THE EFFECT OF GAMMA IRRADIATION ON PROPERTIES OF SOIL HUMIC ACIDS

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Plan of the presentation

- Introduction and purpose of the work
- Material and methods
- Results and discussion
- Conclusions
- References

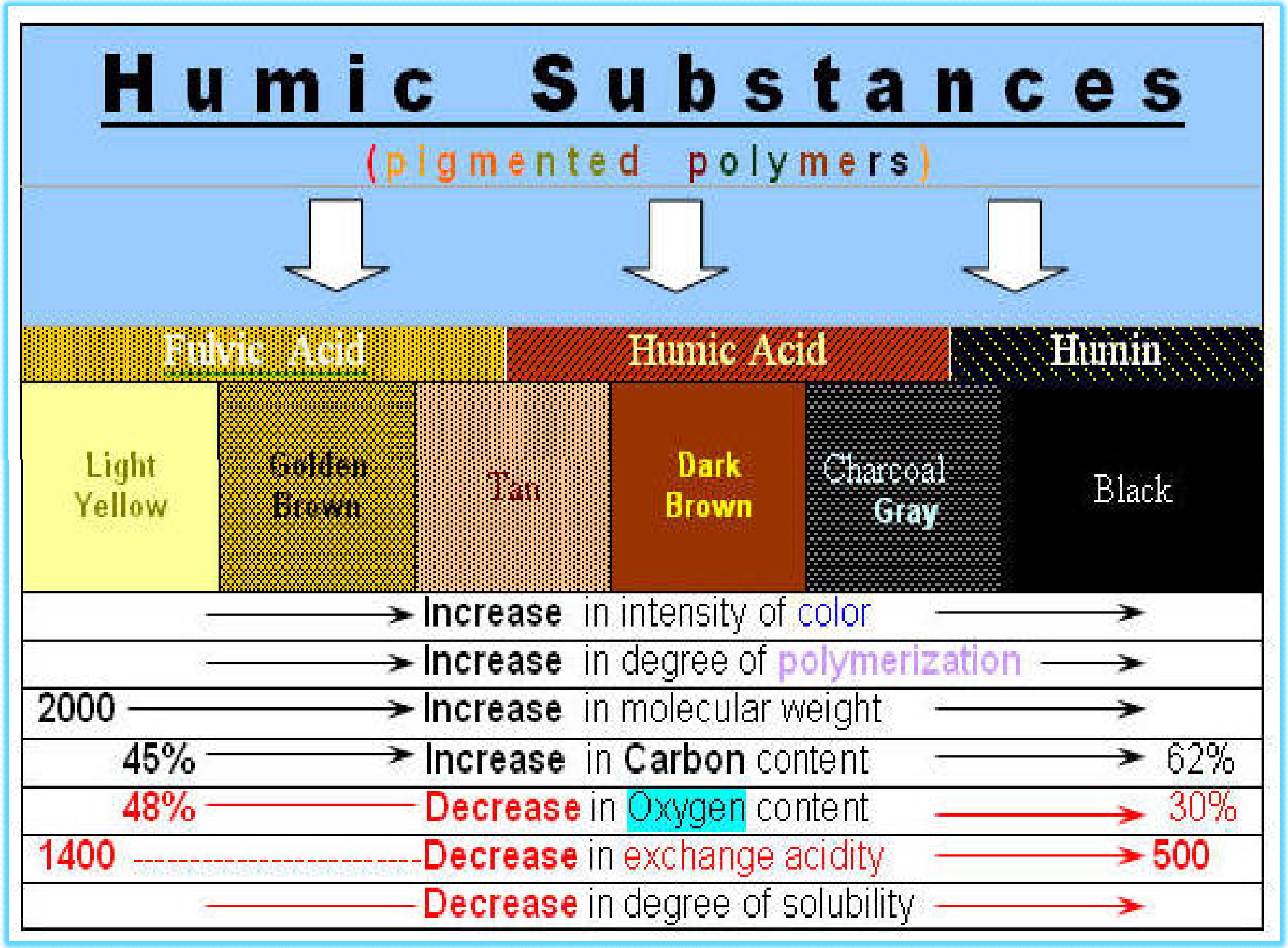

Fig.1. Selected properties of the humic substances.

Humic acids (HAs)

Mean residence time of HAs in soil is evaluate on about **1000 years**.

