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Studying the Surface Radiation and Biopolymer Degradation of Soil under Normal and UV-Illuminated Conditions

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GOAL OF THE STUDY

The aim of this research is to study the relation between the presence of biodegradable polymer films based on gelatin with added glycerol, under normal conditions and under the influence of UV radiation, on the surface radioactivity of five soils with different structure, acidity and physical parameters (Soil 1 -forest coniferous, Soil 2- forest deciduous, Soil 3- cinnamon, Soil -4 black soil "smolnik and Soil 5 -light sandy soil- Figure 1). Although some studies have investigated the behavior of radionuclides in different soil types and their uptake by plants, there is limited knowledge regarding the interaction between biodegradable polymer films and soil radioactivity and the potential of gelatin-based biodegradable polymers, to influence the mobility, adsorption, or surface distribution of radionuclides in soils of different compositions. This study aims to fill this gap by analyzing how the presence and degradation of gelatin-based films may affect the surface radioactivity levels of soils with diverse physicochemical characteristics.

METHODOLOGY OF THE INVESTIGATION

Soil samples from the five soil types are distributed in shallow containers. Surface radioactivity is measured in Bq eq.cm-1, with the measuring device RADIAGEM dosimetric control device and a probe type SABG-15+ used to measure surface radiation contamination from alpha, beta and gamma emitters.

1.1. 1.2. 1.3. 1.4. 1.5.

Fig. 1. Optical microscopy for soil's sample's surface morphology at approximately 16× magnification of Soil 1 -coniferous forest soil (1.1) and Soil 2-deciduous forest soil (1.2), Soil 3-cinnamon soil (1.3), Soil 4-black soil (smolnik) (1.4), Soil 5- light sand soil (1.5)

- **Table 1.** Mean values (MV) of surface radiation of the five soil types at ambient conditions and under UV light

MV Bq eq.cm^{-1}	Soil 1	Soil 2	Soil 3	Soil 4	Soil 5
Control soil samples (no polymer)	0.6783	0.6817	0.6467	0.6900	0.5917
Ambient	0.6617	0.6750	0.6400	0.6867	0.5867
UV	0.6600	0.6583	0.6283	0.6800	0.5850
Control soil samples (no polymer)	0.6783	0.6817	0.6467	0.6900	0.5917

RESULTS

The mean values (MV) of soils with no biopolimer and with biopolymer included, are summarized in Table 1. It can be seen that the average values of surface radioactivity for the measured soil samples range from 0.5850 to 0.6900 Bq eq.cm^{-1}, while for the soil samples irradiated with UV light, these values are slightly lower. It is noted that the trend is in decreasing of the values and the decrease is more clearly expressed in the soil samples irradiated with UV and with biopolymer inserted.

CONCLUSIONS

For clay soils (Soil type 4 – black soil and forest Soils type 1 and type 2), were reported higher values of surface radioactivity than light sandy soil (Soil 5). The probable reason for this is that they are richer in radioactive elements than sandy soils, which may be due to their better absorption properties due to their composition. The higher humus content, could sorb radionuclides to a greater extent (Soil type 4).

The reported values of surface radioactivity in soil samples with embedded biopolymer decreased to a greater extent than in soil samples without polymer, in parallel with the decay of the biopolymer in them. This decrease is stronger in soils exposed to UV radiation, where polymer degradation is more pronounced. This indicates a possible relationship between the content of biopolymer particles in soil samples and the decrease in their surface radioactivity, which may be due to the absorption properties of the biopolymer.

The average values of surface radioactivity reported are in the range of 0.58 to 0.69 Bqeq.cm^{-1}. This describes the reported surface contamination as acceptable, as it is close to the values of 0.4 Bq cm^{-1} for alpha emitters and much lower than 4 Bq cm^{-1} for beta emitters, which are considered safe limits.

The findings suggest that gelatin-based biodegradable polymers may have potential as temporary radionuclide absorbers or stabilizers in agricultural soils. This property could be harnessed in the design of biodegradable agricultural films or packaging materials that not only minimize plastic waste but also contribute to soil radioprotection.