

Safety Data Sheet

1,4-Dinitroso- piperazine

Division of Safety
National Institutes
of Health



WARNING!

THIS COMPOUND IS TOXIC, CARCINOGENIC, AND MUTAGENIC. AVOID FORMATION AND BREATHING OF AEROSOLS OR VAPORS.

LABORATORY OPERATIONS SHOULD BE CONDUCTED IN A FUME HOOD, GLOVE BOX, OR VENTILATED CABINET.

AVOID SKIN CONTACT: IF EXPOSED, WASH WITH SOAP AND COLD WATER. AVOID RUBBING OF SKIN OR INCREASING ITS TEMPERATURE.

FOR EYE EXPOSURE, IRRIGATE IMMEDIATELY WITH LARGE AMOUNTS OF WATER. FOR INGESTION, INDUCE VOMITING. FOR INHALATION, REMOVE VICTIM PROMPTLY TO CLEAN AIR. ADMINISTER RESCUE BREATHING IF NECESSARY. REFER TO PHYSICIAN.

IN CASE OF LABORATORY SPILL, WEAR PROTECTIVE CLOTHING DURING CLEANUP. WASH DOWN AREA. SEE CASTEGNARO ET AL. (1982) FOR DETAILS. DISPOSE OF WASTE SOLUTIONS AND MATERIALS APPROPRIATELY. MONITOR LABORATORY AIR AND CHECK FOR NITROSAMINE RESIDUES AFTER CLEANUP.

A. Background

1,4-Dinitrosopiperazine (DNP) is toxic, carcinogenic, and mutagenic in experimental test systems. Its primary use is for tumor induction in experimental animals and for related research. Use of this compound for other purposes, such as organic synthesis, should be avoided.

B. Chemical and Physical Data

1. Chemical Abstract No.: 140-79-4

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2. Synonyms:

DNP

1,4-Dinitropiperazine

D-NPZ

N,N'-Dinitrosopiperazine

Dinitrosopiperazine

Piperazine, 1,4-dinitroso-

3. Molecular
formula:
 $C_4H_8N_4O_2$

structure:



weight:
144.16

4. Density: 1.425 g/cm³ at 20°C.
5. Absorption spectroscopy: UV: λ (log ϵ) = 239 (4.18) and 337 (2.02) (Druckrey et al., 1967). IR and NMR spectra have been reported (Lambert et al., 1969). For MS data, see Pensabene et al. (1972) and Rainey et al. (1978).
6. Volatility: No data. Air:water distribution coefficient: $10^5 \cdot K = 0.2$ at 37°C (Mirvish et al., 1976).
7. Solubility: 0.58 g/l in water at 23-25°C (Druckrey et al., 1976; Mirvish et al., 1976). Soluble in alcohol, acetone, dimethylsulfoxide, n-hexane.
8. Description, appearance: Pale yellow crystals.
9. Boiling point: No data.
Melting point: 158°C.
10. Stability: Stable at ordinary temperatures. Nonexplosive.
11. Chemical reactivity: Relatively resistant to hydrolysis, but cleaved in strong acid to nitrous acid and piperazine.
12. Flash point: Does not apply.
13. Autoignition temperature: No data.
14. Flammable limits: Does not apply.

Fire, Explosion, and Reactivity Hazard Data

1. Use dry chemical fire extinguisher, water, or soda-acid. Fire fighting personnel should wear air-supplied respirators with full-face masks.

2. Apparently nonvolatile.
3. Decomposed by strong acids, liberating nitrous acid.
4. May be absorbed by elastomers and may cause deterioration of these materials.
5. Volatilization during combustion may produce hazardous vapors. Combustion products contain nitrogen oxides.

Operational Procedures

The NIH Guidelines for the Laboratory Use of Chemical Carcinogens describe operational practices to be followed when potentially carcinogenic chemicals are used in NIH laboratories. The Guidelines should be consulted to identify the proper use conditions required and specific controls to be implemented during normal and complex operations or manipulations involving DNP.

DMN, DEN, and solutions of nitrosamines penetrate various glove materials (Walker et al., 1978). This factor should be taken into account when handling DNP.

