Abstract

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Title of thesis: Characterization of material for gelatin-based ultrasound brain phantom

This thesis deals with the characterization of the material for a gelatin-based ultrasound phantom, which will subsequently serve as a teaching aid for medical students to localize brain tumors and practice ultrasound imaging.

In the experimental part, samples of gelatin gels cross-linked with glutaraldehyde at different concentrations of scattering particles and glycerol were prepared to measure the acoustic parameters (speed of sound and attenuation coefficient) and the gray scale of the imaging and to perform thermal analysis.

Gelatin is an inexpensive, readily available, non-toxic material that is highly soluble in hot water, making it a suitable starting material for phantom preparation. SiC and Al_2O_3 particles (0,3 μm and 3 μm) can be used to increase the echogenicity of the gelatin-based gel. Thanks to the scattering particles, it was possible to vary the gray level of the image and the attenuation coefficient depending on their amount. The best results were achieved with SiC alone, where the gray level of the image increased with increasing particle amount (0,05–1,06 % w/w) and the attenuation coefficient reached values of 0,04–0,28 $dB \cdot cm^{-1}$ (2 MHz). At the same time, it was found that the amount of scattering particles has no significant effect on the speed of sound through the gel, on the contrary, the amount of glycerol (0–51 % w/w) contained in the gelatin gel significantly affects the speed (1 495–1 797 $m \cdot s^{-1}$) and during heating, the influence of glycerol is essential to increase the stability of the gel (increase in melting temperature).

Keywords: gelatin, phantom, acoustic parameters, thermal analysis