED**

ANAEROBIC: A photosynthetic bacterium (*Rhodospseudomonas capsulata*) was able to metabolize 100 mg N-nitrosodimethylamine/L under anaerobic conditions(1). An inoculum of activated sludge, anaerobic sludge digest, and garden soil was used to study the biodegradation of N-nitrosodimethylamine in lake water; it was found that the rate of mineralization and total mineralization increased with decreasing initial N-nitrosodimethylamine concentrations(2). After 114 days incubation at room temperature with basal salts added, 16.4% of N-nitrosodimethylamine at an initial concn of 15 mg/L was mineralized; 78.6% was mineralized when the initial concentration was 0.162 ug/L; formaldehyde and methylamine were identified as biodegradation intermediates(2).[(1) Kobayashi M, Tchan YT; Water Res 12: 199-201 (1978) (2) Kaplan DL, Kaplan AM; App Environ Microbiol 50: 1077-86 (1985)] **PEER REVIEWED**

PURE CULTURE: Enrichment cultures were inoculated with soil and sewage but failed to produce any organisms capable of metabolizing N-nitrosodimethylamine. The lack of N-nitrosodimethylamine biodegradation did not appear to be due to its toxicity but may have been due to the inability of the microorganisms to cleave the N-N bond. Additional tests found a number of bacterial strains were unable to metabolize N-nitrosodimethylamine at concentrations of 25 or 150 ppm nitroso incubated for 72 hours(1). N-Nitrosodimethylamine was biodegraded by a fungus, bacterium, and yeast(2). N-Nitrosodimethylamine was rapidly biodegraded by the bacterium *Propanotroph Rhodococcus ruber* ENV425(3).[(1) Tate RL III, Alexander M; J Environ Qual 5: 131-3 (1976) (2) Harada K, Yamada K; Nippon Suisan Gakki Aishi 45: 925-8 (1979) (3) Fournier D et al; Appl Environ Microbiol 75: 5088-5093 (2009)] **PEER REVIEWED**

ENVIRONMENTAL ABIOTIC DEGRADATION:

Exposure of N-nitrosodimethylamine in the vapor phase to direct sunlight for about 30 min (50% efficiency) yielded nitric oxide, carbon monoxide, and formaldehyde and unidentified compounds.[Castegnaro, M., G. Eisenbrand, G. Ellen, L. Keefer, D. Klein, E.B. Sansone, D. Spincer, G. Telling, K. Webb, and W. Davis (eds.). Laboratory Decontamination and Destruction of Carcinogens in Laboratory Wastes: Some N-Nitrosamines. IARC Publications No. 43. Lyon, France: International Agency for Research on Cancer, 1982., p. 56] **PEER REVIEWED**

The rate constant for the vapor-phase reaction of N-nitrosodimethylamine with photochemically-produced hydroxyl radicals has been measured as 2.53×10^{-12} cu cm/molecule-sec at 25 deg C(1). This corresponds to an atmospheric half-life of about 6.3 days(SRC) at an atmospheric concentration of 5×10^5 hydroxyl radicals per cu cm(1). N-Nitrosodimethylamine disappears rapidly from aqueous solution due to evaporation and photolysis, with acidic solutions giving a somewhat higher removal rate than basic solutions or water with half-lives of 0.8 hours in acidic solutions, 0.9 hours in basic solutions and 1.6 hours in water(2). N-Nitrosodimethylamine at an initial concentration of 74 mg/L photodegraded with a half-life of 79 hours in distilled water exposed to fluorescent light through a Pyrex filter (wavelength > 280 nm)(3). The direct photolysis rate constant for N-nitrosodimethylamine in aqueous solution exposed to irradiation representing Southern California midsummer, midday sun was observed to be 0.040/min with a half-life of 16 minutes(4). The rate constant for the reaction of hydroxyl radicals in aqueous solution is 4.3×10^8 L/mol-sec(5); this corresponds to an aquatic half-life of 1136 days at an aquatic concentration of 1×10^{-17} hydroxyl