1. Chemical inactivation: Validated methods have been reported (Castegnaro et al., 1982).
2. Decontamination: Turn off equipment that could be affected by DNP or the materials used for cleanup. If more than 1 g has been spilled or if there is any uncertainty regarding the procedures to be followed for decontamination, call the NIH Fire Department (dial 116) for assistance. Consult Castegnaro et al. (1982) for details concerning decontamination of surfaces, glassware, and animal cages.
3. Disposal: It may be possible to decontaminate waste streams containing DNP before disposal. For details, see Castegnaro et al. (1982). No waste streams containing DNP shall be disposed of in sinks or general refuse. Surplus DNP or chemical waste streams contaminated with DNP shall be handled as hazardous chemical waste and disposed of in accordance with the NIH chemical waste disposal system. Nonchemical waste (e.g., animal carcasses and bedding) containing DNP shall be handled and packaged for incineration in accordance with the NIH medical-pathological waste disposal system. Potentially infectious waste (e.g., tissue cultures) containing DNP shall be packaged for incineration, as above. Burnable waste (e.g., absorbent bench top liners) minimally contaminated with DNP shall be handled as potentially infectious waste and packaged for incineration, as above. Absorbent materials (e.g., associated with spill cleanup) grossly contaminated shall be handled in accordance with the chemical waste disposal system. Radioactive waste containing DNP shall be handled in accordance with the NIH radioactive waste disposal system.

4. Storage: Store in bottles with caps with polyethylene cone liners inside a sealed secondary container. This should be kept in a solvent storage cabinet, deep freeze, or explosion-safe refrigerator. Avoid exposure to light and moisture.

Monitoring and Measurement Procedures Including Direct Field Measurements and Sampling for Subsequent Laboratory Analysis

1. Sampling: Because of the lack of volatility of DNP, methods developed for air sampling of volatile nitrosamines (collection in cold traps or on solid adsorbents) are not applicable. Water samples may be extracted with dichloromethane or another water-immiscible solvent, which is then concentrated (EPA, 1976).
2. Separation and analysis: No specific methods for DNP have been developed, and the preferred direct methods (GC-MS and GC-TEA) for volatile nitrosamines are probably not applicable. It is likely that procedures involving derivative formation can be used; these include oxidation to nitramines with peroxytrifluoroacetic acid followed by GC-EC (Telling, 1972) and nitrite formation with HBr in glacial acetic acid followed by spectrophotometry (Eisenbrand and Preussmann, 1970).

Biological Effects (Animal and Human)

1. Absorption: DNP is absorbed in animals through the gastrointestinal tract after ingestion and by parenteral injection. No human data.
2. Distribution: No data.
3. Metabolism and excretion: Very few data. Most of the ^{14}C label of intravenously and intraperitoneally injected DNP is excreted in the urine, while small amounts are found in the bile and in exhaled $^{14}\text{CO}_2$ (Sander et al., 1973; Krueger et al., 1976). Identified metabolites include 3-hydroxy-nitrosopyrrolidine and 1-nitrosopiperazine.
4. Toxic effects: Acute LD50s are 100 mg/kg (mouse, intraperitoneal) and 160 mg/kg (rat, oral or subcutaneous). Target organs for toxicity have not been identified.
5. Carcinogenic effects: Oral administration of DNP (in drinking water) to rats produces epithelial tumors in the nasal cavities, upper gastrointestinal tract, liver, and lungs.
6. Mutagenic and teratogenic effects: DNP is mutagenic in the Ames test after metabolic activation. No mammalian mutagenicity or teratogenicity has been reported.

G. Emergency Treatment

1. Skin and eye exposure: For skin exposure, remove contaminated clothing and wash skin with soap and water. Avoid rubbing of skin or increasing its temperature. For eye exposure, irrigate immediately with copious quantities of running water for at least 15 minutes.
2. Ingestion: Drink plenty of water. Induce vomiting.
3. Inhalation: Remove victim promptly to clean air. Administer rescue breathing if necessary.
4. Refer to physician.

H. References

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