

Abstract

Makueni County, located in south-eastern Kenya, faces challenges such as limited potable water and restricted food supplies as the result of semi-aridity. High fluoride (F) concentrations have been reported in drinking water with resultant dental fluorosis affecting the local population. To determine the potential F exposure through the consumption of food crops grown in the area, F concentration was assessed in the main five locally grown and consumed crops. Additionally, the water-soluble F fraction was determined from 30 soil samples with mineralogical determination of 20 samples. Mean F concentration in the food crops was in the order; 700, 288, 71.2, 36.6, and 29 mg/kg in kale, cowpeas leaves, green grams, cowpeas (legume portion), and maize, respectively. The F concentration in farm soils ranged from 0 to 3.47 mg/kg (mean of 0.87 mg/kg) and showed a significant strong positive correlation ($p=0.03$, $r=0.89$) with F values in the crops. Apatite, muscovite, and biotite were identified as the F-rich minerals present. While considering two hypothetical F absorption fractions (75 and 100%), the estimated average daily dose (EADD) of F from consuming the crops ranged between 0.004 and 65.17 mg/kg/day where the highest values were from the vegetables. Most of these values were higher than the F reference dose (RfD) of 0.06 mg/kg. The estimated EADD values of several hypothetical meals prepared from the analyzed crops revealed that steamed kale and maize porridge pose the highest health risk of F associated diseases to the local population, whereas boiled cowpeas pose no health risk. Children, due to their higher daily energy requirement and low body weight, were the most vulnerable group at risk of high daily F intake relative to the RfD. These results suggest that consumption of the analyzed food crops in Makueni County may significantly contribute to F related diseases in the local population. This creates a food security issue for the area because of the potential health risks associated with these crops which are highly relied upon in the semi-arid area with a limited selection of food crops available and viable to grow.