



## OIL SEEDS AS NATURAL RESOURCES OF SELENIUM

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Selenium is an essential trace element that has beneficial health effects in adequate concentration i.e. about 60 µg/day – in humans. Besides its antioxidant function selenium incorporated in seleno-aminoacids, selenomethionine and selenocysteine, as these aminoacids support anti-cancer and anti-aging effects. However ensuring the sufficient intake of this element may be limited in some countries, such as Hungary, because of the soil, which is deficient of selenium. In some literature it has been reported that oil seeds contain higher concentration of selenium, therefore they are potential selenium sources. The main aim of our work is to study and survey the role of these seeds in selenium intake into a human body. It has been pointed out that consuming these food products can minimize but not eliminate inadequate selenium intake, except that of brazil nut (*Bertholletia excelsa*) with its high (20 µg g<sup>-1</sup>) selenium-content.

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### Introduction

Selenium is an essential trace element. It is very important for the healthy function of the human body. It has importance in the antioxidant defense and also active center of the deiodinase enzyme which requires for the peripheral thyroid hormone metabolism<sup>9</sup>.

Selenium is essential for metabolism, energy releasing processes and - promotes normal functioning of the immune system.<sup>9</sup> The adequate amount of selenium is also required for the brain and thyroid function. It is a key nutrient for the protection against variety of environmental toxicants, viruses, and it helps in the delaying of the premature aging of cells, keeps the tissues young, and resiliency. Selenium strengthens the defense mechanisms against cancer, as well as the heart - protective mechanisms against cardiovascular diseases. Plays a role for improving fertility and has a positive effect on the antibody production, stimulates the immune system and also has an anti-inflammatory property.<sup>11</sup>

Selenium gets through the plants and animals into the food chain from the soil. So the selenium concentration of soils has an enormous influence on selenium concentration of food. Hungary is not sufficient in selenium diet that may lead to the incomplete intake of Hungarian population.<sup>1</sup>

The best selenium sources are oil seeds, nuts, among these one important seed is Brazilian nut – each piece contains up to 100 µg, which is about 182 % of the daily needs<sup>10,11</sup>. Peanuts, hazelnuts, almonds, walnuts, cashews, sunflower or pumpkin seeds and peanuts also can help to ensure the daily amount of selenium. On the basis of the information given in the literature these seeds' selenium concentration can

change in wide range, so one part of our study was to determine whether the packaged seeds selenium concentration is high, and the influence of Hungarian soil's poor selenium concentration on the plants grown here.

By these results and discussion one can make an inference that for the balanced, systematic, conscious nutrition oil seeds and nuts are have important role to meet the adequate daily need for selenium.

### Methods

#### Experimental

Brazil nut (*Bertholletia excelsa*) is derived from a soil that has a high selenium concentration. It is grown in the Amazonian basin that is native plant of the Brazilian tropical forest. Its proteins have are rich in methionine. Because the SeMet-Met ratio is regulated by the selenium/sulphur value that occurs in the soil, so the balance moves to the direction of the Met-aminoacid. In case of lack of selenium this raises the possibility of the use of an additional food source.<sup>2</sup>

A 12-week randomized controlled experiment was conducted by Thomson and colleagues, in the year 2007, New Zealand, in which it was found that daily consumption of two grains of Brazil nuts are effectively increases the levels of selenium concentration in blood and glutathione peroxidase activity, than 100 µg of synthetic selenomethionin.

The Brazil nuts are the richest known selenium source. Its selenium concentration varies between 8 to 83 µg g<sup>-1</sup>.<sup>3</sup> Selenium concentration of Brazil nuts which was grown in the middle and eastern part of the Amazonas basin, is up to 512 µg g<sup>-1</sup>, while in the western part it is just 0.03 - 31.7 µg g<sup>-1</sup>.<sup>4</sup> only.

We mostly eat it raw, in a sock or other combinations of seed mixture, but we also use it in chopped or ground form for sweets, cakes, and salads.

In Hungary in general, Brazil nuts are sold without a nutshell. In Western Europe it is used, as a dessert since the British Government told public that Brazil nut is a good, natural selenium source, therefore, by eating it, the blood's selenium concentration can be reinstated.<sup>5</sup>

According to the USDA database, 100 g Brazil nut consist of 1917 µg selenium, sunflower seed 79.3 µg, cashew nut 20.3 µg, almond 2.9 µg, walnut 4.9 µg, pine nut 0.7 µg and peanut 7.5 µg selenium<sup>6</sup> respectively.

Oil seeds have low glycemic index, they are rich in fiber, vitamins and minerals and those are good vegetable protein sources. The high fat content of oil seeds can lead to obesity that is the causing of several modern diseases, but Rajaram and Sabate<sup>7</sup> found that the consumption of Brazil nuts is not causing body weight gain, because they make a full diet.<sup>7</sup>

### Instrumentation

The oil seeds, we used in our experiment, were bought in from several stores in Debrecen: Brazil nuts, cashews, walnuts, peanuts, hazelnuts, almonds, sunflower seeds, pumpkin seeds and pine nuts. Preparation and measurement of the samples were made at the University of Debrecen, Centre for Agricultural and Applied Economic Sciences, Faculty of Agricultural and Food Sciences and Environmental Management, Institute of Food Processing, Quality Assurance and Microbiology.

