BIO-PP12: Effect of Temperature on Electrical Impedance of Biological Tissues

Safia Aktar Dipa[1*], Muralee Monohara Pramanik[1], Mamun Rabbani[1] and Muhammad Abdul Kadir[1]

[1]Department of Biomedical Physics & Technology, University of Dhaka, Dhaka 1000, Bangladesh
*Email: diparahman996@gmail.com

Introduction: Bioelectrical impedance techniques have been useful in a variety of medical applications including body composition analysis, impedance plethysmography, impedance cardiography, lung ventilation, perfusion, and tissue characterization. Bioimpedance techniques have also been useful in the characterization different foods including meat, fruits, and beverages. However, the temperature of the tissue sample may change the dielectric properties like conductivity and relative permittivity, and hence can change the impedance of biological tissues. In this research, the effects of temperature on different biological tissues were investigated over a wide frequency range.

Methods: Electrical impedivity and transfer impedance of biological tissues were measured over the frequency range 1Hz to 10MHz using an impedance spectrometer (Sciospec ISX-5, Germany). Freshly excised animal tissues (lamb, cow, chicken), fish, fruits, vegetables were considered as biological tissues. A test cell containing the tissue sample was submerged on a water bath heated by a hot plate with magnetic stirrer for varying the sample temperature. Impedance measurements were performed in steps of 2^0 in the temperature range 20^0 to 50^0.

Results and Observations: It was observed that the impedivity and transfer impedance values decreased with increased temperature at all frequencies (figure 1, left). At a particular frequency, the impedance values were found to be decreased exponentially with temperature (figure 1, right). However, the newly defined temperature coefficient (B_T) varied with tissue type as well as with measurement frequency. The values of B_T were found to be in the range 0.001 K^{-1} (per kelvin) to 0.064 K^{-1} for all tissue samples over the frequency range under investigation. **Conclusion:** The findings of this research would be useful in tissue characterization studies and in medical applications where tissue temperature is variable.

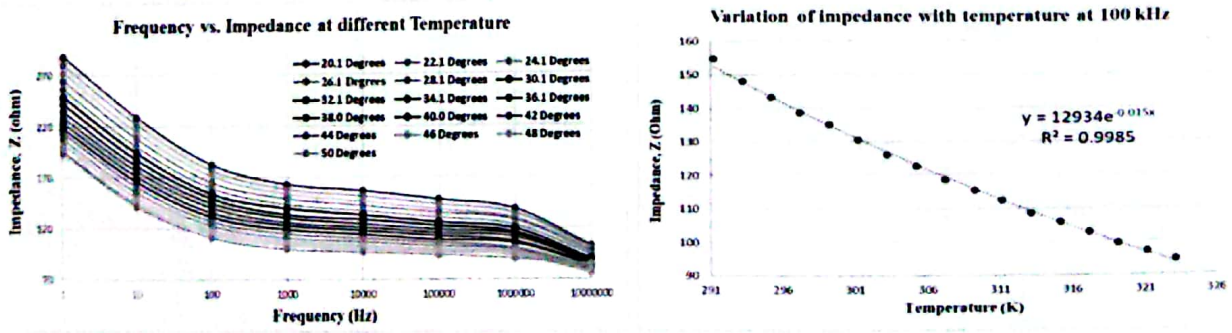

Figure 1 Variation of impedance with frequency at different temperature (left) and variation of impedance with temperature at 100kHz for grapefruits.