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ANTIOXIDANT CAPACITY AND TOTAL PHENOLS CONTENT CHANGES ON CRESS (*LEPIDIUM SATIVUM*) SPROUTS AFTER EXOGENOUS SUPPLY WITH NANO SELENIUM

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Abstract

Selenium is an essential trace element for human health due to its different biological activities. Our aim was to investigate the effects of nano-selenium particles (NSePs) supply on cress sprouts from point of view of total phenols content and antioxidant capacity of selenium – enriched cress sprouts. The NSePs were produced by chemical reduction of $NaHSeO_3$ with glucose. Cress seeds were germinated in the plastic boxes, sprinkled every day with different concentrations of NSePs solution (10, 50, 100 ppm) for 8 days. The length of shoots and roots were measured, and the total phenols content was determined by Folin-Ciocalteu method, while antioxidant capacity was evaluated by DPPH assay. By NSePs supply, the growth parameters of cress sprouts were not affected compared with the control sample. Total phenol content of shoots was not affected by treatment with NSePs at 10 and 100 ppm, but 50 ppm NSePs supply increased the total phenols content compared with the control. The antioxidant capacity of shoots was increased significantly (P=0,05) in the samples treated with 10 and 100 ppm NSePs. Using NSePs as fertilizer, selenium enriched cress sprouts can be obtained, with positive effects on human health.

Key words: nano-selenium, antioxiyesnt capacity, cress

INTRODUCTION

The importance of selenium for human health has been suggested in variety of studies, however, the recommended optimal amount is far from conclusive (Piekarska et al., 2014). Selenium is a trace element that performs important functions in the body. Its deficiency may cause serious conditions, but an overdose may also have adverse effects (Tinggi, 2008).

The interval between the therapeutic dose and the toxic dose being very narrow, depending on the dose and the form of administration. All this makes it difficult and complex to choose the most effective supplement (Kiełczykowska et al., 2018).

For this reason, many researchers have turned their attention to studying selenium in the form of nanoparticles (Desai et al., 1997; Gokavi et al., 2004; Benko et al., 2012; Laslo et al., 2018). Selenium in the form of nano particles attracts more attention due to its increased bioavailability and lower toxicity than inorganic and organic forms (Shi et al., 2011).

Cress is a herbaceous plant of the *Brassicaceae* family. The cress is originated in the Middle East spread over extensive areas in Egypt and

Tibet. The very spicy taste of the leaves made it to be used as a spice, especially in France and England (Nehdi et al., 2012).

As early as 1966, Farnsworth et al. (1966) carried out a phytochemical analysis of *Lepidiumsativum*seeds and detected the presence of alkaloids, glycosides, flavonoids, tannins, saponins, sterols, terpenes, volatile oils. The rich composition of enzymes, vitamins and minerals gives the cress a special nutritional value.

The aim of our work was to evaluate the effects of nano-selenium particles (NSePs) supply on cress sprouts from point of view of total phenols content and antioxidant capacity of selenium – enriched cress sprouts.

MATERIAL AND METHOD

Plant material and experimental design

The research was conducted in the Biotechnological, Chemical and Biochemistry laboratories from The Faculty of Environmental Protection of the University of Oradea. The plant material, the cress seeds (*Lepidiumsativum*), were purchased from the Agrosel Company and certified as professional products.

The seeds were placedin plastic boxes, 50 seeds/box (in duplicates – 2 boxes for each treatment with NSePs). The growing substrate used for the seedlings was the filter paper. The seeds were sprinkled twice a day with different concentrations of NSePs solution (10, 50 and 100ppm). The martor group was sprinkled with pure water. The experiments continued for 8 days.

The NSePs were produced by chemical reduction of sodium hydrogen selenite ($NaHSeO_3$) with glucose according to the paper of Cavalu et al., 2018.

The germination was carried out on a plant growth chamber with controlled temperature (25^0C) and a photoperiod (16 h of light and 8 h in the dark). The germination capacity was determined at 48 hours from the starting of the experiment, when the radicle was approximately 2 mm long or more.

At the final stage of the experiment (after 8 days), stems and roots were separated, and their length/weight were measured immediately after the harvesting. Values were calculated in gram per 20 seedlings.

