Contribution ID: **500** Type: **Poster**

Influence of gamma radiation dose rate and some other parameters on the radiation protection of microbial cells by OH radical scavenging

Tuesday, 15 May 2018 17:45 (15 minutes)

The effects of dose, dose rate, hypothermia (1 hour at 0 ℃ before and after irradiation) and simultaneous action of two different scavengers on the radiation protection of microorganisms due to the scavenging of OH radicals were investigated. The quantitative evaluation of this protection was carried out by means of the slope k = dσ / dQ where σ = ln S0 / ln S, Q is the scavenging efficiency of the scavenger and S0 and S are the surviving fractions of cells after irradiation without and with scavenger, respectively.
Methanol and ethanol were used as scavengers. The radiation sensitivity of both prokaryotic (bacteria Escherichia coli) and eukaryotic (yeast Saccharomyces cerevisiae) cells was studied. Irradiation was carried out by gamma radiation of radionuclide 60Co in Gammacell 220. The values of dose rates ranged from 18.7 to 41.7 Gy h-1.
The σ-values were found to be higher than 1 and they increase linearly with the scavenging efficiency Q for both microorganisms in intervals from 0 to 1.86 x 109 s-1 for methanol and from 0 to 4 x 109 s-1 for ethanol. These results lead to the conclusion that both scavengers (methanol and ethanol) protect living cells against ionizing radiation. The scavenging of radicals is probably one of the main mechanisms of protection against irradiation. The specific protection k of both yeast and bacteria does not depend on the dose of gamma radiation and linearly increases with dose rates in above mentioned interval for both alcohols. Both protections σ and k are higher for bacteria than for the yeast. It may be related to the dissipation of DNA molecules in cytoplasm of bacteria. No effect was found when the microbial culture undergoes the hypothermia before and after irradiation. No synergic effect was determined when both scavengers were used simultaneously.
This research has been supported by the Grant Agency of the Czech Technical University in Prague (grant number SGS17/195/OHK4/3T/14).

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Session Classification: Poster RCH

Track Classification: Radiation Chemistry