Gamma radiation

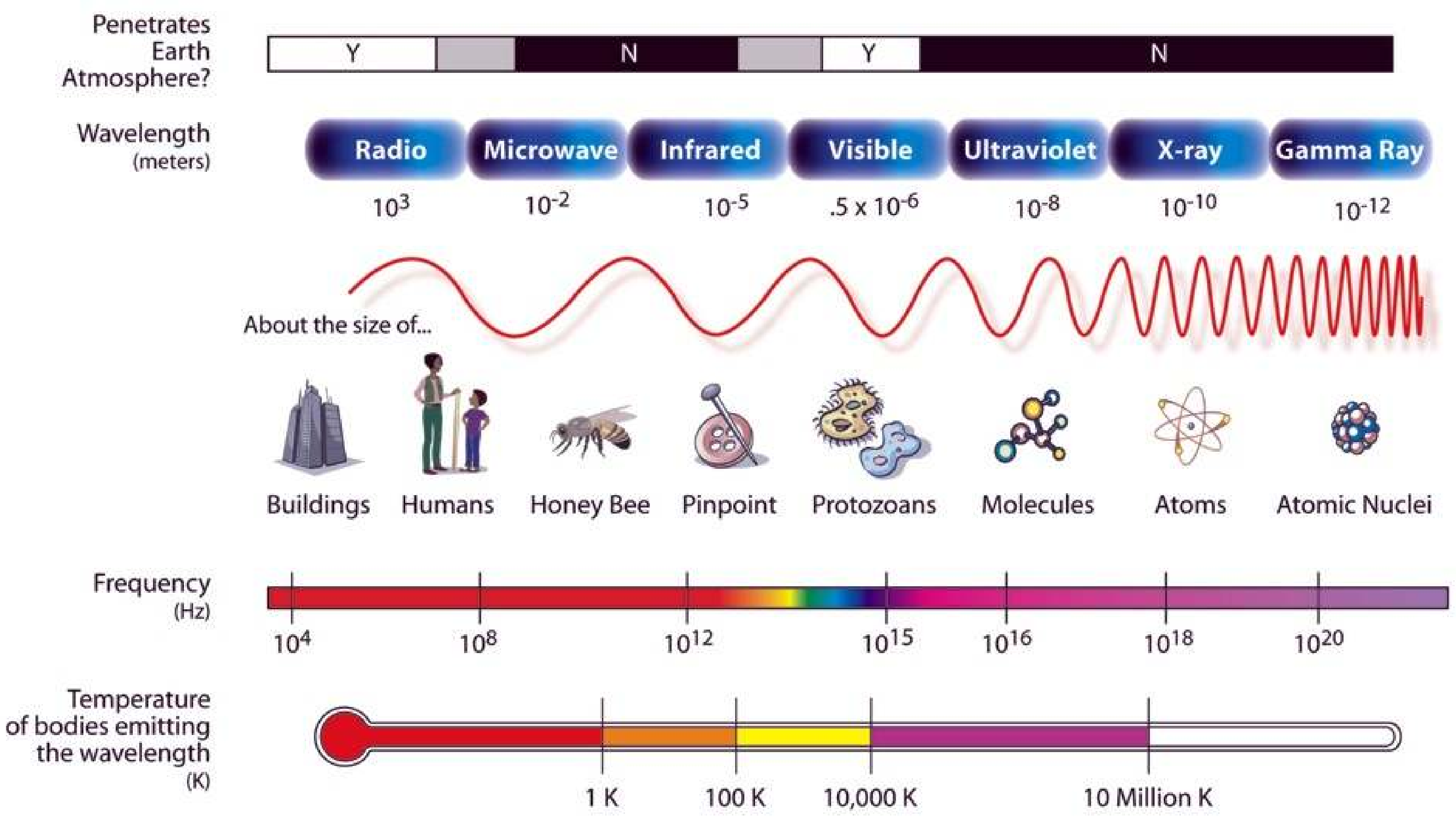

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Fig.2. The electromagnetic spectrum.

