

Probabilistic Health Risk Assessment of Polycyclic Aromatic Hydrocarbons in Repeatedly Used Edible Oils and Finger Foods

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Abstract : Polycyclic aromatic hydrocarbons (PAHs) are a group of organic compounds that can form in edible oils during repeated frying and accumulate in fried foods. This study assesses the chances of health risks (carcinogenic and non-carcinogenic) due to PAHs levels in popular finger foods (bean cakes, plantain chips, doughnuts) fried in edible oils (mixed vegetable, sunflower, soybean) from the Ghanaian market. Employing probabilistic health risk assessment that considers variability and uncertainty in exposure and risk estimates provides a more realistic representation of potential health risks. Monte Carlo simulations with 10,000 iterations were used to estimate carcinogenic, mutagenic, and non-carcinogenic risks for different age groups (A: 6-10 years, B: 11-20 years, C: 20-70 years), food types (bean cake, plantain chips, doughnut), oil types (soybean, mixed vegetable, sunflower), and re-usage frying oil frequencies (once, twice, thrice). Our results suggest that, for age Group A, doughnuts posed the highest probability of carcinogenic risk (91.55%) exceeding the acceptable threshold, followed by bean cakes (43.87%) and plantain chips (7.72%), as well as the highest probability of unacceptable mutagenic risk (89.2%), followed by bean cakes (40.32%). Among age Group B, doughnuts again had the highest probability of exceeding carcinogenic risk limits (51.16%) and mutagenic risk limits (44.27%). At the same time, plantain chips exhibited the highest maximum carcinogenic risk. For adults age Group C, bean cakes had the highest probability of unacceptable carcinogenic (50.88%) and mutagenic risks (46.44%), though plantain chips showed the highest maximum values for both carcinogenic and mutagenic risks in this age group. Also, on non-carcinogenic risks across different age groups, it was found that age Group A) who consumed doughnuts had a 68.16% probability of a hazard quotient (HQ) greater than 1, suggesting potential cognitive impairment and lower IQ scores due to early PAH exposure. This group also faced risks from consuming plantain chips and bean cake. For age Group B, the consumption of plantain chips was associated with a 36.98% probability of HQ greater than 1, indicating a potential risk of reduced lung function. In age Group C, the consumption of plantain chips was linked to a 35.70% probability of HQ greater than 1, suggesting a potential risk of cardiovascular diseases.

Keywords : PAHs, fried foods, carcinogenic risk, non-carcinogenic risk, Monte Carlo simulations

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