Measurement of total phenols content and antioxidant capacity

The total, the cress extract, diluted 10 times (100 µl), was mixed phenols content were determined by the Folin-Ciocalteu method according to the protocol described by Singleton et al., 1999; Vicaş et al. 2011; Chiş, Purcărea, 2013. Briefly with 1700 µl of distilled water and 200 µl of Folin-Ciocalteu (freshly diluted 1: 10, v / v) reagent. After about 3 minutes, 1 ml

of 15% sodiumcarbonatewasadded to create the necessary basicity for the reaction between the Folin-Ciocalteu reagent and the phenolic compounds.

The samples were then incubated at room temperature for 2 hours. Absorbance was measured at 765 nm using the Shimadzu miniUV-Vis spectrophotometer. The calibration curve was performed using gallic acid over a range of 0.05-0.25 mg / ml, and the result was expressed in mg of gallic acid equivalent (GAE) / 100µl. Samples were performed in duplicate and the total phenols content was expressed in gallic acid equivalents as mg GAE / 100mg dry weight.

A quick, simple and relatively inexpensive method to measure the antioxidant capacity of plant extracts involves the use of 2,2-diphenyl-1-picrylhydrazyl free radical (DPPH). DPPH assay was widely used to test the ability of compounds to act as neutralizers of freeradicals or as hydrogendonors.

The reaction involves changing the color from purple to yellow, a reaction that can be easily monitored using the spectrophotometer at the wavelength of 515 nm. The DPPH method was determined according to the method described by Vicaş et al., 2011. Briefly, 2.9 ml of a DPPH solution of 80 µM concentration was introduced into the spectrophotometer cuvette. 100 µl of the extract was added over the reagent and the reaction was monitored at 515 nm for 5 minutes. The percentage neutralization of DPPH was calculated using the following equation:

Percent inhibition of DPPH (%) = $[(A_0 - A\ s) \times 100] / A_0$ (where, A_0isthe absorbance of the blank, and As is the absorbance of the sample).

Statistical analysis

All the data were processed by one-way analysis of variance (ANOVA) (P = 0.05). Mean value differences were analysed with Tukey's test (P = 0,05).

RESULTS AND DISCUSSION

Under the treatment with three different concentration of NSePs (10, 50 and 100 ppm), the germination of cress seeds was not affected by the presence of nanoparticles. Also, the growth of seedlings was not dependent on NSePs concentrations (data no shown). Similar results were obtained from broccoli sprouts under NSePs treatment, where the broccoli germination was not affected when the different concentrations of nanoselenium were used, compared with control sample (Tocai et al., 2016).

The results regarding to the content of total phenols from roots and stems of cress under different treatment (with three different concentrations of NSePs and the control) are shown in the Fig. 1.

The lowest content of total phenols was recorded in the roots of cress comparated with stems (0.902 ±0.355 and 3.381 ±1.320 mg GAE/100 mg

dw, respectively). Under the treatment with NSePs was recorded slight decreases of total phenols but no significantly from point of view of statistical analyses. The content of total phenols in stems was not affected by the treatment with 10 an 100 ppm NSePs compared with the control. Instead the treatment with 50 ppm increases significantly the content of total phenols (4.896 ±1.980 mg GAE/100 mg dw, compared with the martor sample were 3.044 ±0.484 mg GAE/100 mg dw was recorded) (Fig. 1).

