Environmental and Molecular Mutagenesis 00:00–00 (2014)

Research Article

Abnormalities in the Male Reproductive System After Exposure to Diesel and Biodiesel Blend

Elena R. Kisin,[1] Naveena Yanamala,[1] Mariana T. Farcas,[1] Dmitriy W. Gutkin,[2] Michael R. Shurin,[2] Valerian E. Kagan,[3] Aleksandar D. Bugarski,[4] and Anna A. Shvedova[1,5*]

[1]*Pathology and Physiology Research Branch, and Exposure Assessment Branch, HELD, NIOSH, Morgantown, West Virginia*

[2]*Department of Pathology, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania*

[3]*Department of Environmental and Occupational Health, University of Pittsburgh, Pittsburgh, Pennsylvania*

[4]*Office of Mine Safety and Health Research, NIOSH, Pittsburgh, Pennsylvania*

[5]*Department of Physiology and Pharmacology, West Virginia University, Morgantown, West Virginia*

Altering the fuel source from petroleum-based ultra-low sulfur diesel to biodiesel and its blends is considered by many to be a sustainable choice for controlling exposures to particulate material. As the exhaust of biodiesel/diesel blends is composed of a combination of combustion products of polycyclic aromatic hydrocarbons and fatty acid methyl esters, we hypothesize that 50% biodiesel/diesel blend (BD50) exposure could induce harmful outcomes because of its ability to trigger oxidative damage. Here, adverse effects were compared in murine male reproductive organs after pharyngeal aspiration with particles generated by engine fueled with BD50 or neat petroleum diesel (D100). When compared with D100, exposure to BD50 significantly altered sperm integrity, including concentration, motility, and morphological abnormalities, as well as increasing testosterone levels in testes during the time course postexposure. Serum level of luteinizing hormone was significantly depleted only after BD50 exposure. Moreover, we observed that exposure to BD50 significantly increased sperm DNA fragmentation and the upregulation of inflammatory cytokines in the serum and testes on Day 7 postexposure when compared with D100. Histological evaluation of testes sections from BD50 exposure indicated more noticeable interstitial edema, degenerating spermatocytes, and dystrophic seminiferous tubules with arrested spermatogenesis. Significant differences in the level of oxidative stress assessed by accumulation of lipid peroxidation products and depletion of glutathione were detected on exposure to respirable BD50 and D100. Taken together, these results indicate that exposure of mice to inhalable BD50 caused more pronounced adverse effects on male reproductive function than diesel. Environ. Mol. Mutagen. 00:000–000, 2014.

Key words: pulmonary exposure; biodiesel particles; oxidative stress; male reproduction; sperm quality; DNA fragmentation

Grant sponsor: NIOSH; Grant numbers: 2927ZKCY, OH008282.

Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health. Mention of trade names or commercial products do not constitute endorsement or recommendation for use.

*Correspondence to: Anna A. Shvedova, Pathology and Physiology Research Branch, and Exposure Assessment Branch, HELD, NIOSH, 1095 Willowdale Rd, Morgantown, WV 26505, USA. E-mail: ats1@cdc.gov

Received 30 June 2014; provisionally accepted 25 September 2014; and in final form 00 Month 2014

DOI 10.1002/em.21915

Published online 00 Month 2014 in Wiley Online Library (wileyonlinelibrary.com).