

Studi Pembentukan DNA Adduct 8-OHdG dan Analisis Histopatologi akibat Paparan Dibutil Ftalat dan Mikroplastik Poli(etilena tereftalat) dalam Kemasan Minuman secara In Vivo pada Rattus norvegicus = Study of Formation DNA Adduct 8-OHdG and Histopathology Analysis due to Exposure of Dibutyl Phthalate and Microplastics Poly(ethylene Terephthalate) in Beverage Packaging In Vivo in Rattus norvegicus

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Abstrak

Poli(etilena tereftalat) (PET) merupakan polimer plastik yang digunakan secara luas, terutama dalam industri kemasan minuman. Di lingkungan plastik PET dapat mengalami degradasi terus-menerus menghasilkan mikroplastik PET yang diketahui mudah terakumulasi dalam tubuh, bersamaan dengan termigrasinya senyawa aditifnya, yaitu dibutil ftalat. Dibutil ftalat merupakan senyawa aditif tambahan untuk meningkatkan fleksibilitas dalam pembuatan plastik PET. Mikroplastik PET dan dibutil ftalat diketahui memicu peningkatan produksi spesies oksigen reaktif (ROS) dan menciptakan keadaan stres oksidatif ketika terakumulasi dalam tubuh. ROS yang bersifat reaktif berpotensi merusak molekul biologis DNA.

Pada penelitian ini dianalisis kerusakan DNA, berupa DNA adduct 8-Hidroksi-2deoksiganosin (8-OHdG) akibat mikroplastik PET dan dibutil ftalat. Hasil menunjukkan kadar 8-OHdG meningkat akibat paparan tunggal dan kombinasi kedua senyawa tersebut. Peningkatan tertinggi terjadi pada kadar 8-OHdG kelompok paparan mikroplastik PET mencapai 35,02 ng/mL dibandingkan kelompok kontrol 11,96 ng/mL. Disertai dengan fluktuasi berat badan hewan uji. Potensi migrasi senyawa aditif DBP dari mikroplastik PET, dianalisis juga dengan uji Toxicity Characteristic Leaching Procedure (TCLP) dengan simulasi kondisi fisiologis, yaitu dengan pH 2,0 (lambung), pH 7,2 (darah), dan pH 8,2 (hati). Hasil menunjukkan migrasi DBP tertinggi pada pH 2,0 dan pH 8,2. Sedangkan histopatologi jaringan menunjukkan peradangan bervariasi pada periportal hati, limfoid usus submukosa lambung, dan area pyelum dan interstitial ginjal, dengan tingkat peradangan tertinggi terdapat pada kelompok paparan mikroplastik PET. Sedangkan kelompok paparan DBP dan kombinasi kedua senyawa menunjukkan kadar 8-OHdG dan tingkat peradangan yang lebih rendah, mengindikasikan adanya efek antagonis dari paparan kombinasi mikroplastik PET dan DBP.

.....Poly(ethylene terephthalate) (PET) is a widely used plastic polymer, particularly in the beverage packaging industry. In the environment, PET plastic can undergo continuous degradation, producing PET microplastics that are known to easily accumulate in the body, along with the migration of its additive compounds, such as dibutyl phthalate. Dibutyl phthalate is an additional additive used to enhance flexibility in the production of PET plastic. PET microplastics and dibutyl phthalate are known to trigger increased production of spesies oksigen reaktif(ROS) and induce oxidative stress when accumulated in the body. ROS, due to their reactive properties, have the potential to damage biological molecules such as DNA.

This study analyzed DNA damage, in the form of DNA adduct 8-Hydroxy-2deoxyguanosine (8-OHdG) due to PET and dibutyl phthalate microplastics. The results showed that 8-OHdG levels increased due to single exposure and the combination of the two compounds. The highest increase occurred in 8-OHdG levels in the PET microplastic exposure group reaching 35.02 ng/mL compared to the control group of 11.96 ng/mL.

Accompanied by fluctuations in body weight of the test animals. The potential migration of DBP additive compounds from PET microplastics was also analyzed by Toxicity Characteristic Leaching Procedure (TCLP) test with simulated physiological conditions, namely with pH 2.0 (stomach), pH 7.2 (blood), and pH 8.2 (liver). The results showed the highest DBP migration at pH 2.0 and pH 8.2. While tissue histopathology shows inflammation varies in the liver periportal, gastric submucosal intestinal lymphoid, and kidney pyelum and interstitial areas, with the highest level of inflammation found in the PET microplastic exposure group. The DBP exposure group and the combination of both compounds showed lower levels of 8-OHdG and inflammation, indicating an antagonistic effect of combined exposure to PET microplastics and DBP.