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Multivariate analyses of chloropropanol and fatty acid profiles in lipid-based foods: Implications for health risk and oxidative stability

By

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Abstract

Foods formulated with refined vegetable oils are widely consumed in Malaysia, raising concerns about processing contaminants such as 3-monochloropropane-1,2-diol (3-MCPD), 2-MCPD, and glycidol, as well as their nutritional implications. This study analysed 56 commercially available products, comprising 11 chocolate spreads (CS), 8 evaporated creamers (EC), 11 sweetened creamers (SC), 5 milk powders (MP), and 21 potato chips (PC), to determine fatty acid composition and contaminant levels. The relationships between fatty acids and contaminants were evaluated using principal component analysis (PCA) and hierarchical cluster analysis (HCA). Concentrations of 3-MCPD, 2-MCPD, and glycidol ranged from 0.11 to 4.84, 0.17-3.37, and 0.21-4.07 mg/kg, respectively, with two samples exceeding European Union limits. CS (36 % fat)

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exhibited the highest contaminant concentrations, while EC, SC, and MP generally contained lower amounts. PCA (explaining 70.3 % of total variance) showed that palmitic acid correlated strongly with chloropropanol occurrence. Palm olein-based formulations were more susceptible to contamination, whereas products containing sunflower or canola oils showed lower contamination levels. Overall, higher saturated fatty acid content, particularly palmitic acid, was associated with increased contaminant formation, while oleic- and linoleic-rich formulations presented lower risks. These findings provide evidence-based guidance for regulatory monitoring and safer formulation of lipid-based foods.

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