Gamma radiation

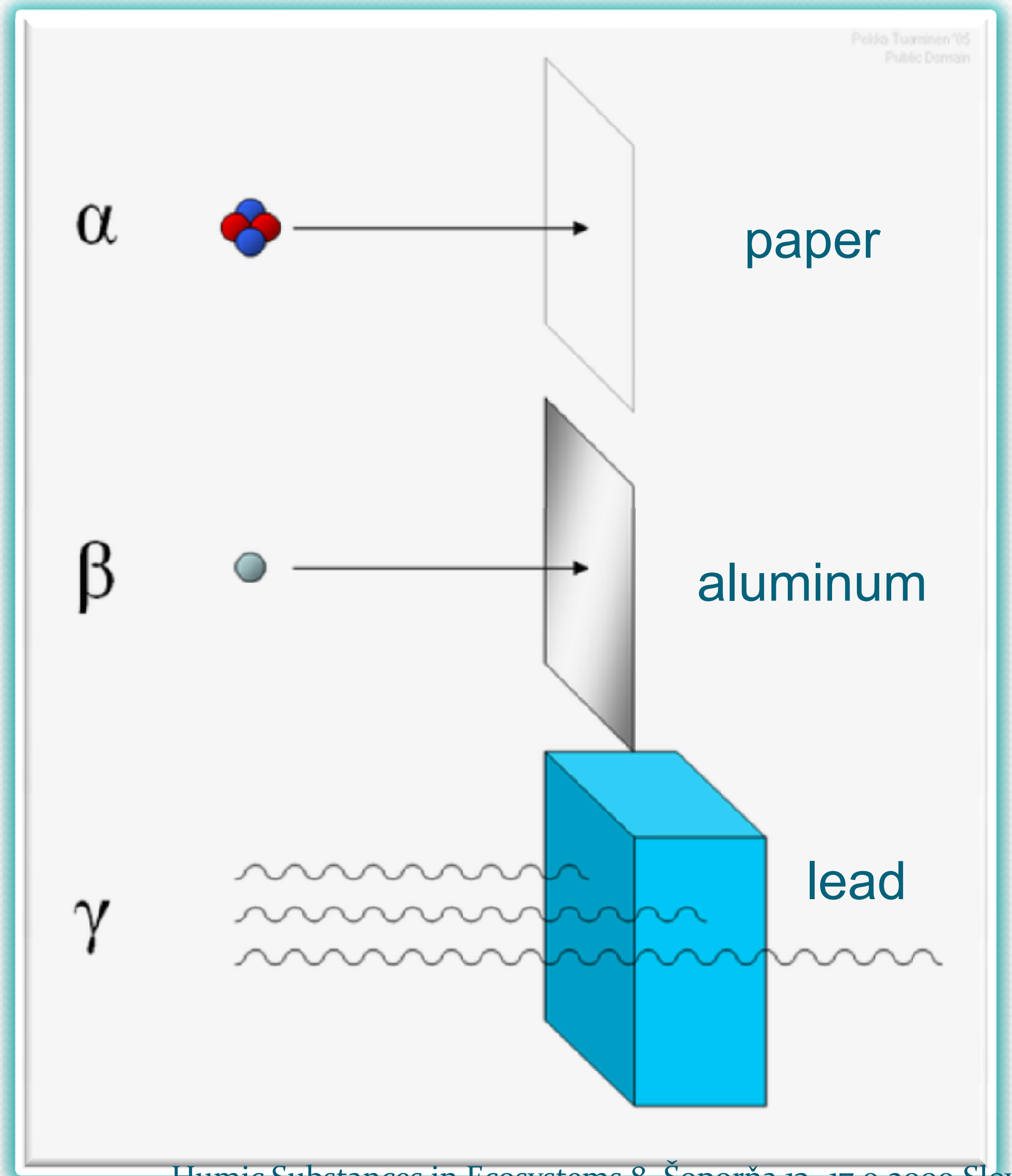

Fig.3. Ability to penetrate the afla, beta and gamma radiation by different shields.

