Investigation of dielectric permittivity preservation after freezing and thawing the bovine brain, porcine brain and bovine liver

Anđela Matković[1], Anton Kordić[2], Antonio Šarolić[1]

[1]Chair of Applied Electromagnetics, University of Split, FESB, Split, Croatia, andjela.matkovic@fesb.hr

[2]Department of Neurosurgery, University Hospital Centre Zagreb, Zagreb, Croatia

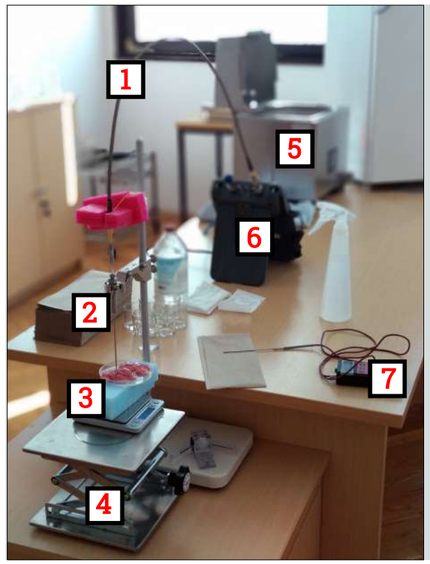
UNIVERSITY OF SPLIT
FACULTY OF ELECTRICAL ENGINEERING, MECHANICAL ENGINEERING AND NAVAL ARCHITECTURE

Introduction

- In our previous work (in BioEM 2021 [1]), we emphasized the need to find a proper way to preserve the tissue over an extended period.
- Freezing the tissue below zero preserves it during longer periods, but **does it affect the dielectric permittivity**?

Materials and Methods

- We measured ε' and ε'' of ex-vivo biological tissues at 25°C when they were fresh and then after they were frozen in the freezer below -18°C and thawed back to the room temperature in the water bath at 25°C.
- The brains were bisected to hemispheres and then dissected into coronal slices ca. 1.5 cm thick. The liver lobe was dissected into rectangular volumes of ca. 3 x 3 x 2 cm^3.
- Slim Form open-ended coaxial probe N1501A, FieldFox N9927A VNA (Keysight Technologies), 500 MHz to 18 GHz
- Probe either firmly pressed (brain tissue) or inserted (liver tissue) into the sample.
- Several measurements were performed on each sample at different points with the results averaged across one sample, and subsequently across all samples of the same tissue type.

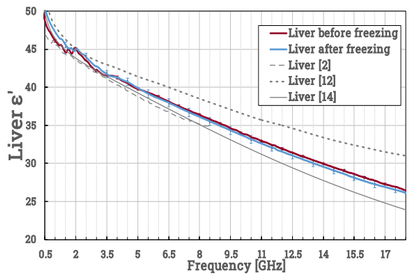


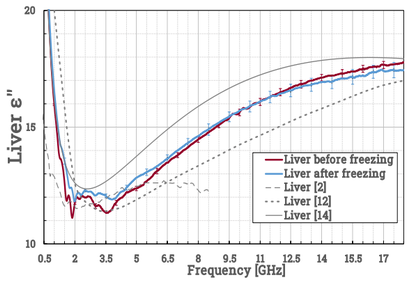
Measurement setup

1. Phase stable coaxial cable
2. Slim Form probe fixed to the vertical stand
3. Sample in a dish on top of a polystyrene block on a precise digital scale
4. Height-adjustable table
5. Water bath
6. FieldFox N9927A VNA
7. Digital thermometer

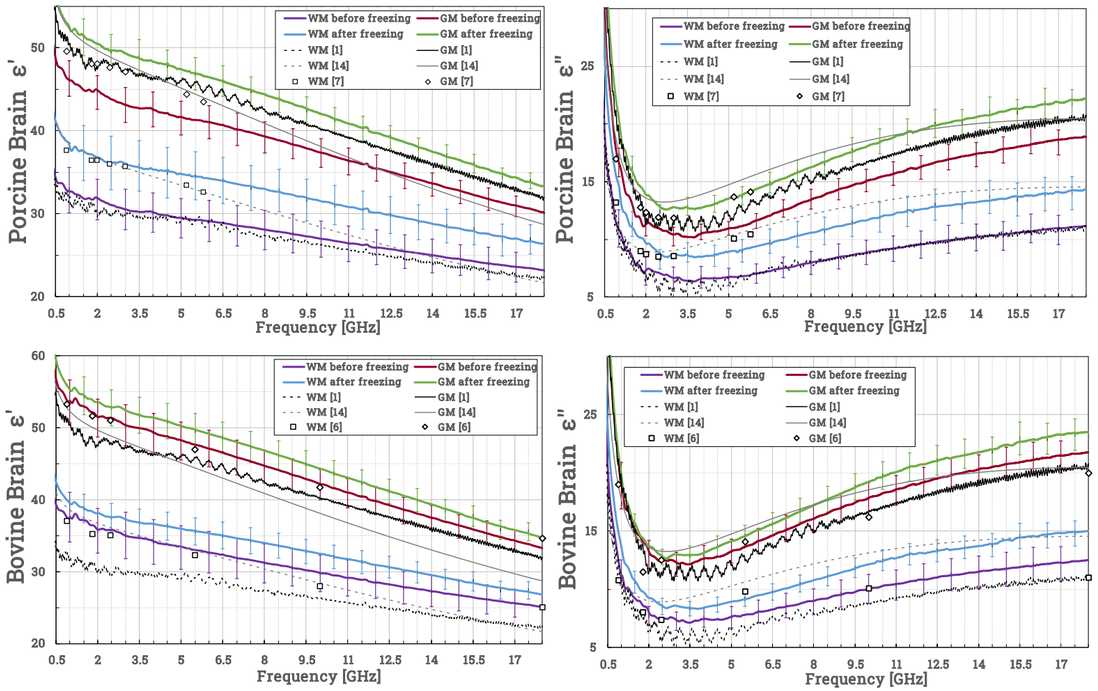
Results

- Colored lines show averaged results with bars denoting ± SD, black and grey lines present existing literature data.





- GM = grey matter, WM = white matter



Conclusions

Results suggest that the described freezing and thawing protocol is not a proper way to preserve dielectric permittivity of brain white and grey matter.

The liver permittivity is practically entirely preserved after freezing and thawing using the described protocol.

Acknowledgments

This study was performed within the research project "Measurements in Bioelectromagnetics (M-BEM)" by FESB, University of Split, and within the framework of COST Action MyWAVE CA17115.

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