
Abstract
Foods are fortified with elemental forms of iron to reduce iron deficiency. However, the nutritional efficacy of current, commercially produced elemental iron powders has not been verified. We determined the bioavailability of six commercial elemental iron powders and examined how physicochemistry influences bioavailability. Relative biological value (RBV) of the iron powders was determined using a hemoglobin repletion/slope ratio method, treating iron-deficient rats with repletion diets fortified with graded quantities of iron powders, bakerygrade ferrous sulfate or no added iron. Iron powders were assessed physicochemically by measuring iron solubility in hydrochloric acid at pH 1.0 and 1.7, surface area by nitrogen gas adsorption and surface microstructure by electron microscopy. Bioavailability from the iron powders, based on absolute iron intake, was significantly less than from FeSO4 (100%; \( P < 0.05 \)) with the following rank order: Carbonyl (64%; Ferronyl, U.S.) > Electrolytic (54%; A-131, U.S.) > Electrolytic (46%; Electrolytic Iron, India) > H-Reduced (42%; AC-325, U.S.) > Reduced (24%; ATOMET 95SP, Canada) > CO-Reduced (21%; RSI-325, Sweden). Solubility testing of the iron powders resulted in different relative rankings and better RBV predictability with increasing time at pH 1.7 (\( R^2 = 0.65 \) at 150 min). The prediction was improved with less time and lower pH (\( R^2 = 0.82 \), pH 1.0 at 30 min). Surface area, ranging from 90 to 370 m\(^2\)/kg, was also highly predictive of RBV (\( R^2 = 0.80 \)). Bioavailability of iron powders is less than bakery-grade ferrous sulfate and varies up to three times among different commercial forms. Solubility at pH 1.0 and surface area were predictive of iron bioavailability in rats.