50 g of the samples were measured in teflon vessels with electronic analytical balance. 8 cm<sup>3</sup> of cc. HNO<sub>3</sub> (65% w/w, Scharlau Chemie, Spain) has been added, and then allow to stand for overnight in a fume hood. Then the samples were digested for 20 minutes in 200 °C in a Milestone Start D microwave digestion apparatus.<sup>12</sup>

### Selenium determination

For the trace element analysis an inductively coupled plasma emission spectrometer with mass spectrometer (ICP-MS), Type X7, made by Thermo Elemental was used. For measuring elements in relatively high concentration a Thermo Scientific iCAP6300 Duo inductively coupled plasma optical emission spectrometer (ICP-OES) was used.

## Results

The selenium concentrations of different samples are shown in Table 1., compared with the average, given in the literature.<sup>8</sup> Selenium concentration of sunflower seeds that was grown in Hungary was much less, than the literature data. It is because Hungarian soils are lacking in selenium.

Overall, in the oil seeds the selenium concentration was meager than the expected, except in the Brazil nut. In view of the selenium content only, in some cases we should eat more than 1 kg nut or seed per day to ensure the needed amount of Selenium for covering the daily intake demand to save our health. Such a huge dose would be harmful, in the view of other components.

**Table 1.** Measured selenium concentration of the samples (µg g<sup>-1</sup>)

	Se concentration (µg g <sup>-1</sup> )		Quantity (g) required for 60 µg Se intake
	Literature average	Own measurements	
<b>brazil nut</b>	1-50	20.52 ± 0.13	2.9
<b>pumpkin seed</b>	0.06	0.226 ± 0.000	266
<b>sunflower seed</b>	0.6	0.083 ± 0.034	722
<b>nut</b>	0.12	0.051 ± 0.001	1173
<b>peanut</b>	0.01	0.052 ± 0.002	1148
<b>cashew</b>	0.12	0.052 ± 0.002	1163
<b>peanut</b>	0.05	0.173 ± 0.001	346
<b>almond</b>	0.03	0.106 ± 0.000	564
<b>hazelnut</b>	0.02	0.081 ± 0.001	745

The selenium concentration measured in Brazil nut was found to be 20.5 µg g<sup>-1</sup>. Because one piece of Brazil nut is 3.5 g in average, so each one has at least 71.8 µg selenium. Ordinary a 150g package of Brazil nut has 42 pieces, which cost 810 HUF. Therefore we had to pay 20 HUF per Brazil nut, so 71.8 µg Se costs that price. When it is compared to the Se pills, sold in the market, we can see that it's much worth eating one piece of Brazil nut a day, because the Se food supplements costs 53.3 Ft/80 µg Se. Brazil nut consists beside selenium some other useful nutrients including minerals as well. It has a very high concentration of zinc (40.4 µg g<sup>-1</sup> phosphorus (7.24 mg g<sup>-1</sup>), copper (18.7 µg g<sup>-1</sup>), and magnesium (3.18 mg<sup>-1</sup>).

**Table 2.** The amount of oil seeds for the daily mineral intake (g)

Oil seed	Zn	Co	Mn	Cu	Fe	Ca	Cr	K	Mg	P
brazil nut	513	66	562	96	560	746	768	775	126	138
pumpkin seed	286	4160	74	177	185	2451	412	451	66	47
sunflower seed	345	429	76	82	242	1002	610	526	98	98
nut	952	5283	106	189	481	1515	708	1162	275	299
peanut	313	6667	33	106	227	5386	437	674	164	164
cashew	465	3232	120	91	231	2126	142	793	158	223
peanut	513	80206	246	317	754	2297	866	783	245	256
almond	781	508	180	194	348	374	571	694	155	213
hazelnut	741	3642	60	107	406	726	11	791	233	299

**Table 3.** Element content of Brazil nut (mg kg<sup>-1</sup>)

	Element concentration (mg kg <sup>-1</sup> )	
	literature average	own measurements
<b>K</b>	6 300	5 350
<b>P</b>	6 900	6 962
<b>Mg</b>	4 100	3 183
<b>Ca</b>	1 700	1 415
<b>Na</b>	30	47.0
<b>Fe</b>	27	27.6
<b>Zn</b>	42	48.4
<b>Cu</b>	18	20.9
<b>Mn</b>	13	7.1
<b>Cr</b>	0.02-8	0.18
<b>Ni</b>	7	5.06
<b>Mo</b>	0.02	0.14

Table 2 shows the daily needed amount of oil seeds to reach the minimal intake of other important mineral substances.

For the calculation we used the following values: 20 mg of zinc, 140 µg of cobalt, 4 mg of manganese, 2 mg of copper, 15 mg of iron, 1000 mg of calcium, 140 µg of chromium, 3800 mg of potassium, 400 mg of magnesium and 1000 mg of phosphorus. We also measured the other element concentration in Brazil nut. The results are shown in the Table 3.

## Discussion

Nuts and oil seeds are one of the oldest food for the mankind. It had a major role in the hunter-gatherer way people's life. Oil seeds are a part of the healthy and balanced diet. So it is worth eating natural, unsalted seeds. It is a good delicacy for everyone, because it contains a lot of vitamins and antioxidants. To live a healthy life our body requires enough trace elements.

Selenium concentration of the soil determines the concentration of the product, therefore if the plant grown on a selenium poor soil, the product would also be low in Se. So it is hard to assure the selenium intake with only the different kind of food.

Brazil nut contains the maximum amount of selenium, each of them has 72 µg, which corresponds to the dietary supplement pills' concentration. We can cover with it our daily need. The Brazil nuts are not only cheaper, but also having good flavor also, which is very useful for the human. In addition, other valuable nutrition, some other good elements are also found in it.

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