Abstract

The goal of this study was to determine how different types of tea waste (green, black, and white) interact with aluminum ions, Al^{3+} (aq), to remove this toxic heavy metal from solution as efficiently as possible. The Molecular Operating Environment computer program was used to predict the electrostatic interaction energies and bond lengths between aluminum ions and tea waste components. The amount of aluminum removed from a pH 5 buffer solution after interacting with various types of tea waste was determined using a UV-Visible absorption spectrophotometer. Acquired absorption spectra were used to assess aluminum concentration in four situations for each tea (regular, fine, regular ultrasonicated, fine ultrasonicated). Each condition had five vials with increasing concentrations of Al^{3+} (aq). After 90 minutes of reaction between tea waste and aluminum ions, the absorption spectra of the five runs (four conditions and one control) were collected for each tea sample. Ultrasonication of samples generated increased interactions between Al^{3+} (aq) ions and tea waste that resulted in increased adsorption capacity (from 1.59 mg/g for fine green tea to 2.40 mg/g for the same tea ultrasonicated) and removal efficiency (from 36.8% for fine green tea to 55.7% for the same tea ultrasonicated). Thus, higher agitation of tea waste solutions containing aluminum may aid in more efficiently filtering aluminum out of drinking water. However, there was no discernible differences in removal efficiency between regular and fine tea waste samples. FTIR spectra of black, green, and white tea waste leaves were recorded using an ATR-FTIR spectrometer before and after aluminum adsorption. The intensities of the FTIR spectra diminished in the presence of aluminum ions due to their interactions with tea waste, but there was no significant spectral shift in the FTIR peak positions of the tea waste after aluminum addition, suggesting that the adsorption process was a physical change.