

Supplementary Information

Radiofrequency heating

A power-adjustable RF Generator System (ThermMed, LLC, Erie, PA) operating at 13.56 MHz was used to heat aqueous solutions. A high-voltage RF field was generated in the 8 cm air gap between the transmitting and receiving heads of the generator. Samples were loaded into a 1.3 mL quartz cuvette placed atop a non-conducting Teflon holder at ambient temperature and open to air. The cuvette was placed 8 mm from the transmitting head of the RF field generator and exposed to the high-voltage RF field at 100 W generator power. Sample temperatures were recorded using an infrared camera (FLIR SC 6000, FLIR Systems, Inc., Boston, MA) with a time-resolution of 0.17 s. Samples were heated from 23 °C to 27 °C or for a duration of 60 seconds, whichever occurred first. Over this selected small temperature range, the variation of the temperature-dependence of dielectric properties was negligible.^{1,2} Heating rates were calculated by fitting a linear regression to the temperature-versus-time plot of each sample for the duration of RF exposure. Measurements were performed in triplicate with each measurement conducted with fresh sample material.

Dielectric Characterization

The complex relative permittivity (ϵ_r' and ϵ_r'') of all samples was measured over the frequency range 10 MHz-3 GHz. From these measurements, the frequency-dependent conductivity was obtained using the relationship $\sigma = \omega\epsilon_0\epsilon_r''$. Given the RF operating frequency of 13.56 MHz, only the conductivity values for this frequency were used throughout this study. High conductivity led to electrode polarization in all samples, but this phenomenon primarily affects ϵ_r' and polarization corrections were not necessary for determining sample conductivity.

Complex permittivity measurements were taken using an Agilent 85070E high-temperature coaxial dielectric probe (Agilent Technologies, Santa Clara, CA) connected to an Agilent E4991A impedance analyzer to extend the frequency range of the probe down to 10 MHz. Four-point calibration (open, short, 50 ohm load, low-loss capacitor) of the impedance analyzer was performed prior to each measurement session. Three-point probe calibration of the probe (air, short, water) was performed periodically between samples and a single-point calibration (air) was performed between every sample to eliminate signal drift. For measurements, 600 μ L of sample was loaded onto the probe and approximately 150 logarithmic data points were acquired across the frequency range 10 MHz-3 GHz. Measurements were performed in triplicate with each measurement conducted with fresh sample material under different calibrations.

1 A. Stogryn, *IEEE Trans. Microw. Theory Techn.*, 1971, **19**, 733–736.

2 U. Kaatze, *J. Chem. Eng. Data*, 1989, **34**, 371–374.

3 H. M. Gach and T. Nair, *Bioelectromagnetics*, 2010, **31**, 582–588.