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THE EFFECT OF γ-RADIATION ON DYNAMIC MECHANICAL PROPERTIES OF ANIMAL BONE

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Dynamic Mechanical Analysis (DMA) is the method accepted in studies on mechanical properties of bone but there is not many data on dynamic mechanical properties of irradiated bone. The principles of DMA are based on the fact that the sinusoidal oscillations of stress generate the response of bone – the sinusoidal oscillation in strain. The purpose of this study was to determine the temperature dependence of storage modulus (E'), loss modulus (E") and length change (delta) of irradiated bone.

Femoral bones from adult bovine (2–3 years old animals) were machine-cut from the central part of the diaphyses using a diamond saw. Specimens of 20 × 5 × 2 mm were dried and irradiated with the dose of 10 and 100 kGy. The irradiation was performed at room temperature using a Co60 source and the dose rate was 1.5 kGy/h. DMA testing was performed on dynamic mechanical analyser DMA 242, Netzsch using a three point bending configuration with dynamic load of 7 N, in the frequency range of 1–20 Hz, and in the temperature range of 30–200°C.

For all doses the E' and E" were both, temperature and frequency dependent. The frequency increase always led to increased E' values. The E' decrease was observed first, in the temperature range of 333–343K, than reaching the plateau and increasing again above the temperature of 423K. Increased dose of ionizing radiation decreased E' values. For the dose of 0 kGy and 10 kGy, the minima of E' values appear in the temperature range of 333–343K. For 100 kGy, minima of E' were observed in the temperature range of 393–403K. However, similarly to E', also E" values were temperature and frequency dependent, the frequency increase led to the decrease in E" values. The maxima of E" were observed at the temperature of 373K for all doses. Moreover the effect of irradiation was noticed in the sample length. The increasing dose always led to decreased length changes of the sample. Increasing temperature always led to decreased sample length.