THE ROLE OF SELENIUM-ENRICHED FOOD SPROUTS WITH RESPECT TO OUR DAILY SELENIUM NEEDS

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Trace mineral selenium is an essential nutrient of fundamental importance to human biology, therefore it is very important to be in our daily diet. Although it is known that selenium content of foods show wide variety, the most commonly consumed food have low selenium content. The main object of our work is to study the enrichment of selenium during germination of wheat and pea (*Triticum aestivum* and *Pisum sativum*) because we are of the view based on previous studies that the sprouts are able to take up element high in concentration. Sprouting was chosen because it additionally enhances the nutritional value of seeds, for example, by a higher vitamin content, a better quality of protein, and some other parameters. We dicided to combine this with higher selenium content. Inductively coupled plasma mass spectrometry (ICP-MS) was used to determine the total element concentration. After determining the element, we calculated the percent of selenium which was found in sprouts treated with Se, may cover our daily need. With regards to our experiments, we concluded that, selenium are good for the treatment of sprout because the 0.1 mg dm^{-3} selenium treatment contribute to cover our daily need of selenium needs.

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Introduction

Unlike other seeds, it has been established that sprout seeds, due to its transform protein content, has higher biological value, polyunsaturated fatty acid content, vitamin content and better utilization of minerals has a higher nutritional value. Therefore, germinated seeds are highly nutritious foods. During germination, polysaccharides degrade into oligo- and mono-saccharides, while fats into free fatty acids, whereas the proteins into oligopeptides and free amino acids, which processes support the biochemical mechanisms in our organism.[1]

Different investigations show, that we can further enhance the above high nutritional value of sprouts if we grown the seeds on various trace elements solution, namely they are able to take element high in concentration.[2,3,4]

We studied the enrichment of sprout with selenium during our work. We took into account the fact, we choose micronutrients to our treatment, that selenium can be delivered to the body by a small amount with the most widely consumed food. As a result of which, selenium deficiency affects many inhabitants of European countries, including the Hungarian population.[5] In general we can say that the selenium content of plant raw materials in most fertile soil, the selenium content may be determined.[6] In Hungary, however, selenium soils are quite poor, so that the plant product from selenium supplementation is only a fraction of what is needed.

Selenium deficiency itself usually does not cause disease, but directly or indirectly, by selenium deficiency wide variety of diseases or exacerbation of the disease may play a role, for example: adult-onset diabetes, cystic fibrosis, cerebrovascular disease, colonic ulceration, different types of cancer as well as cardiovascular diseases.[7] In addition, Pappa et al. (2006) noticed, that low Se status was associated with a significantly greater incidence of depression and other adverse effects such as anxiety, confusion and hostility.[8] However, several studies have reported that selenium supplementation reduces the likelihood of developing certain diseases, and increases resistance power of the body. For example the daily extra-dietary supplement of 200 mg Se has been indicated to increase resistance to viral infections and reduce the possibility of cancer.[9] In addition, the importance of selenium is also emphasized by the fact that selenium deactivates the heavy metals (Cd, Hg) which has toxic effect in the body.[10]

Materials and methodes

We used bio wheat (*Triticum aestivum*) and green pea (*Pisum sativum*) for germination. In the experiment, in the case of selenite and selenate 0.1; 1; 10 mg dm^{-3}, selenium concentrations have been applied along with control treatment with distilled water.

For the determination of total selenium concentration a cc. nitric acid – cc. hydrogen peroxide wet digestion sample preparation method was applied. The sample preparation was carried out on the basis of paper made by Kovács et al (1996).[11] For us to completely observe the element concentration, our team used inductively coupled plasma mass spectrometry (ICP-MS). Collision cell technique (7% H_2+93% He) was used to eliminate the polyatomic interferences.

For the statistical analysis we used One-Way analysis of variance (ANOVA) and Tukey-test. Significance was evaluated at the $P<0.05$ level. All statistical analyses were performed using SPSS v.13.0.

Result and Discussion

We monitored the selenium concentration changes of wheat- and pea sprout at increasing concentrations of selenite and selenate treatments in our experiments. The control treatment included distilled water for germination too.

The results of our research are summarized in Table 1-2. These show that on distilled water, grew wheat- and pea sprout had only low selenium concentration. However the concentration of selenium increased significantly the effect of each selenium treatments. Further, this increase was more obvious in the case of wheat sprout.

We measured increased selenium concentrations in sprout at selenate treatment concentrations, in the case of wheat- and pea sprout too, which is known to be in collaboration with the selenite and selenate, their uptake was different. The plants took up selenate actively during sulfur metabolism and accumulated selenite passively.