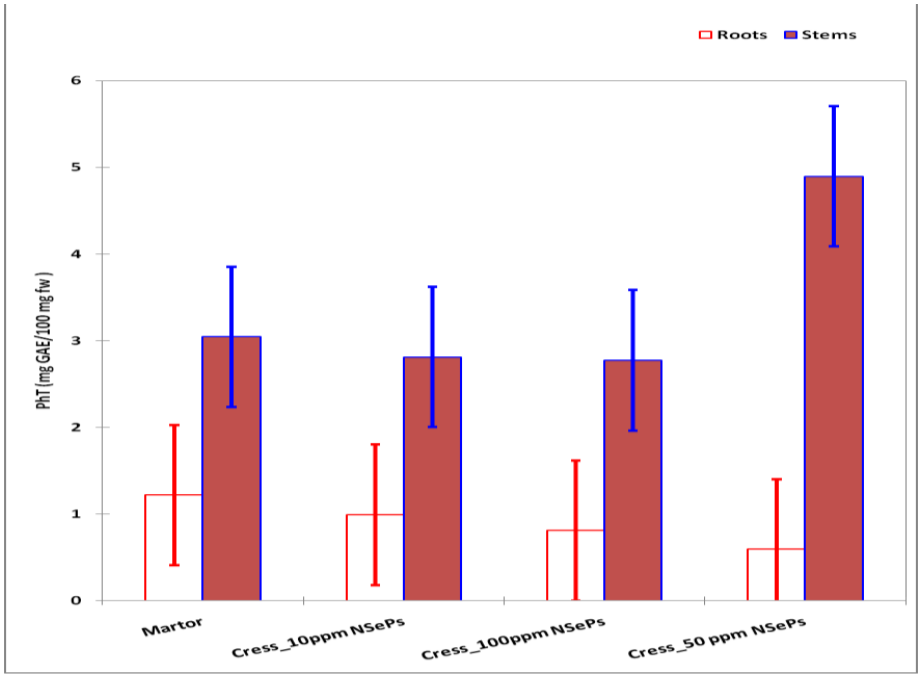

Fig. 1. Effects of different concentrations of NSePs on total phenols content from roots and stems cress

These results are similar with those obtained from broccoli sprouts by Tocai et al., 2018, where total phenol content of shoots was not affected by treatment with NSePs, instead, 50 ppm and 100 ppm NSePs supply increased the total phenols content of roots, compared with the control.

From point of view of antioxidant capacity determined by DPPH assay, the highest value was recorded in the stems compared with roots of cress (30.154±7.350% and 13.393 ±4.045%, respectively). The results are shown in Figure 2. Compared to the control, the treatment with 10 and 100 ppm NSePs increased the antioxidant capacity of cress samples (19.848 ±3.546% for martor, 28.581 ±11.887% and 22.996 ±12.075%, respectively). In contrast the treatment with 50 ppm NSePs decreased the antioxidant capacity of the samples (19.848 ±3.546% for martor vs.15.669 ±8.407%) (Fig. 2).

Similar results were obtained of broccoli sprouts from NSePs treatmentby Tocai et al., 2017, where the antioxidant capacity of shoots was increased significantly (P=0.05) in all the samples treated with NSePs. As respects to the roots, was only the treatment with 10 ppm NSePs the one which has significantly increased the antioxidant capacity. Also, our results at creson sprouts are consistent with those reported by Frias et al., 2010.

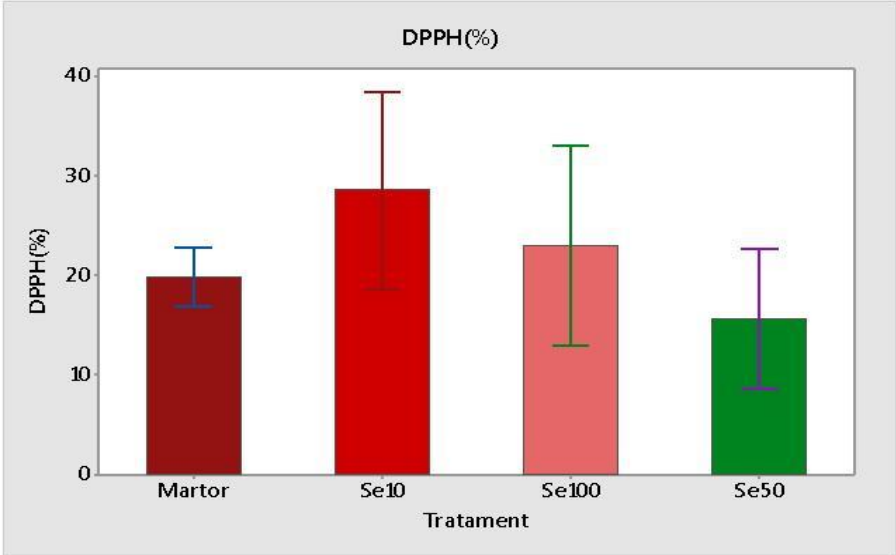

Fig. 2. The antioxidant capacity of roots and stems cress under the treatment with NSePs.

CONCLUSIONS

The following conclusions can be drawn from our study:

1. All three different concentrations of NSePs (10, 50 and 100 ppm, respectively) did not showntoxicity effects on germination and growth of cress sprouts.

2. The treatment with 50 ppm NSePs increased significantly the content of total phenols compared with martor group.

3. In contrast, the treatment with 10 and 100 ppm increased the antioxidant capacity of the samples compared with martor group.

Using NSePs as fertilizer, selenium enriched cress sprouts can be obtained, with positive effects on human health.

