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The influence of coated nanoCeO₂ on the phenol content in wheat and pea

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The use of nanomaterials in various commercial products and industrial processes has increased. Although the application of nanoparticles has great importance, some of them can be risky to human health and the environment. The unregulated usage of nanoparticles can result in excessive accumulation in sediments, soils, air and aquatic environments, endangering terrestrial plants¹.

Cerium oxide nanoparticles (nanoCeO₂) have been extensively investigated due to the excellent oxygen storage capacities on the basis of the redox transition between Ce³⁺ and Ce⁴⁺ and formation of oxygen vacancies on their surface². The effect of nanoCeO₂ on individual organisms and the ecosystem in general are not sufficiently explored and the literature on the toxicity of nanoCeO₂ in edible plants is contradictory. NanoCeO₂ is very stable in soil and different environmental media and has been found to transfer within plant tissues unaltered. It is very likely that it interacts with plants in nanoparticulate forms³.

In this research we used CeO₂, naked and coated with three different carbohydrates (glucose, pullulan or levan), to study their effect on phenol content, as an important indicator of plant stress^{4,5}, in aboveground plant organs in wheat and pea. NanoCeO₂ was synthesized using self-propagating room temperature method by the procedure of Matović et al⁶. NanoCeO₂, synthesized by this method, was subsequently coated to make glucose-, levan- and pullulan-coated nanoCeO₂ (G-CeO₂, L-CeO₂ and P-CeO₂). Suspensions of these nanoparticles (200 mg/L) were prepared in water, and characterized by X-ray diffraction (XRD) and transmission electron microscopy (TEM). After the treatment the aboveground parts of plants were cut off and phenols were isolated by the procedure⁷.

The physiochemical properties of the synthesized nanoCeO₂ were analyzed using XRD and HRTEM methods. The XRD patterns of obtained nanoCeO₂ are shown in Figure 1. Samples exhibited typical peaks corresponding to planes which are the typical of face centered. All samples showed broad peaks, explained due their synthesis procedure at low temperature, but no shift was found following synthesis and coating process.