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Development of a zebrafish model for toxicity evaluation of adulterated Apis mellifera honey
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Abstract
Since ancient times, honey has been used for medical purposes and the treatment of various disorders. As a high-quality food product, the honey industry is prone to fraud and adulteration. Moreover, limited experimental studies have investigated the impact of adulterated honey consumption using zebrafish as the animal model. The aims of this study were: (1) to calculate the lethal concentration (LC50) of acid-adulterated Apis mellifera honey on embryos, (2) to investigate the effect of pure and acid-adulterated A. mellifera honey on hatching rate (%) and heart rate of zebrafish (embryos and larvae), (3) to elucidate toxicology of selected adulterated honey based on lethal dose (LD50) using adult zebrafish and (4) to screen the metabolites profile of adulterated honey from blood serum of adult zebrafish. The result indicated the LC50 of 31.10 ± 1.63 (mg/ml) for pure A. mellifera honey, while acetic acid demonstrates the lowest LC50 (4.98 ± 0.06 mg/ml) among acid adulterants with the highest mortality rate at 96 hpf. The treatment of zebrafish embryos with adulterated A. mellifera honey significantly ($p \leq 0.05$) increased the hatching rate (%) and decreased the heartbeat rate. Acute, prolong-acute, and sub-acute toxicology tests on adult zebrafish were conducted at a concentration of 7% w/w of acid adulterants. Furthermore, the blood serum metabolite profile of adulterated-honey-treated zebrafish was screened by LC-MS/MS analysis and three endogenous metabolites have been revealed: (1) Xanthotoxol or 8-Hydroxypsoralen, (2) 16-Oxoandrostenediol, and (3) 3,5-Dicaffeoyl-4-succinoylquinic acid. These results prove that employed honey adulterants cause mortality that contributes to higher toxicity. Moreover, this study introduces the zebrafish toxicity test as a new promising standard technique for the potential toxicity assessment of acid-adulterated honey in this study and hazardous food adulterants for future studies. © 2024

Author Keywords
Apis mellifera honey; Danio rerio; Embryotoxicity assay; Honey adulteration; Honey quality; Toxicity evaluation

Index Keywords
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