REFERENCES

1. Benko I., Nagy G., Tanczos B., Ungvari E., Sztrik A., Eszenyi P., Banfalvi G., 2012, Subacute toxicity of nano-selenium compared to other selenium species in mice. Environmental toxicology and chemistry, 31(12)
2. Cavalu S., Antoniac I., Fritea L., Mates I.M., Milea C., Laslo V., Vicas S.I., Mohan A., 2018, Surface modifications of the titanium mesh for cranioplasty

using selenium nanoparticles coating. Journal of Adhesion Scienceand Technology, DOI: 10.1080/01694243.2018.1490067
3. Chiş A., Purcărea C., 2013, The Influence of theextraction solvent on thepolyphenolcontent determination in cocoaproducts. Natural Resources and Sustainable Development, Vol 3, pp.115-120
4. Desai M.P., Labhasetwar V., Walter E., Levy R.J., Amidon G.L., 1997, The mechanism of uptake of biodegradable microparticles in Caco-2 cells is size dependent. Pharmaceutical research, Vol.14, pp.14(11)
5. Farnsworth N.R., Henry L.K., Svoboda G.H., 1966, Biological and phytochemical evaluation of plants. I. Biological test procedures and results from two hundred accessions, Vol. 29, pp.101-122
6. Frias J., Gulewicz P., Martinez-Villaluenga C., Peñas E., Piskula M.K., Kozlowska H., Vidal-Valverde C., 2010, Changes in nutritional value and cytotoxicity of garden cress germinated with different selenium solutions. Journal of agricultural and food chemistry, Vol. 58(4), pp.2331-2336
7. Gokavi S.S., Malleshi N.G., Guo M., 2004, Chemical composition of Garden Cress (Lepidium sativum) seeds and its fractions and use of bran as a functional ingredient. Plant foods for human nutrition, 59(3)
8. Kiełczykowska M., Kocot J., Paździor M., Musik I., 2018, Selenium-a fascinating antioxidant of protective properties. Advances in clinical and experimental medicine: official organ Wroclaw Medical University, 27(2)
9. Laslo V., Cavalu S., Teusdea A., Vicaș S., Agud E., Oneț A., Fritea L., Lestyan M., 2018, Green biosynthesis silvernanoparticles using leaf extract, Natural Resources and Sustainable Development, Vol .8, No 1, pp.59-66
10. Nehdi I.A., Sbihi H., Tan C.P., Al-Resayes S.I., 2012, Garden cress (LepidiumsativumLinn.) seed oil as a potential feedstock for biodiesel production. Bioresource technology, 126
11. Piekarska A., Kołodziejski D., Pilipczuk T., Bodnar M., Konieczka P., Kusznierewicz B., Namieśnik J., 2014, The influence of selenium addition during germination of Brassica seeds on health-promoting potential of sprouts. International Journal of Food Sciences and Nutrition, 65(6)
12. Shi L., Xun W., Yue W., Zhang C., Ren Y., Shi L., Lei F., 2011, Effect of sodiumselenite, Se-yeast and nano-elemental selenium on growth performance, Se concentration and antioxidant status in growing male goats. Small Ruminant Research, 96(1)
13. Singleton V.L., Orthofer R., Lamuela-Raventós R.M., 1999, Analysis of total phenols and other oxidation substrates and antioxidants by means of folin-ciocalteu reagent. Methods in Enzymology, Vol 299, pp.152-178, Elsevier, Journals & Books, (https://doi.org/10.1016/S0076-6879(99)99017-1)
14. Tinggi U., 2008, Selenium: its role as antioxidant in human health. Environmental health and preventive medicine, vol. 13(2), pp.102-108
15. Tocai M., Laslo V., Vicas S.I., 2016, Effects of selenium and copper supply on growth parameters of *Lepidium sativum* and *Brassica oleracea* seedlings. Analele Universității din Oradea, Fascicula: Protecția Mediului, vol.27, pp.149-154
16. Tocai M., Cavalu S., Laslo V., Burescu P., Vicaș S.I., 2017, Antioxidant capacity and total phenols content changes of broccoli sprouts after exogenus supply with nano selenium (abstract). Journal of Medicine and Life, vol.10, ISSN 1844-122x
17. Tocai M., Cavalu S., Laslo V., Burescu P., 2018, Antioxidant capacity and total phenols content changes of broccoli sprouts after exogenous supply with nano selenium. International Journal of Current Research, Vol. 10, Issue 03, pp.66592-66594

18. Vicas S.I., Rugina D., Socaciu C., 2011, Antioxidant Activity of European Mistletoe (*Viscum album*). In book: Phytochemicals as Nutraceuticals - Global Approach esto Their Role in Nutrition and Health, DOI: 10.5772/26845

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