

INFLUENCE OF THE IONIZING RADIATION ON THE ANTIOXIDANT CHARACTERISTICS OF THE SEA BUCKTHORN

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Abstract

Sea buckthorn is used as pharmaceutical product as well as nutritional supplement, especially for its antioxidative potential. As we noticed in our previous work that the electron beam irradiation could be a suitable mean to ensure the microbiological safety of sea buckthorn, in this work we have proposed to investigate the ionizing radiation influence on the sea buckthorn antioxidant characteristics. Consequently, the sea buckthorn samples have been treated by electron beams with doses up to 40 kGy and the antioxidant activity and compounds have been evaluated in comparison to the control sample after irradiation and storage at room temperature during 3 months. The study revealed that the irradiation of sea buckthorn lead to the reduction of antioxidant potential with the increase of the dose both immediately after treatment and after storage time.

Keywords: medicinal plants, electron beams, antioxidant potential.

1. Introduction

Sea buckthorn is known as the wonder plant [1] due to its important content in dietary and medicinal compounds. Nowadays, it is used in pharmaceutical formulas as well as nutritional supplement. In our previous work [2] we studied the potential of the electron beam (e-beam) irradiation to be applied on sea buckthorn in order to decontaminate it. To optimize this process one should investigate the influence of electron beams on every category of the compounds from sea buckthorn. Therefore, the purpose of this work was to study the ionizing radiation effects on the sea buckthorn antioxidant characteristics.

2. Method and samples

The samples used for the experiments were obtained from sea buckthorn berries (Romanian spontaneous flora) which have been transformed in powder state by controlled drying at temperatures lower than 60⁰ C and then grounding. Sea buckthorn powder has been packed up in polyethylene bags and treated in electron beams with doses up to 40 kGy, at room temperature and atmospheric pressure. It has been used a linear electron accelerator with the mean energy of 6 MeV, the peak intensity of 75 mA at a repetition rate of 50-100 Hz.

Antioxidant potential of sea buckthorn has been identified both by enzymatic measurement (superoxide dismutase – SOD) in guinea pig brain homogenate and by biochemical measurement of lipid peroxidation (LPO). SOD activity has been determined by standard method, following the catching action of free radicals in a generating system of them. Inhibition of LPO has been estimated using a technique based on the measurement of the malonaldehyde concentration that uses thiobarbituric acid, which generates a colored product detected at 532 nm.

Quantitative *determination of total flavonoid derivatives* has been performed using aluminium chloride colorimetric method and expressed in terms of rutin equivalent.

Polyphenolcarboxylic acid content has been quantified by their characteristic color reaction reading the extinction at 660 nm. The total acid content has been expressed in terms of caffeic acid equivalent.

Sea buckthorn *content in carotenoids* has been determined in benzene extract of sea buckthorn by a spectrophotometrical method. The absorbance of samples has been measured at $\lambda = 460$ using for standardization a β -carotene solution.

All measurements have been carried out immediately after irradiation and after 3 months storage at room temperature.

3. Results and Discussion

Figure 1 shows the variation of the SOD activity for sea buckthorn as related to e-beam dose and storage period. The decrease of the SOD value appeared even after 5 kGy irradiation, and for the others doses the decrease of the SOD activity was insignificant. The same behaviour was noticed after 3 months storage time and the values were comparable with those obtained immediately after irradiation.

The second method of evaluation of antioxidant activity (LPO) showed the reduction of antioxidant protection of sea buckthorn extract with the increase of irradiation dose (Fig. 2). But in this case, it was noticed drastically reduction for the sample irradiated with 40 kGy in comparison to control sample (from 82% to 25%). After storage period, the same evolution and only slight decrease of the values were observed.