Table 1. In case of 1x Se (0.1 mg dm^{-3}), 10x Se, 100x Se treatments, the concentration of the 5 days old wheat sprout grown on a solution containing selenium (mg kg^{-1}), (n=3)

Treatments	Wheat sprout			
	Selenite		Selenate	
Control	0.065^{a}	± 0.017	0.065^{a}	± 0.017
1x Se	2.18^{b}	± 0.16	3.55^{b}	± 0.12
10x Se	15.5^{c}	± 0.5	18.5^{c}	± 0.8
100x Se	36.8^{d}	± 1.2	84.3^{d}	± 1.6

Table 2. In case of 1x Se (0.1 mg dm^{-3}), 10x Se, 100x Se treatments, the concentration of 4 days old pea sprout grown on a solution containing selenium (mg kg^{-1}), (n=3)

Treatments	Pea sprout			
	Selenite		Selenate	
Control	0.131^{a}	± 0.014	0.131^{a}	± 0.014
1x Se	2.50^{b}	± 0.04	1.43^{b}	± 0.05
10x Se	4.08^{c}	± 0.20	4.93^{b}	± 0.07
100x Se	29.6^{d}	± 0.6	44.0^{c}	± 0.9

The practical application of our measurement

In some literature, the daily consumption of the recommended amounts to two or three tablespoons, which approximately corresponds to 15 g. During our investigation, we calculated using this value; how many percent from selenium contain of sprouts treated with Se covers our daily need. Results are summarized in Tables 3-4.

Dietary Reference Intakes (DRIs) defining the value for daily selenium need (2004) was taken into account in calculation. The DRIs selenium is 45 µg/day. This value defines the amount that highly absorbable form the core of a healthy person should.[12]

With regard to the determination of the values, we also evaluated by the germs in our body selenium intake is not utilized 100%. Study of literature by foreign authors outlined that the body of organically bound selenium intake is only up to 80% of the absorbed.[13]

However, this is only an approximate value, since the utilization of selenium in our body also defines a number of factors. For example the health status, age, sex, diet of consumer as well as the distribution of different selenium species.

Table 3. Se content (µg) of wheat sprout mass recommended to daily consumption (15 g) and its Se content rate (%) compared with our daily requirements plotted against control, 1x Se (0.1 mg dm^{-3}), 10x Se, 100x Se treatments

Treat-ments	Se content of 15 g wheat sprout (µg)		The rate of Se content of 15 g wheat sprout compared to daily requirements (%)
	dry mass calculated	wet mass calculated	
selenite treatments			
Control	0.975	0.244	0.434
1x Se	32.7	8.18	14.5
10x Se	233	59.6	106
100x Se	552	140	248
selenate treatments			
Control	0.975	0.243	0.433
1x Se	53.25	15.6	27.7
10x Se	278	70.5	125
100x Se	1268	304	541

Table 4. Se content (µg) of pea sprout mass recommended to daily consumption (15 g) and its Se content rate (%) compared with our daily requirements plotted against control, 1x Se (0.1 mg dm^{-3}), 10x Se, 100x Se treatments

Treat-ments	Se content of 15 g pea sprout (µg)		The rate of Se content of 15 g pea sprout compared to daily requirements (%)
	dry mass calculated	wet mass calculated	
selenite treatments			
Control	1.96	0.432	0.769
1x Se	37.5	9.08	16.1
10x Se	61.2	13.5	23.9
100x Se	444	92.8	165
selenate treatments			
Control	1,97	0.432	0.769
1x Se	21.5	4.44	7.89
10x Se	74.0	14.9	26.5
100x Se	660	148	262

We recommend tenfold selenite or selenate treatment at wheat germination on the basis of the data in Table 3, because the hundredfold treatment significantly exceed the needs of our daily selenium.

We prefer to keep also 1 mg dm^{-3} concentration treatment also at pea germination on the basis of the results of Table 4, because if the amount of added selenite additional tenfold change, they would expose the 165 respectively 262% of the daily needs of selenium, which is close to the toxic quantity.

The data also shows, that the ratio of daily need of selenium content of sprouts on control treatment is very low (0.5-1%), so we recommend the germination on selenite and selenate solution especially those living in areas of selenium deficiency. In addition, vegetarians may also find useful selenite and selenate enriched sprouts for consumption, mainly because of the domestically produced fruits and vegetables are extremely low in concentrations of selenium. Takács (2001) noted that of 0.01 µg/g.[14] This value is much higher in meats, fish, shellfish, 0.3 µg/g. Animal offar, particularly the liver, kidney have their selenium concentration very high.

Besides this we found it is important to note, however, that in some cases it may be necessary for the daily selenium levels are greater than what our bodies need. For example, investigation has shown that selenium may be used in cancer prevention and treatment, by ensuring that the average level of the body is in excess of this amount must be consumed.[15,16]

Conclusions

With regards to our observations, we concluded that sodium-selenite and sodium-selenate are good for the treatment of sprout, since the wheat- and pea sprouts are able to take up these elements high in concentration, thereby contribute to cover our daily need of selenium requirement.

On the basis of our result we prefer to keep 1 mg dm^{-3} concentration selenite and selenate treatment because the hundredfold treatment significantly exceed the needs of our daily selenium requirement.

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