



RESEARCH ARTICLE

Evaluation of health hazards linked to heavy metal concentrations in date palm (*Phoenix dactylifera* L.) fruits from Basrah, Iraq

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Abstract

This study aims to determine the levels of heavy metals, namely lead (Pb), cadmium (Cd) and chromium (Cr), in date palm fruits (Barhi cultivar) grown in the Basrah Governorate, Iraq. It also assesses the health risks associated with the consumption of date fruits, including estimated dietary intake (EDI), hazard quotients (HQ), hazard index (HI) and cancer risk (CR) indices. Fruit samples were collected from four sites, namely, Al-Qurna, Shatt Al-Arab, Abu Al-Khaseeb and Zubair, during different ripening stages, such as Khalal (Bisr), Rutab and Tamar. Results demonstrate that the concentrations of heavy metals in date palm fruits increased as the fruits ripened. Moreover, the mean values of Cd and Cr were below the maximum allowable levels (MAL) set by WHO/FAO in all sites and at all ripening stages. In contrast, the Pb levels exceeded the MAL at all sites and ripening stages. The results of the health risk assessment indicated that the EDI of Pb, Cd and Cr through date consumption (100 g per person per day) was below the provisional maximum tolerable daily intake across all examined sites. The HQ and HI values were below 1 except for HI in the Zubair site. The CR index confirmed that no carcinogenic threats are associated with the consumption of date palm fruits in Basrah Governorate. This study provides valuable insights for improving food safety and protecting public health in Iraq.

Keywords: carcinogenic; dietary intake; food contamination; health risk

Introduction

The date palm (*Phoenix dactylifera* L.) is a tree species native to tropical and subtropical regions, classified under the Arecaceae family and primarily cultivated for its edible fruits. Historically, date palm trees have significantly influenced human life. In many countries of Asia and Africa, locals depend on date palm fruits for both sustenance and trade. They contribute remarkably to the economy, society and environment of these regions (1). Dates are either consumed fresh or undergo various methods of packing and processing, while the other components of the tree serve multiple purposes (2). The fruits of these date palms are highly valued for their rich nutritional content, including sugar, dietary fiber, vitamins and minerals, each of which plays a crucial role in providing numerous health benefits (3). Toxic metals enter the food chain through multiple environmental routes. The introduction of these metals into the soil, air and water is intensified by industrial activities, agricultural practices and urban expansion. When these heavy metals accumulate in agricultural soils, they are taken by plant roots and subsequently translocate to the consumable part of the plants, including fruits and vegetables (4). Heavy metals can build-up in the body through long-term consumption of food containing contaminants and may pose serious health hazards, including

toxicity to organs, developmental issues and increased risk of cancer (5). Iraq is regarded as one of the top producers of dates worldwide, with date palm cultivation serving a key role in the country's agricultural sector (6). Iraq hosts approximately 17.35 million date palm trees, of which around 11.24 million are female productive palms, reflecting the significant role of date cultivation in the country's agricultural sector (7). The southern section of Iraq, especially the Basrah Governorate, is famous for its exceptional date production, thriving due to its ideal climate and fertile soils. Basrah stands out for its extensive date palm orchards, which contribute significantly to the annual date yield in the country (8). Monitoring heavy metals in date palms is essential, as these trees thrive in various climatic conditions. Date palms are often found near roads, residential neighbourhoods, rural areas and industrial sites, increasing their susceptibility to pollutant accumulation (9). The evaluation of toxic metal levels in the fruits of date palm and the potential health concerns linked to the consumption of fruits has emerged as a critical concern for many date-producing nations. Several investigations have been carried out in various date-producing countries to estimate the levels of heavy metals in fruit and to evaluate the health risks related to the intake of these fruits. These countries include Saudi Arabia (9-11), Palestine (12), Sudan (13), Libya (14) and Iran (15).