

Abstract

Coffee is one of the most popular beverages in the world with an average annual consumption of 500 billion cups per year or 9.4 million tons per year. Coffee is generally roasted at temperatures in the range of 220-250 °C. Roasting is responsible for the Maillard reaction and subsequently the specific color, aroma, and flavor of coffee brew. In addition, it is responsible for the formation of acrylamide from its precursors in coffee beans. Acrylamide has been classified by the International Agency for Research on Cancer as a possible human carcinogen and exposure to its high levels for the long term has detrimental effects to the human health. This research consisted of 2 parts. In the first part, the comparison of ion mobility spectrometer (IMS) and high performance liquid chromatography (HPLC-PDA) was investigated in order to determine the amount of acrylamide in coffee. Then, in the second part, we studied the risk assessment of exposure to acrylamide through the consumption of espresso coffee. HPLC-PDA method validation resulted in the acceptable limit of detection (9.19 µg/liter), limit of quantification (30.62 µg/liter) and accuracy (recovery percentage equal to 92±1.5). Regarding IMS, the detection and quantification limit were determined as 0.39 and 1.29 µg/liter, respectively. The content of acrylamide determined by HPLC-PDA in 3 Arabica coffee powder samples from low, medium and high roasting degree was calculated as 248.8, 378.3 and 467.5 µg/kg. While the content of acrylamide determined by IMS was calculated as 219.7, 347.3 and 557.6 µg/kg from low, medium and high roasting degree, respectively. There was a significant difference between the obtained values. In the second part, due to the effect of acrylamide on the health of the consumer, the risk assessment study of receiving this compound through the consumption of espresso coffee was studied. For this purpose, 35 espresso samples were gathered from coffee shops in the city of Mashhad and home-made espressos. The amount of acrylamide in all samples was reported as an average of 4.06±2.11 µg/100 ml. The average daily intake of acrylamide in a total of 35 espresso samples by teenagers and adults was 0.004 and 0.007 respectively (µg/kg of bw/day). The margin of exposure (MOE) was greater than 10,000 in all samples and for both age groups. Therefore, the risk of adverse health effects such as carcinogenesis due to espresso consumption in the studied population is probably insignificant. The increased risk of cancer in teenagers and adults was 2.44×10^{-6} and 2.2×10^{-6} , respectively, which is lower than the dose announced by the US Environmental Protection Agency. The non-carcinogenic risk of receiving acrylamide by teenagers was

0.0019 and in adults 0.0026, which is less than 1 according to the specified dose, and as a result, the non-carcinogenic risk will be insignificant.

Keywords: Acrylamide, Roasting, Espresso, Ion mobility spectroscopy, High performance liquid chromatography, Risk assessment, Carcinogenic