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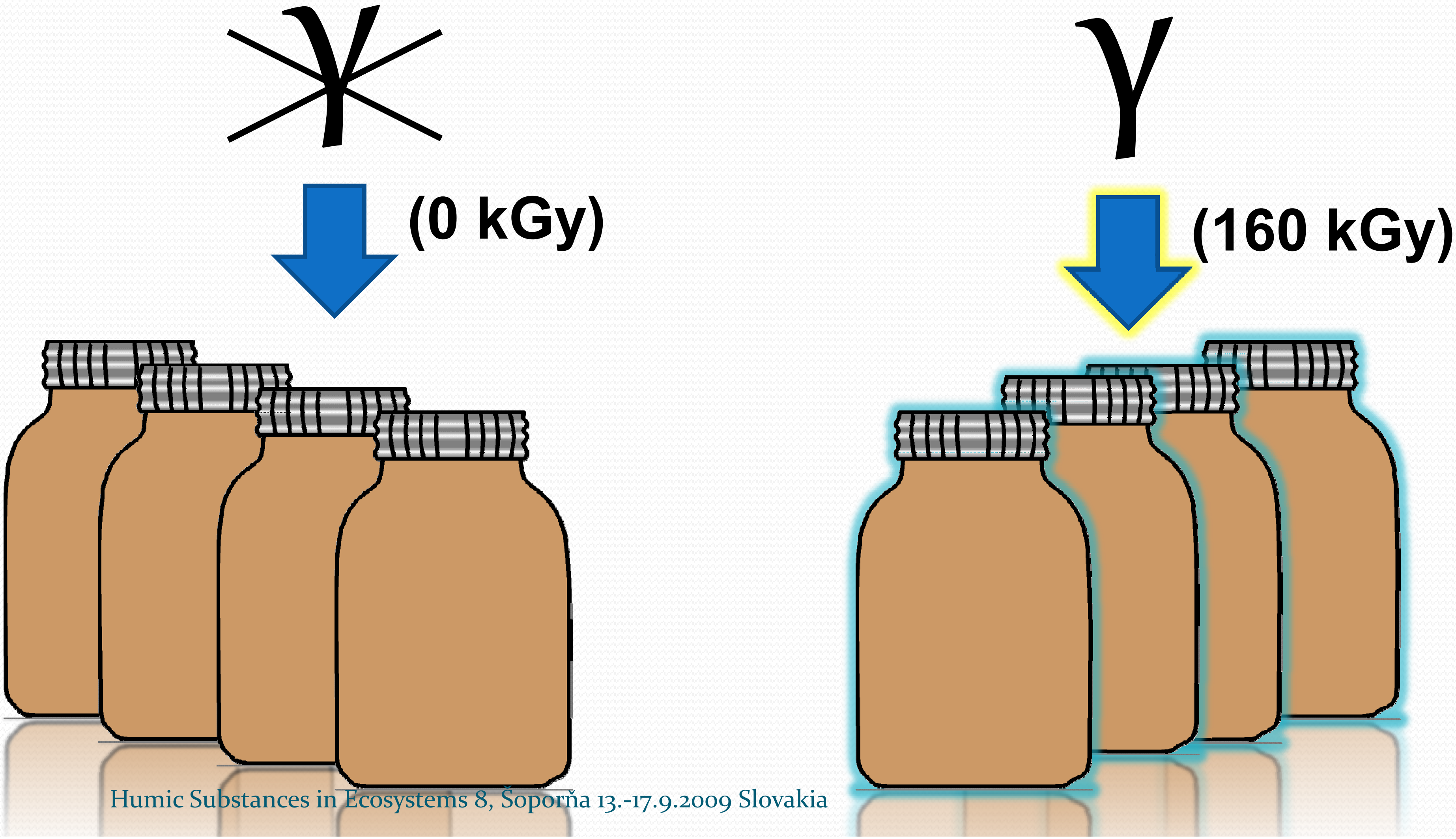
Purpose of the work

The purpose of this study was to identify possibly broad diagnosis of nature, deposition and effect scale of gamma radiation on soil humic acids (Has) and the attempt at answering the question whether resistant to chemical and microbial decomposition, HAs are also resistant to gamma radiation, as seen primarily through the relationship of dose – effect.

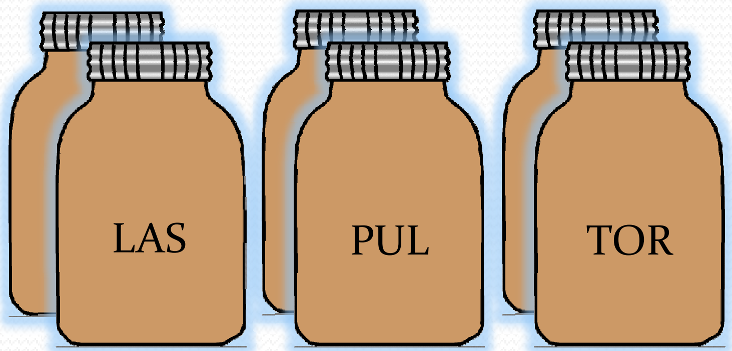
Material and methods

Symbol of HA sample	Origin
LAS	HA extracted from O-horizon of Albic Arenosol under the pine trees
PUL	HA extracted from A-horizon of the Haplic Luvisol used for agriculture
TOR	HA extracted from layer 0-30 of Eutri-Fibric Histosol

Humic acids samples



Gamma radiation



Source of γ : ^{60}Co
Radiation dose : 160 kGy*
Time of irradiation: 1,5 months
* $D = \bar{E} \cdot m^{-1}$ [Gy] [Gy] = $[J \cdot kg^{-1}]$