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radicals per liter(6). Hydrolysis of N-nitrosodimethylamine is probably not an important fate process since its concentration in lake water did not essentially change after 3.5 months incubation in the dark at 30 deg C(7). Similar lack of hydrolysis was observed in groundwater adsorption studies(8).[(1) Atkinson R; Journal of Physical and Chemical Reference Data. Monograph 1 (1989) (2) MacNaughton MC, Stauffer TB; Air Force Civil Eng Cen Environ Dir. (AFCEC-TR-75-9) (1975) (3) Polo J, Chow YL; J Natl Cancer Inst 56: 997-1001 (1976) (4) Plumlee MH, Reinhard M; Environ Sci Technol 41: 6170-6176 (2007) (5) Mezyl SP et al; Environ Sci Technol 38: 3161-3167 (2004) (6) Mill T et al; Science 207: 886-887 (1980) (7) Tate RL, Alexander M; J Natl Cancer Inst 54: 327-30 (1975) (8) Fleming EC et al; Hazard Ind Wastes 26: 285-292 (1994)] **PEER REVIEWED**

ENVIRONMENTAL BIOCONCENTRATION:

An estimated BCF of 3 was calculated in fish for N-nitrosodimethylamine(SRC), using a log Kow of -0.57(1) and a regression-derived equation(2). According to a classification scheme(3), this BCF suggests that bioconcentration in aquatic organisms is low(SRC).[(1) Hansch C et al; Exploring QSAR. Hydrophobic, Electronic, and Steric Constants. ACS Prof Ref Book. Heller SR (consult ed) Washington, DC: Amer Chem Soc p. 5 (1995) (2) US EPA; Estimation Program Interface (EPI) Suite. ver. 4.1. Jan, 2011. Available from, as of May 11, 2012: <http://www.epa.gov/oppt/exposure/pubs/episuite1.htm> (3) Franke C et al; Chemosphere 29: 1501-14 (1994)] **PEER REVIEWED**

N-Nitrosodimethylamine applied to sandy soil at 10 and 100 ppm exhibited 3.20 and 3.25% uptake by lettuce plants after 2 days exposure(1). 1.56, 0.21, and 0.02% uptake was observed following application of 100 ppm after 4, 9, and 15 days, respectively(1). 10 and 100 ppm added to spinach plants in water resulted in 0.38 and 0.27% uptake after 2 days, respectively(1).[(1) Dean-Raymond D, Alexander M; Nature 262: 394-6 (1976)] **PEER REVIEWED**

SOIL ADSORPTION/MOBILITY:

Kd (soil distribution coefficient) values of 0.45-0.64 L/kg were measured for N-nitrosodimethylamine in turfgrass, ground cover and bare surface soils that corresponded to Koc values 68-118(1). Similar results were observed in a study of subsurface soil samples including sand, sandy loam and loamy sand soils with Kd values ranging from 0.4-1.2 L/kg(2). According to a recommended classification scheme(3), the Koc values suggests that N-nitrosodimethylamine is expected to have high mobility in soil(SRC). N-Nitrosodimethylamine was found to leach through 4 different soils as readily as chloride ion(4). Another study also found that N-nitrosodimethylamine readily leached through soils(5). The leaching risk of N-nitrosodimethylamine in soils receiving reclaimed wastewater depend upon the hydraulic conductivity of the soil and irrigation intensity(6); proper irrigation volumes can reduce the leaching risk(6).[(1) Yang WC et al; J Environ Qual 34: 336-341 (2005) (2) Gunnison D et al; J Hazard Mater 73: 179-197 (2000) (3) Swann RL et al; Res Rev 85: 23 (1983) (4) Dean-Raymond D, Alexander M; Nature 262: 394-6 (1976) (5) Greene S et al; J Environ Qual 10: 416-21 (1981) (6) Haruta S et al; Ecotox Environ Safety 69: 374-380 (2008)] **PEER REVIEWED**

VOLATILIZATION FROM WATER/SOIL:

