Prion diseases are fatal neurodegenerative diseases that affect mammals, including humans, which are characterized by accumulation of pathological prion protein isoform (PrP\textsuperscript{TSE}) in the brain. The animals were commonly used for the prion disease research in the past but in recent years, the tissue cultures are being used as well. Tissue cultures have many advantages compared with animals. E.g. the possibility of a detailed study of the biochemical processes associated with prion diseases, and rapid and sensitive PrP\textsuperscript{TSE} detecting method. However no reliable \textit{in vitro} model was developed for human prion diseases so far.

We focused on monitoring of transmission and propagation efficiency of different prion strains and on the influence of cultivation conditions on the transfer of the neuronal cell line CAD5, which is highly sensitive to prion infection. We confirmed the sensitivity of CAD5 cells to mouse-adapted scrapie prion strains and we presented new facts about their ability to propagate mouse adapted prions of human strains and bovine spongiform encephalopathy. We have used CAD5 cell sensitivity to be infected with different prion strains in other parts of this work. In the second part, we focused on the cell sensitivity to prion infection and propagation of prion strains under different culture conditions. Relation of cultivation conditions and prion infection is one of the main factors that differentiate processes associated with the transmission of prions \textit{in vitro} and \textit{in vivo}. In this section we used cells which were set into the stationary growth phase by cultivation in medium containing less serum as a potential \textit{in vivo} conditions simulation. The results showed that the cell culture prepared this way is sensitive to prion infection, but in comparison with the culture in the exponential growth phase leads to lower propagation of PrP\textsuperscript{TSE} in the chosen culture conditions. In the last part, we made pilot experiments aimed at studying the relationship of the prion strain used for infection of cells and the mechanism of transmission of prion infection among the cells in the culture.

The results obtained yielded new findings about the applicability of the CAD5 cell lines for a research of a wide range of prion strains and aspects of prion diseases that are associated with these strains. Furthermore, the results showed a limited possibility of prion infection transmission and subsequent PrP\textsuperscript{TSE} propagation in cells infected in the stationary growth phase.

**Key words:** prion diseases, cell prion protein, pathological isoform of prion protein, prion strain, cell cultures, CAD5 cell line