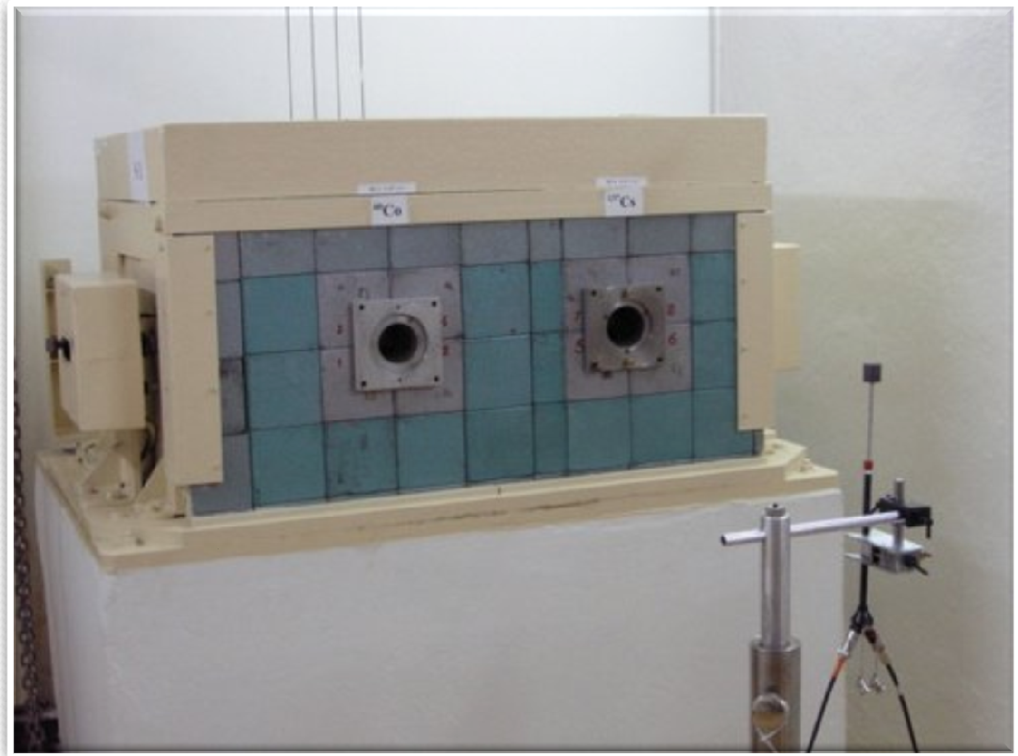
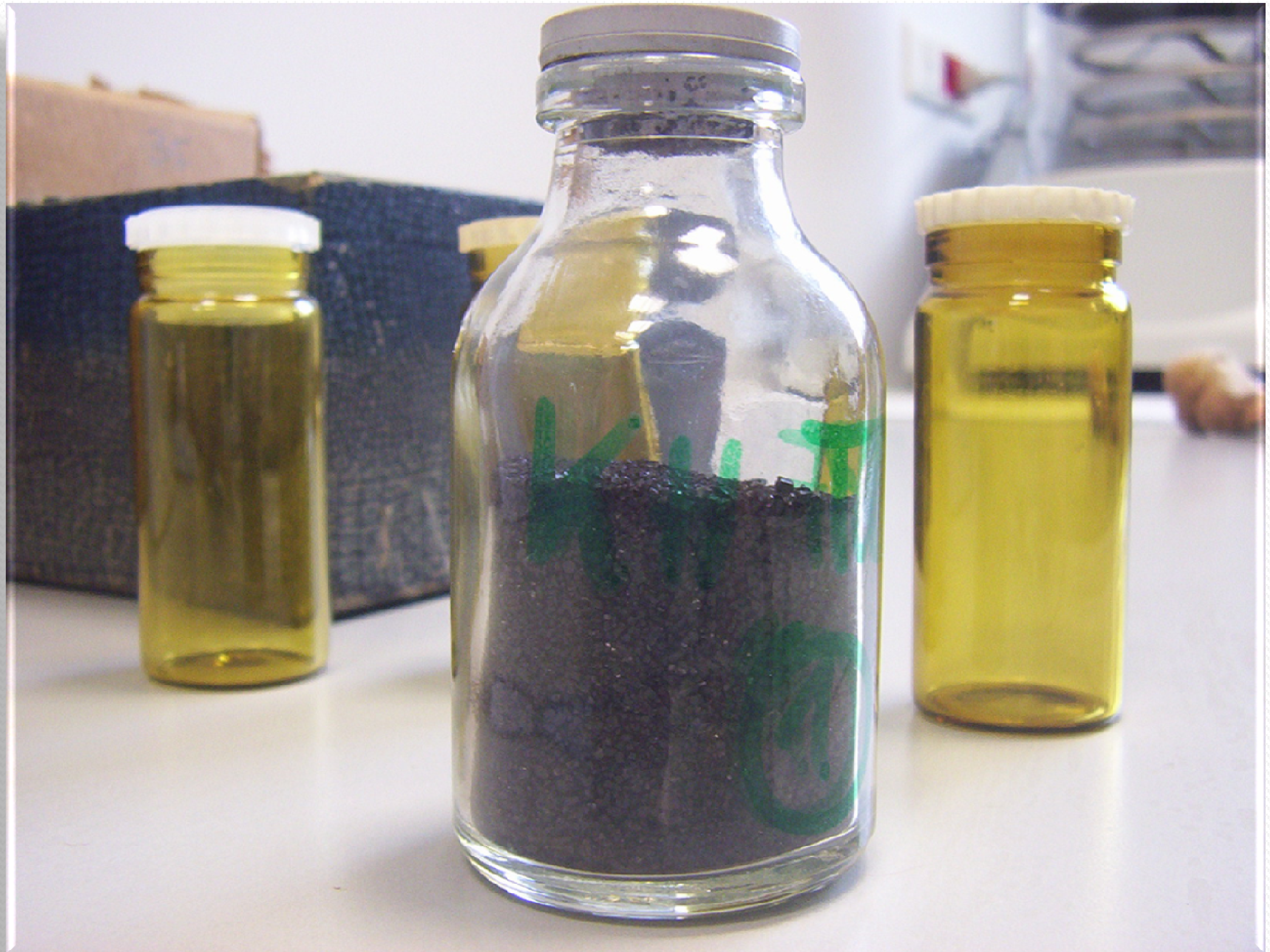