A half-life of 3 to 6 hours, with respect to volatilization from distilled water in a petri dish, at an initial concentration of 200 mg/l, was reported. The results with Cayuga Lake water indicated that volatilization, if it occurred, was very slow in comparison to the 3.5 month period of observation. The water samples were well stirred and maintained at 30 deg C during this time. It should be noted that the concentration of dimethylnitrosamine never fell below 20 mg/l even though the water-depth in the petri dish did not exceed one centimeter. The rate of volatilization from water or highly solvated molecules becomes very

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slow compared to the rate of volatilization of the water itself at very dilute concentrations of the solute molecule.[Callahan, M.A., M.W. Slimak, N.W. Gabel, et al. Water-Related Environmental Fate of 129 Priority Pollutants. Volume I. EPA-440/4 79-029a. Washington, DC: U.S. Environmental Protection Agency, December 1979., p. 99-3] **PEER REVIEWED**

The Henry's Law constant for N-nitrosodimethylamine is 1.08×10^{-6} atm-cu-m/mol at 20 deg C(1). This value indicates that N-nitrosodimethylamine is expected to volatilize slowly from water surfaces(2). Based on this Henry's Law constant, the volatilization half-life for N-nitrosodimethylamine in a model river (1 m deep flowing at 1 m/s with a wind speed of 3 m/s) is estimated to be 29 days(SRC). The estimated volatilization half-life from a model lake (1 m deep, flowing 0.05 m/sec, wind velocity of 0.5 m/sec) is estimated as approximately 215 days(2,SRC). N-Nitrosodimethylamine is expected to volatilize from dry soil surfaces(SRC) based upon a vapor pressure of 2.7 mm Hg at 20 deg C(1). Under laboratory conditions, greater than 70% of N-nitrosodimethylamine applied to the surface of a moist, warm soil (12% moisture content, 22 deg C) volatilized in 10 hours(3).[(1) Klein RG; Toxicology 23: 135-47 (1982) (2) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 15-1 to 15-29 (1990) (3) Oliver JE; J Environ Qual 8: 596-601 (1979)] **PEER REVIEWED**

ENVIRONMENTAL WATER CONCENTRATIONS:

DRINKING WATER: N-Nitrosodimethylamine's concentration in Philadelphia tap water was 3 to 6 ng/L(1), 0.03 to 0.34 ppb in water exposed to deionizing resins(2), and 0.06 ug/L in deionized, distilled laboratory water(3). N-Nitrosodimethylamine was detected in source and finished drinking water samples collected in China at concentrations of no detection-13.9 ng/L and no detection-20.5 ng/L, respectively; detection limits of 0.1-0.9 ng/L(4). N-Nitrosodimethylamine concentrations of 0-108.2 ng/L (detection limit of 3.1 ng/L) were detected in water from four distribution systems in Canada(5). In 313 samples of treated water analyzed from 100 locations within Ontario between 1994 and 1996, N-nitrosodimethylamine was detected in at least one sample at 40 of these 100 sites at levels greater than the detection limit of 0.001 ug/L (mean concentration was 0.0027 ug/L)(6).[(1) Kimoto WI et al; Water Res 15: 1099-106 (1981) (2) Fiddler W et al; Food Cosmet Toxicol 15: 441-4 (1977) (3) Gough TA et al; Food Cosmet Toxicol 15: 437-40 (1977) (4) Wang W et al; Water Res 45: 4930-4938 (2011) (5) Zhao Y et al; Environ Sci Technol 40: 7636-7641 (2006) (6) WHO; N-Nitrosodimethylamine in drinking-water. World Health Organization 2006. Available from, as of Dec 19, 2012: http://www.who.int/water_sanitation_health/dwq/chemicals/ndma2ndadd.pdf] **PEER REVIEWED**

SURFACE WATER: N-Nitrosodimethylamine was reported in a preliminary aqueous sample collected from the Potomac River, Quantico, VA, at a concentration of < 6 ug/L(1). N-Nitrosodimethylamine was detected in six of seven surface water samples collected from river and lake sites in Canada and the US in 2006 at concentrations ranging from 0 to 53 ng/L(2); concentrations increased to 0 to 118 ng/L after commercial disinfection treatments(2).[(1) Hall LW Jr; Aquat Toxicol 10: 73-99 (1987) (2) Zhao YY et al; Environ Sci Technol 42: 4857-4862 (2008)] **PEER REVIEWED**