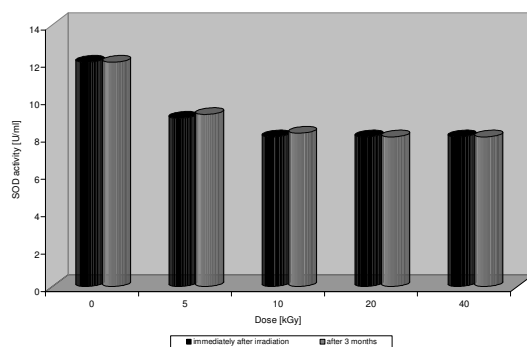


Figure 1. Variation of SOD activity with e-beam dose and storage time

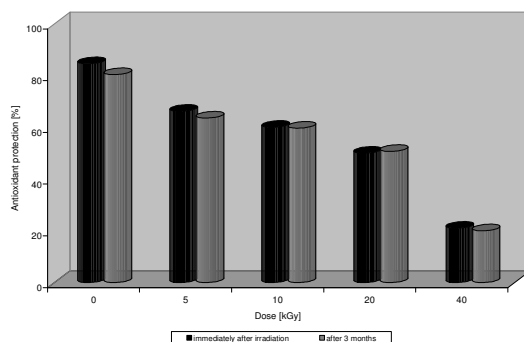


Figure 2. Antioxidant protection variation with e-beam dose and storage time.

Total content of flavonoids suffered a decrease after sea buckthorn treatment (Fig. 3); slight decrease for sample treated with 5 kGy and accentuated one at doses higher than 20 kGy. After 3 months storage time, the mean decrease was ~12 % for irradiated samples than the values measured immediately after irradiation.

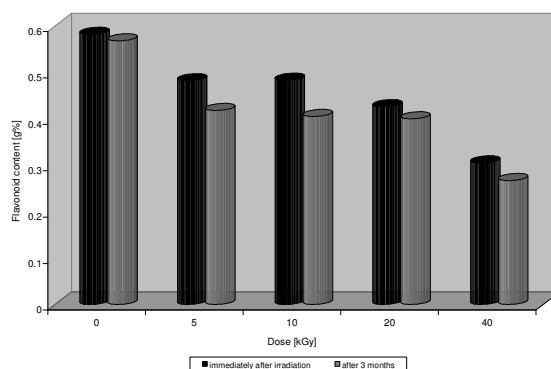


Figure 3. Variation of the flavonoid derivatives in the irradiated samples

The content of polyphenolcarboxylic acids decreased as the irradiation dose increased (Fig. 4). The irradiation at high doses (20 and 40 kGy) led to significant decrease of the polyphenolcarboxylic acid content.

During storage period it was noticed the decrease in polyphenolcarboxylic acid content for all samples (~8%) in comparison to the values measured immediately after treatment.

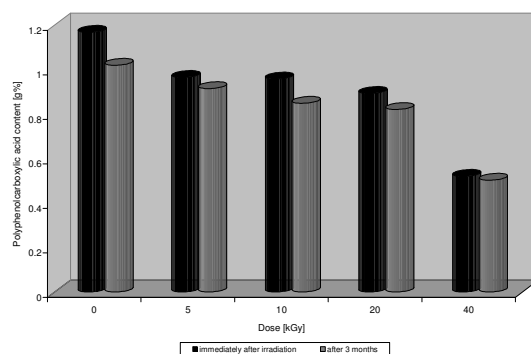


Figure 4. Polyphenolcarboxylic acid content evolution in sea buckthorn samples

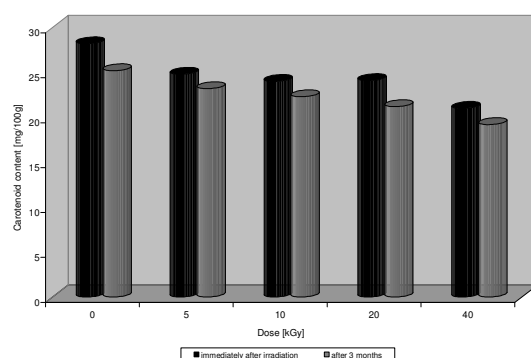


Figure 5. Carotenoid content of sea buckthorn before and after treatment and storage time

Figure 5 shows the carotenoid levels in sea buckthorn immediately after e-beam treatment and after 3 months storage in comparison to the control sample. These results suggested that immediately after irradiation slight decrease with the increase of the irradiation dose was remarked. During storage time the carotenoid content decreased both for control and irradiated samples with the mean value of ~9%.

4. Conclusions

The antioxidant characteristics (antioxidant potential and chemical compounds with antioxidative role) of sea buckthorn were influenced by electron beam (ionizing radiation) treatment. This influence has been observed by the decrease of these characteristics with the increase of irradiation dose. The same evolution could be observed even after the 3 months period of storage of samples including control one at room temperature.

References

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