Fig.4. Radiation device RChM-γ, commonly known as ”cobalt bomb“.

For both series HAs were estimated:

- elemental analysis,
- spectra within the scope of the visible and ultraviolet light (UV-VIS),
- infrared spectra (IR),
- nuclear magnetic resonance spectra (NMR).

Results and discussion



Elemental analysis

Table 1. Elemental analysis (in atomic percentage; calculated on ash-free dry mass) values of atomic ratios of internal oxidation (ω) of humic acids.

Sample	Variant	atomic %				H:C	N:C	O:C	O:H	ω
		C	H	N	O					
LAS	0 kGy	35.4	40.7	2.0	21.9	1.15	0.06	0.62	0.54	0.257
	160 kGy	35.5	40.5	1.9	22.1	1.14	0.05	0.62	0.54	0.265
PUL	0 kGy	32.8	43.7	2.8	20.7	1.33	0.09	0.63	0.47	0.186
	160 kGy	32.9	43.4	2.8	20.8	1.32	0.09	0.63	0.47	0.201
TOR	0 kGy	35.0	42.3	1.8	20.9	1.21	0.05	0.59	0.49	0.140
	160 kGy	34.9	42.3	1.8	21.0	1.21	0.05	0.60	0.50	0.146

UV-VIS

Table 2. Absorbance values in UV-VIS region and quotient of absorbance values of humic acids solutions.

Sample	Variant	A_{280}	A_{465}	A_{665}	$A_{2/4}$	$A_{2/6}$	$A_{4/6}$
LAS	0 kGy	0.970	0.174	0.0306	5.6	31.7	5.7
	160 kGy	0.881	0.159	0.0280	5.5	31.5	5.7
PUL	0 kGy	0.829	0.149	0.0298	5.6	27.8	5.0
	160 kGy	0.814	0.144	0.0288	5.7	28.3	5.0
TOR	0 kGy	0.845	0.150	0.0301	5.6	28.1	5.0
	160 kGy	0.911	0.164	0.0326	5.6	27.9	5.0