SEAWATER: N-Nitrosodimethylamine was present in seawater adjacent to a 1,1-dimethylhydrazine chemical factory in Baltimore which was emitting N-nitrosodimethylamine into the air; levels varied from 0.08 to 0.25 ug/L(1). N-Nitrosodimethylamine concentrations in Curtis Bay and Stonehouse Cove (Baltimore) were 35 to 940 ng/L and in Newark Bay (Elizabeth, NJ) the N-nitrosodimethylamine concentration was 0.22 ng/mL(2,3).[(1) IARC; IARC Monographs on the Evaluation of Carcinogenic

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Risks to Humans 17: 125-76 (1978) (2) Fine DH et al; Environ Sci Technol 11: 581-4 (1977) (3) Fine DH et al; Spec Conf Toxic Subst Air Environ (Proc) Meet Date 1976 p 168-81 (1977)] **PEER REVIEWED**

EFFLUENT CONCENTRATIONS:

N-Nitrosodimethylamine's concentration in a chemical plant effluent released to a river was 9040 ng/L(1); it was detected, but not quantified, in the effluent from an Addison, IL wastewater treatment plant(2). Other N-nitrosodimethylamine concentrations in wastewater and wastewater related samples were: 2 ng/mL in an aerobic lagoon in Belle, WV(3); 2700 ng/L in a sewer sample in Baltimore(4); 0.2 to 0.3 ug/L in wastewater(5); 0.374 ug/g in a municipal sewage sludge sample(6); 53 ppb in dried sludge from a Syracuse, NY treatment plant(7); 0.2 ng/L in the influent to a wastewater treatment plant in Belle, WV(3); and 0.5 ng/mL in lagoon seepage at Belle, WV(3). Heavy duty diesel engines emitted from 4.4 to 136.0 g N-nitrosodimethylamine/hour; the maximum N-nitrosodimethylamine concentration in the diesel crankcase emissions was 17.2 ug/cu m(8). N-Nitrosodimethylamine has also been detected in the exhaust from catalyst equipped cars(9). Analysis of anaerobic digester mixed liquor (ADML) from three wastewater treatment plants in the southeastern US detected N-nitrosodimethylamine concentrations of 383, 273 and 159 ng/L, respectively(10); N-nitrosodimethylamine concentrations in the primary sludge supernatant and thickened waste-activated sludge ranged from 139 to 834 ug/L(10). Effluent samples collected from four wastewater treatment plants on the Quinnipiac River, CT in 2003 contained N-nitrosodimethylamine concentrations ranging from 7.6 to 400 ng/L(11). Effluent samples collected from seven wastewater treatment plants in California between 2002 and 2004 contained median N-nitrosodimethylamine concentrations of about 80 ng/L in the untreated water(12).[(1) Hartmetz G, Slemrova J; Bull Environ Contam Toxicol 25: 106-12 (1980) (2) Ellis DD et al; Arch Environ Contam Toxicol 11: 373-82 (1982) (3) Fine DH et al; Spec Conf Toxic Subst Air Environ (Proc) Meet Date 1976 p. 168-81 (1977) (4) Fine DH et al; Environ Sci Technol 11: 581-4 (1977) (5) IARC; N-Nitroso Compd: Anal Form Occurrence 31: 377-87 (1980) (6) Brewer et al; Environ Pollut Ser B Chem Phys 1: 37-44 (1980) (7) Mumma RO et al; Arch Environ Contam Toxicol 13: 75-83 (1984) (8) Goff EU et al; Anal Chem 52: 1833-6 (1980) (9) Smith LR; Characterization of Emissions from Motor Vehicles Designed for Low Nitrogen Oxide (NOx) Emissions USEPA-600/2-80-276 (1980) (10) Padhye L et al; Environ Sci Technol 43: 3087-3093 (2009) (11) Schreiber IM, Mitch WA; Environ Sci Technol 40: 3202-3210 (2006) (12) Sedlak DL et al; Water Environ Res 77: 32-39 (2005)] **PEER REVIEWED**

