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RESEARCH ARTICLE

Dietary intake and health risk assessment of nitrate, nitrite, and nitrosamines: a Bayesian analysis and Monte Carlo simulation

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Abstract

Nitrate, nitrite, and nitrosamines intake from the diet creates human health risks. In this study, nitrate/nitrite intake from diet and its association with nitric oxide (NO) level in humans have been surveyed. Besides nitrate/nitrite, nitrosamines risks were also determined from the diet. This study was conducted as a pilot study; 33 heathy adults participated in and completed the Food Frequency Questionnaire (FFQ) for 3 days. Then, concentrations of nitrate, nitrite, and nitrosamines were studied by the literature review. Also, the association between the intake of nitrate and nitrite with salivary and urinary NO was evaluated by Bayesian bivariate analysis. Then, the health risk was assessed for nitrate/nitrite from food groups and drinking water, and nitrosamines from food groups based on hazard index (HI) and cancer risk with the Monte Carlo simulation. The nitrate/nitrite intakes had no association with NO level in the saliva and urine samples. The mean of HI value for the mean of 3 days was 3.57 and 0.32 from food groups and drinking water, respectively. The cancer risk amount of nitrosamines from food groups was (1.74 to 2.22) × 10^{-3} based on 95% confidence interval (CI 95%) values. This study showed the Iranian diet had a high risk, but drinking water consumption was safe based on nitrate/nitrite and nitrosamines for humans. There is a need to determine the concentration of nitrosamines in drinking water in Iran and to recommend for decrease risk of nitrate, nitrite, and nitrosamines exposure by food groups.

Keywords Nitrate/nitrite · Nitrosamines · Nitric oxide · Health risk assessment · Food groups · Drinking water

Introduction

In recent years, one of the most important environmental problems is nitrate contamination. Nitrate and its metabolites are the parts of the nitrogen cycle and they can pollute human food and drinking water via anthropogenic origins such as application and leaching of nitrogen fertilizers, combustion of fossil fuels, and food additives (Mortada and Shokeir 2018; Sindelar and Milkowski 2012; Ward et al. 2018). The primary sources of exposure to nitrate are diet, including fruits and vegetables, especially leafy greens such as lettuce and spinach, and drinking water. It is also added into processed meats as a food additive, antimicrobial agent, flavor enhancer, and colorant in the form of sodium or potassium salts of nitrate

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