IR

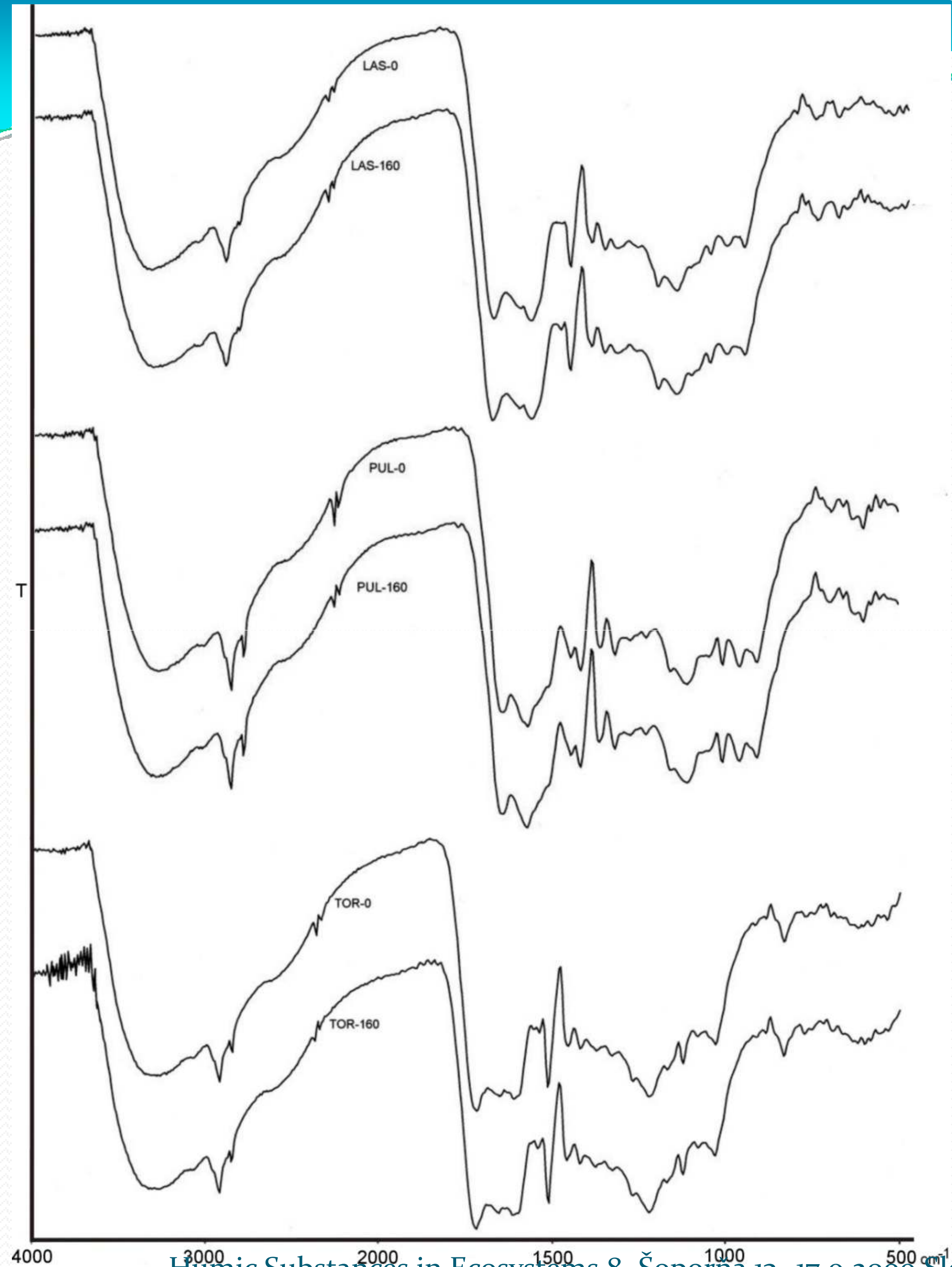


Fig.5. IR – spectra of Has.

NMR

Table 3. Results (in % of peak area) from integration of the ^{13}C-NMR CP/MAS spectra of humic acids.

Chemical shift (ppm)	HA sample					
	LAS		PUL		TOR	
	0 kGy	160 kGy	0 kGy	160 kGy	0 kGy	160 kGy
0 – 45	20.9	23.9	27.7	27.1	22.8	23.5
45 – 65	14.2	12.7	15.3	13.7	12.2	11.5
65 – 95	12.5	9.0	12.4	10.8	11.6	10.5
95 – 110	5.5	3.5	2.7	3.5	4.3	4.6
110 – 145	20.2	20.8	17.9	20.1	18.7	17.3
145 – 165	9.5	10.2	6.5	6.7	9.6	9.7
165 – 180	10.0	11.2	12.2	14.0	13.5	13.9
180 – 220	7.1	8.6	5.4	4.3	7.3	9.0
$\propto$	0.85	0.85	0.57	0.66	0.81	0.77