SEDIMENT/SOIL CONCENTRATIONS:

N-Nitrosodimethylamine has been found in a number of soil samples at the 1 to 8 ug/kg (dry basis) level.[Fine DH et al; Determination of Dimethylnitrosamine in Air, Water and Soil by Thermal Energy analysis (1977c) as cited in USEPA; Ambient Water Quality Criteria Doc: Nitrosamines p.C-5 (1980) EPA-440/5-80-064] **PEER REVIEWED**

SOIL: Soil samples taken from several locations near industrial plants in New Jersey contained N-nitrosodimethylamine at concentrations ranging from 0 to 15.1 ng/g(1). Soil samples from West Virginia, near Belle and Charleston contained 0.2 to 5.4 ng/g; in New York City soil samples contained 0 to 0.32 ng/g N-nitrosodimethylamine(1). Sediment samples collected from the Huaihe River in China in 2002 contained N-nitrosodimethylamine concentrations of 0.01-0.70 mg/kg(2).[(1) IARC; IARC Monographs on the Evaluation of Carcinogenic Risks to Humans 17: 125-76 (1978) (2) Huang H et al; Bull Environ Contam Toxicol 73: 339-346 (2004)] **PEER REVIEWED**

ATMOSPHERIC CONCENTRATIONS:

N-Nitrosodimethylamine was identified as an air pollutant near two chemical plants, one using the amine as a raw material and the other

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discharging it as an unwanted by-product. Typical levels at the first factory were 6 to 36 ug/cu m on site, 1 ug/cu m in the residential neighborhood adjacent to the factory, and 0.1 ug/cu m two miles away. ... Typical levels adjacent to the second site were 0.001 to 0.04 ug/cu m. [Fine DH et al; Origins of Human Cancer (1977) as cited in USEPA; Ambient Water Quality Criteria Doc: Nitrosamines p.C-12 (1980) EPA-440/5-80-064] **PEER REVIEWED**

N-Nitrosodimethylamine concentrations in ambient air were: 32,000 ng/cu m in East Brooklyn area of Baltimore(1); 56 ng/cu m at Union Carbide, South Charleston, WV(1); 980 ng/cu m at DuPont, Belle, WV(1); 1070 ng/cu m (average) in a community near a chemical plant in Baltimore that manufactured unsymmetrical dimethylhydrazine(2); 30 to 100 ng/cu m in downtown Baltimore(2); 0.07 to 0.83 ug/cu m (0.29 ug/cu m average) in the front passenger area of new 1979 automobiles(3); 0.3 ug/cu m (average) in the interior of new 1979 automobiles(4); 0.02 to 0.05 ng/l in smoke-filled rooms(5); 15.6 ng/cu m on I-95 through New York City, NY(6); 0.01 to 0.2 ug/cu m in Paris(7); and 0.03 to 0.15 ug/cu m in Hidazubo City, Japan(8). Average daily ambient air concentrations for N-nitrosodimethylamine were 0.58 ppbv in the U.S. between 1980 and 1987; median N-nitrosodimethylamine concentrations were 0.003, 0.013, 0.014, and 0.016 ppbv for rural, suburban, urban and source dominated sites, respectively(9). [(1) Pellizzari ED; The Measurement of Carcinogenic Vapors in Ambient Atmospheres USEPA-600/7-77-055 (1977) (2) Fine DH et al; Environ Sci Technol 11: 581-4 (1977) (3) Rounbehler DP et al; Food Cosmet Toxicol 18: 147-52 (1980) (4) Fine DH et al; IARC Sci Publ 31: 541-54 (1980) (5) Stehlik G et al; Ecotoxicol Environ Safety 6: 495-500 (1982) (6) Fine DH et al; Spec Conf Toxic Subst Air Environ (Proc) Meet Date 1976: 168-81 (1977) (7) Chuong BT et al; Stud Environ Sci 1: 73-6 (1978) (8) Aihara K, Shinozaki M; Kanagawa-Ken Kogai Senta Nempo 11: 38 (1980) (9) Shah JJ, Heyerdahl EK; National Ambient Volatile Organic Compounds (VOCs) Database Update, EPA/600/3-88/010 (1988)] **PEER REVIEWED**

