

Microwave Dielectric Properties of Brown Adipose Tissue (BAT)

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Brown adipose tissue (BAT) is prevalent in mammals that lack the capability to produce enough heat to stay warm due to their surroundings, i.e. shivering. This form of thermogenesis is found in new born children, and while it was believed to change into a type of white adipose tissue by adulthood, BAT has been discovered along the neck and torso in adults. While occurrence of BAT in adults is limited, its presence is becoming better known. Unlike white adipose tissue, BAT contains a significant amount of mitochondria, which leads to the browning in color. The mitochondria assist in converting high amounts of glucose and lipids into the necessary heat for the individual to stay warm. Not only does this conversion provide heat, it also provides assistance in increasing metabolic output. Several recent studies proposed the possibility of manipulating BAT to reverse the obesity in adults. One big challenge in developing drugs to stimulate BAT is that there is no technology available to continuously monitor its activity. To overcome this challenge, in collaboration with our colleagues from Duke Medical School, we are currently designing a small radiometer to continuously monitor temperatures at the BAT site in the body. Because the radiometer operates at microwave frequencies, the design requires the knowledge of BAT microwave electrical properties. Thus, in this study, we performed microwave dielectric property measurements of BAT samples extracted from rats between 500 MHz and 20 GHz. We used Agilent 85070 E dielectric slim form probe, a fiber optic temperature probe, and a water bath. The tissues dielectric properties are measured at a temperature range from 25 °C to 45 °C. Based on these measurements, we have developed first- and second-order cole-cole models. We will present dielectric constant, electrical conductivity and cole-cole model data over the frequency range of interest.