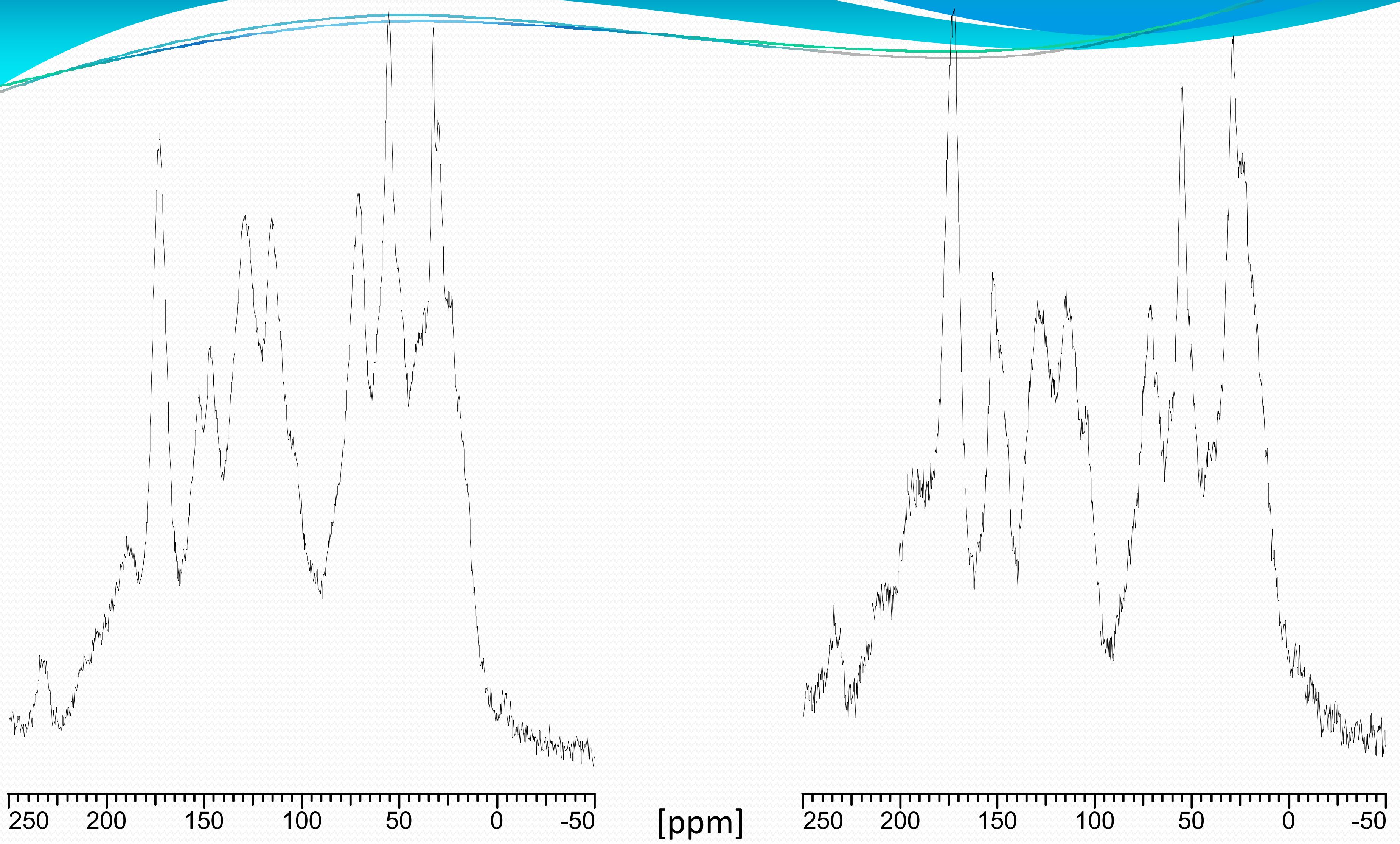


Fig.6. ^{13}C-NMR CP/MAS spectra of humic acids samples „LAS" before (left) and after gamma irradiation (right).

Conclusions

- HAs are resistant to gamma irradiation at a dose of 160 kGy,
- irradiation of HAs samples did not have influence on elemental composition and course of spectra within the scope of the visible and ultraviolet light and infrared one and ^{13}C-NMR CP/MAS spectra,
- structure and properties of HAs depend on their source of origin (type of soil).

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Thank you for your attention!