FOOD SURVEY VALUES:

N-Nitrosodimethylamine has been found to be present in a variety of foods (included smoked, dried or salted fish, ... salami, frankfurters, and cured meats) in the 1 to 100 ug/kg range, but more usually in the 1 to 10 ug/kg range. [Montesano R, Bartsch H; Mutagenic and Carcinogenic N-nitroso Compounds, Mutation Research V32 (1976) as cited in USEPA; Ambient Water Quality Criteria Doc: Nitrosamines p.179 (1980) EPA-440/5-80-064] **PEER REVIEWED**

N-Nitrosodimethylamine concns in foods were: 0.02 ppb in sukiyaki broth(1); not detected to 7.7 ppb in beer(2); 2.7 ppb (avg) and 68 ppb (max) in draft and bottle beers(3); 7.7 ppb (avg) in lager beer(4); 5 ppb in ale(4); 2.8 ppb (avg) in malt lager(4); 150 ug/kg in barley malt(5); 22 to 118 ppb in commercially malted barley(6); 2.7 ppb (avg) in fried bacon(7); 2.6 ppb in cooked bacon(7); 0.26 to 0.93 ppb in edible oils(8); 0.3 ppb in margarine(9); traces in cheeses(10); 1.2 ppb in whole wheat biscuits(11); 0.8 ppb in flour(11); 0.8 ppb in dried peas(11); 0.4 ppb in malt vinegar(11); and 1.0 ug/kg in infant formula(5). N-Nitrosodimethylamine was detected in samples of smoked and unsmoked bacon at concns ranging from < 2.0 to 8.0 ug/kg(12). N-Nitrosodimethylamine was detected in the following canned luncheon meats produced in Italy at the following median concns, ppb: beef with jelly, 0.35; ground beef and pork, 8.7; and turkey, 0.94(13). It was detected in the following cured meats produced in Italy at median concns of, ppb: prosciutto, 0.54; bologna, 4.76; salami, 5.35; rolled bacon, 0.59; coppa, 3.29 to 6.23; and bresaola, 24.70(13). Concns of N-nitrosodimethylamine in Italian beer were not detected to 0.71 ppb in light beer and not detected to 0.42 ppb in dark beer; imported light and dark beer contained 0.07 to 0.19 ppb and 0.15 and 0.36 ppb N-nitrosodimethylamine, respectively(13). N-Nitrosodimethylamine has been detected in the following Italian cheeses,

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ug/kg: grana padano, 0.35; gorgonzola, 0.84; processed cheese, 0.40; processed cheese with added polyphosphates, 0.38; edam, 0.73; and gouda, 0.39(14). Canadian beer analyzed in 1988-1989 had a mean concentration of only 0.10 ug/L; imported beer averaged 0.71 ug/L in 1991-1992 and 0.15 ug/L in 1994(15). [(1) Shibamoto T et al; J Agric Food Chem 29: 57-63 (1981) (2) Andrzejewski D et al; J Assoc Off Anal Chem 64: 1457-61 (1981) (3) Spiegelhalder B et al; Food Cosmet Toxicol 17: 29-32 (1979) (4) Scanlan RA et al; Food Cosmet Toxicol 18: 27-30 (1980) (5) Lawrence FJ, Weber DF; J Agric Food Chem 32: 749-7 (1984) (6) Hotchkiss JH et al; J Agric Food Chem 28: 678-80 (1980) (7) IARC; N-nitroso Compd: Anal Form Occurrence 31: 403-17 (1980) (8) Fiddler W et al; J Food Sci 46: 603-5 (1981) (9) Sen NP, Seaman S; J Agric Food Chem 29: 787-9 (1981) (10) Alliston TG et al; Analyst 97: 915-20 (1972) (11) Weston RJ; J Sci Food Agric 35: 782-6 (1984) (12) Massey RC et al; Food Addit Contam 8: 585-98 (1991) (13) Gavinelli M et al; Bull Environ Contam Toxicol 40: 41-56 (1988) (14) Dellisanti A et al; Bull Environ Contam Toxicol 57: 16-21 (1996) (15) WHO; N-Nitrosodimethylamine in drinking-water. World Health Organization 2006. Available from, as of Dec 19, 2012: http://www.who.int/water_sanitation_health/dwq/chemicals/ndma2ndadd.pdf **PEER REVIEWED**

