

# Cytotoxicity of exhaust emissions from a generator fuelled by waste-edible-oil-biodiesel with acetone and isopropyl alcohol addition

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Exhaust fumes from diesel engines may cause cancers, according to a panel of experts working for the International Agency for Research on Cancer (IARC) (IARC, 2012). To alleviate the environment impacts and adverse health effects from diesel exhausts, although the mechanical design of diesel engines has been improved and catalytic converters have been installed, the fuel used by diesel engines is also a critical factor which influences the compositions of particle and gas pollutants emitted by diesel engines. Lin *et al.* (2010) and Lee *et al.* (2011) reported that diesel engines using blended fuels (bio-fuels; blends of diesels, biodiesels, and alcohols) could reduce the emissions of total-PAHs and total-BaP<sub>eq</sub>. Although the use of blended fuels may significantly reduce emissions from diesel engines, it is necessary to evaluate the potential cytotoxicity of diesel exhausts and their effects on health when using bio-fuels.

In this study, the combination of 1–3 vol. % pure acetone (denoted as A), 1 vol. % pure isopropyl alcohol (the stabilizer, denoted as P), and 1–20 vol. % waste-edible-oil-biodiesel (denoted as W) addition into conventional fossil diesel (D100) was tested. Different blended fuels were tested at the stable energy output (110 V/60 Hz, 1800 rpm) of a generator under varying engine loadings. An auto-detector flow sampling system equipped with quartz fiber filters and two connected cartridges (filled with XAD-16 resins) were used to collect particulate phase and gas phase PAHs, respectively. Each sample was extracted in a Soxhlet extractor using a mixed solvent (n-hexane and dichloromethane 1:1 vol/vol) for 24 hr. Subsequently, human male macrophage/monocyte cell strains (U937) were exposed to various extract samples for 24 hours after various organic solvents had been replaced by DMSO (dimethyl sulfoxide). The MTT (3-(4,5-dimethyl-thiazol-2-yl)-2,5-diphenyltetrazolium bromide) assay was adopted to analyze the cell viability rates of various extracts of diesel exhaust emissions (DEEs).

Figure 1 shows the cytotoxicity (cell death rate (CDR)) of DEEs from the diesel-engine generator fuelled with various biofuel blends. Among these tested fuels, using various bio-fuels in place of D100 could reduce the CDR of DEEs' organic solvent extracts by 4.89–57.6% (average, 21.9%). Regardless of the percentages of added waste-edible-oil-biodiesel, acetone,

and isopropyl alcohol, the CDR value decreased with increasing percentage of biofuel blends; in particular, W20 had the best cytotoxicity reductions (57.6%). When the addition percentage of waste-edible-oil-biodiesel was less than 5%, the cytotoxicity of DEEs decreased as the addition percentage of acetone increased; however, an opposite trend was observed at waste-edible-oil-biodiesel addition  $\geq 5\%$ . Nevertheless, the values of cytotoxicity were still less than that using fossil diesel as the fuel, at waste-edible-oil-biodiesel  $\geq 5\%$ . The above results suggest that the blended fuel (fossil diesel with waste-edible-oil-biodiesel, acetone, and isopropyl alcohol addition) may be used as an alternative fuel to petroleum diesel to reduce the hazards of emissions from diesel engines to human health.

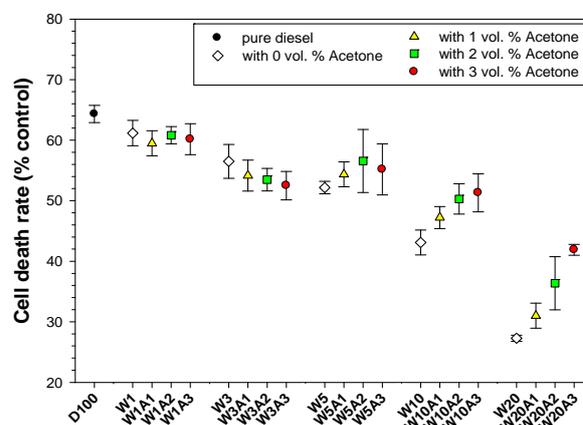


Figure 1. Cytotoxicity (cell death rate) of DEEs from the diesel-engine generator fuelled with biofuels.

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