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Gamma-Irradiation for Cultural Heritage – Treatment of Selected Fungi on Linen Textile

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Background of the study. A common carrier for paintings is glue-coated linen that is vulnerable to fungal biodeterioration. The study aimed to assess antifungal effect of gamma-irradiation doses and dose rates against naturally occurring mycobiota and artificially inoculated fungal colonizers common for cellulose materials like linen. The composition of natural mycobiota on glue-coated linen (initial level) and eventual post-irradiation recovery of mycobiota were analyzed.

Methodology. The initial level of common fungal colony-forming mycobiota on model glue-coated linen textile was determined by plate count method upon 7 days of incubation (at 25℃ and 70-80% r.h.) and the data expressed as the number of colony-forming units per gram (CFU/g). Next, linen samples were separately inoculated with selected primary (*Aspergillus jensenii*), secondary (*Cladosporium spaherospermum*) and tertiary colonizers (*Trichoderma harzianum*) at concentration of 10000 CFU/g. Inoculated linen and controls were incubated as described. One group of samples was analysed immediately upon the incubation while the rest of the samples were irradiated at 60-Co gamma source at RCDL to doses of 2, 7, 20 and 50 kGy, at dose rates of 0.1 and 9.8 Gy/s and analysed after incubation for 0, 7, 14 and 28 days.

Results. *Alternaria* spp., *Aspergillus* spp., *Cladosporium* spp. *Fusarium* spp., *Penicillium* spp. and yeasts comprised naturally occurring mycobiota, in initial concentrations of 1000 CFU/g (moulds) and 10000 CFU/g (yeasts). These fungi were non-homogeneously dispersed on glue-coated linen. On incubation in humid atmosphere the concentration of mycobiota increased for four orders of magnitude. Similar increase was obtained for non-irradaited artificially inoculated samples.
All applied doses and dose rates were effective against primary and tertiary colonizers but not for secondary colonizers and linen mycobiota. Doses of 2 and 7 kGy was ineffective in reduction of linen mycobiota to the initial level; after 28 days of incubation fungi were recovered up to 1000000 and 100000 CFU/g, respectivelly. Dose of 20 kGy (0.1 Gy/s) reduced *Cladosporium* spp., and *Alternaria* spp. to 10000 CFU/g; *Penicillium* spp. was reduced to the initial level while yeasts, *Aspergillus* spp., and *Fusarium* spp. recovered in concentrations below initial. For both 7 and 20 kGy dose rate of 9.8 Gy/s was more effective in fungal elimination than 0.1. Gy/s, while for 2 kGy the dose rate effect was inconsistent. Upon exposure to 50 kGy sterile white mycelia was recovered on few plates *C. sphaerospermum* survived radiation with 2, 7 and 20 kGy, showing the similar recovery pattern as obtained for *Cladosporium* spp. After treatment with 7 and 20 kGy (0.1 Gy/s) cladosporia recovered between 7th (or 14th) and 28th day in concentrations between 1000 and 1000000 CFU/g. The same doses applied at 9.8 Gy/s inhibited recovery of *C. sphaerospermum*.

Conclusion. For successful gamma-radiation reduction of fungal contamination on cultural heritage it is essential to determine mycobiota composition and to irradiate at an appropriate dose rate.

Country/Organization invited to participate

Croatia

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