Examination of over 100 apple brandies has shown that N-nitrosodimethylamine was present in the majority of samples at an average concentration of 0.5 ug/kg; maximum concentration 10 ug/kg(1). It was also found in a number of ciders, cognacs, Armagnac, rums, and whiskeys; average levels ranged from 0.1 to 0.4 ug/kg with a maximum concentration of 1.6 ug/kg(1).[(1) IARC; IARC Monographs on the Evaluation of Carcinogenic Risks to Humans 17: 125-76 (1978)] **PEER REVIEWED**

PLANT CONCENTRATIONS:

N-Nitrosodimethylamine was detected, not quantified in the fruit of Capsicum annuum L., also known as bell pepper, cherry pepper, cone pepper, green pepper, paprika, or sweet pepper(1).[(1) USDA; Dr. Duke's Phytochemical and Ethnobotanical Databases. Plants with a chosen chemical. N-Nitrosodimethylamine. Washington, DC: US Dept Agric, Agric Res Service. Available from, as of Jun 7, 2012: <http://www.ars-grin.gov/duke/>] **PEER REVIEWED**

FISH/SEAFOOD CONCENTRATIONS:

N-Nitrosodimethylamine concentrations in fish and seafood were: 200 to 1400 ng/kg in fried salted yellow croaker(1), 0.2 ppb (average) in frozen cod and sole fillet(2), 0.6 ppb (average) in miscellaneous smoked fish(2), 0.26 ng/g in a crab from the Raritan River, NJ(3) and a trace in uncooked, fresh cod(4). N-Nitrosodimethylamine is often present in fish meal(5).[(1) Huang DP et al; Food Cosmet Toxicol 19: 167-72 (1981) (2) Sen NP et al; J Agric Food Chem 33: 264-8 (1985) (3) Fine DH et al; Spec Conf Toxic Subst Air Environ (Proc) Meet Date 1976: 168-81 (1977) (4) Alliston TG et al; Analyst 97: 915-20 (1972) (5) Lewis RJ Jr; Hawley's Condensed Chemical Dictionary 12th ed NY, NY: Van Nostrand Reinhold Co p. 831 (1993)] **PEER REVIEWED**

MILK CONCENTRATIONS:

ENVIRONMENTAL: N-Nitrosodimethylamine concentrations in milk were: 3.559 ppb (average) in nonfat dry milk(1), 0.10 ppb (average) in whole milk(2), 0.09 ppb (average) in low fat milk(2), 0.10 ppb (average) in skim milk(2), 0.32 ppb avg in evaporated milk(2), 0.58 ppb (average) in sweetened condensed milk(2), 1.69 ppb (average) and 4.5 ppb in nonfat dried milk(2,3), 1.8 ppb in dried buttermilk(3), and 0.3 ug/kg skim milk powder(4). In 175 samples of human milk collected from 16 nursing women, 76.5% of the samples contained less than 0.2 ppb N-nitrosodimethylamine (minimum level of reliable measurement)(5). In 54 human milk samples from 54 healthy nursing women, trace amounts of N-nitrosodimethylamine (below detection limit of 0.5 ug/L) were detected in the milk of 10 mothers and

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two other samples contained levels of 1.1 and 1.2 ug/L(6).[(1) Sen NP et al; J Agric Food Chem 33: 264-8 (1985) (2) Lakritz L, Pensabene JW; J Dairy Sci 64: 371-4 (1981) (3) Libbey LM et al; Food Cosmet Toxicol 18: 459-62 (1980) (4) Lawrence FJ, Weber DF; J Agric Food Chem 32: 749-7 (1984) (5) Lakritz L, Pensabene; Food Chem Toxicol 22: 721-724 (1984) (6) Uibu J et al; Acta Paediatr 85: 1140-1142 (1996)] **PEER REVIEWED**

