Sources of Exposure

General Populations

- The general population may be exposed to nitrophenols through the inhalation of contaminated ambient air.
- People living near landfill sites or agricultural areas that contain nitrophenols may be exposed to higher levels of the compounds than the general population.
- Since nitrophenols are released from car exhaust, potentially high exposures could also occur in populations living near heavy traffic or people who work with or around running gas- or diesel-powered motor vehicles.

Occupational Populations

- Workers who manufacture or use nitrophenols and applicators of certain pesticides may be at higher risk of exposure to nitrophenols than the general population. People that work with or around running gasoline or diesel powered motor vehicles may also be at risk of higher exposures to nitrophenols.

Toxicokinetics and Biomonitoring

Toxicokinetics

- 4-Nitrophenol that is orally administered is rapidly absorbed through the gastrointestinal tract.
- Absorbed 4-nitrophenol is widely distributed in the body after oral exposure, but the majority is distributed to the gastrointestinal tract. Levels steadily decrease in all tissues over a 24-hour period.
- 2-Nitrophenol and 4-nitrophenol undergo metabolic transformation by hepatic and extrahepatic phase I and phase II metabolism.
- Urine is the main route of excretion for nitrophenols. Small amounts are excreted in the feces.

NHANES Biomonitoring

- For survey years 2011-2012 and 2013-2014, the geometric mean of urinary 4-nitrophenol for the total U.S. population was 0.64 µg/L. This is the last year that NHANES reported information for any nitrophenols.

Biomarkers/Environmental Levels

Biomarkers.

- 2- and 4-nitrophenols break down into many metabolites that could be used to detect exposure, although none have been studied as such in the literature. The presence of 4-nitrophenol in urine may be associated with exposure to the chemical itself or to any of the chemicals for which it is a metabolite, such as methyl parathion or nitrobenzene.

Environmental Levels

- Air:
  - There is no recent air monitoring data in the U.S. for nitrophenols
- Groundwater:
  - 2-nitrophenol: 0–1,000 µg/L
  - 4-nitrophenol: 0–250 µg/L
- Surface Water:
  - 2-nitrophenol: 0–200 µg/L
  - 4-nitrophenol: 0–200 µg/L
- Soil and Sediment:
  - 2-nitrophenol: 0.33–67,000 µg/kg
  - 3-nitrophenol: 17–3,800 µg/kg
  - 4-nitrophenol: 0.03–330,000 µg/kg

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2022. Toxicological Profile for Nitrophenols (Draft for Public Comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

ToxGuide™ for Nitrophenols

$C_6H_5NO_3$

CAS# 88-75-5, 554-84-7, and 100-02-7

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U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
www.atsdr.cdc.gov

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Chemical and Physical Information

2-Nitrophenol is a light yellow crystalline solid.

- 2-Nitrophenol (also known as ortho- or o-nitrophenol) is used to manufacture pesticides, fungicides, and other agricultural chemicals.
- 2-Nitrophenol has an aromatic odor.

3-Nitrophenol is a colorless to pale yellow crystalline solid.

- 3-Nitrophenol (also known as meta- or m-nitrophenol) is used as an indicator and to synthesize dyestuffs and drugs.
- 3-Nitrophenol has an odor between aromatic and sweet.

4-Nitrophenol is colorless to slightly yellow solid.

- 4-Nitrophenol (also known as para- or p-nitrophenol) is used to darken leather, produce drugs, fungicides, methyl and ethyl parathion insecticides, and dyes.
- 4-Nitrophenol is odorless.
- Nitrophenols are manufactured or formed in vehicular exhaust and do not occur naturally in the environment.
- Nitrophenols are expected to be soluble in water and have low vapor pressures.

Routes of Exposure

- Inhalation – Inhalation exposure from nitrophenols released into the atmosphere may occur on or near agricultural land. Nitrophenols may also be released from vehicle exhausts. Inhalation is the primary route of exposure.
- Oral –Oral exposure may occur through contaminated drinking water, which may be a greater risk for those living or working near a farm, waste, or industry site that utilizes certain pesticides.
- Dermal – Dermal exposure may occur through contact with contaminated soil and/or water. This may also be a greater risk near a farm, waste, or industry site.

Nitrophenols in the Environment

- The primary source of anthropogenic nitrophenol release is traffic activity, though only a very small portion of released chemical is expected to be in ambient air due to photolysis and physical removal processes (atmospheric half-lives: 3-18 days).
- Nitrophenols can deposit in soil and degrade very slowly (4-nitrophenol half-life: 1-14 days in topsoil, 40+ days in subsoil).
- Photolysis and biodegradation break down nitrophenols in water (half-life 1-8 days in fresh, 13-21 days in sea water). Nitrophenols bioaccumulate in edible aquatic species, though there is no evidence that the chemicals transfer from plant to animal.

Relevance to Public Health (Health Effects)

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

Minimal Risk Levels (MRLs)

Inhalation

- No acute- (≤14 days), intermediate- (>14 –364 days), or chronic-duration (≥365 days) inhalation MRLs were derived for 2-, 3-, or 4-nitrophenol.

Oral

- No acute-, intermediate-, or chronic-duration oral MRLs were derived for 2-, 3-, or 4-nitrophenol.

Health Effects

- No studies exist that report health effects in humans after inhalation, oral, or dermal exposure to nitrophenols.
- Respiratory effects are a suspected health effect of exposure to 4-nitrophenol (inhalation and oral). Intermediate inhalation exposure to 2- and 4-nitrophenol and acute and intermediate oral exposure to 4-nitrophenol produced adverse respiratory effects. These included squamous metaplasia of the nasal epithelium, decreased lung weight, wheezing, and dyspnea.

Health Effects

- Hematological effects are a suspected health effect of exposure to 4-nitrophenol. Following acute inhalation of 2- and 4-nitrophenol, rat methemoglobin levels increased, which lowers oxygen carrying and delivery capacity to tissues and can cause hypoxia, cyanosis, fatigue, weakness, dyspnea, headache, and dizziness. Humans may be more sensitive to this toxicity because rats have 2-5 times more methemoglobin reductase (controls methemoglobin levels) than humans.
- In animals, inhalation or direct exposure to 4-nitrophenol in the eye caused eye irritation.
- No domestic or international agency has evaluated or classified the carcinogenicity status of nitrophenols.

Children's Health

- It is not known if children are more sensitive to nitrophenols than adults.