OTHER ENVIRONMENTAL CONCENTRATIONS:

In relatively high concentrations (in the order of 100 mg/cu m), secondary amines and nitrogen dioxide can react rapidly to form nitrosamines; this reaction apparently occurs in tobacco smoke. /Nitrosamines/[USEPA; Ambient Water Quality Criteria Doc: Nitrosamines p.A-2 (1980) EPA-440/5-80-064] **PEER REVIEWED**

Under an interagency agreement between the National Center for Toxicological Research and the Consumer Product Safety Commission (CPSC), data were obtained on the baseline and compliance concentrations of volatile N-nitrosamines in infant pacifiers sold in the United States. Pacifiers made by 18 different manufacturers before and after the January 1, 1984 action level of 60 ppb was set by the CPSC were analyzed for volatile N-nitrosamines. N-Nitrosodibutylamine was the principal N-nitrosamine found, along with trace amounts of N-nitrosodimethylamine, N-nitrosodiethylamine, and N-nitrosopiperidine. Mean total volatile N-nitrosamine levels for baseline and compliance samples were 63.9 and 21.2 ppb, respectively. The pacifier lots sampled after January 1, 1984 showed a significant decrease in contamination levels, indicating that at least 98% of the market share is in compliance with the CPSC enforcement policy for N-nitrosamines in infant pacifiers sold in the United States.[Billedeau SM et al; J Assoc Off Anal Chem 69 (1): 31-4 (1986)]

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N-Nitrosodimethylamine concentrations in cigarette smoke were 5 to 180 ng/cigarette(1) and 460 to 1880 ng/cigarette(2). N-Nitrosodimethylamine was detected in 5 brands of snuff from the U.S. and 5 Swedish brands of snuff at 2 to 215 ug/kg and 2 to 60 ug/kg, respectively(3). Sidestream and mainstream cigarette smoke from commercial U.S. cigarettes contained N-nitrosodimethylamine at concentrations ranging from 680 to 1040 ug/cigarette in sidestream smoke and 6 to 65 ug/cigarette in mainstream smoke(3). N-Nitrosodimethylamine was detected in sidestream and mainstream smoke from small cigars at 1,770 and 43 ug/cigarette, respectively(3). N-Nitrosodimethylamine was detected in a sample of a pacifier nipple at concentrations of 14.1 to 21.9 ng/g(4). It was detected in baby bottle rubber nipples at concentrations ranging from 2.1 to 24.6 ppb(5). N-Nitrosodimethylamine concentrations in cigarette tobacco ranged from 0.4 to 1.7 ng/cigarette and 0.5 to 5.0 ng/cigarette for filter and non-filter cigarettes, respectively(6). N-Nitrosodimethylamine was detected in the mainstream smoke of 20 commercial brands of filter and non-filter cigarettes at concentrations ranging from 6.3-76.4 ng/cigarette(7). Trace levels of N-nitrosodimethylamine have been detected in infant pacifiers sold in the US(8). [[(1) McCormick A et al; Nature 244: 237-8 (1973) (2) Brunnenmann KD et al; J Agric Food Chem 31: 1221-4 (1983) (3) Preussman R; Occurrence and Exposure to N-nitroso Compounds and Precursors, IARC Sci Publ 57: 3-15 (1984) (4) Thompson HC Jr et al; J Toxicol Environ Health 13: 615-32 (1984) (5) Gray JI, Stachiw MA; J Assoc Off Anal Chem 70: 64-8 (1987) (6) Tricker AR, Preussmann R; Clin Invest 70: 283-9 (1992) (7) Tricker AR et al; Carcinogenesis 12: 257-261 (1991) (8) Billedeau SM et al; J Assoc Off Anal Chem 69: 31-34 (1986)] **PEER REVIEWED**