Monitoring of Nickel content in foodstuffs on the Luxembourgish market.

Contributions to dietary intake.

Luc SCHULER, Ph.D.
Division of Food Safety
Ministry of Health
Nickel related health hazards

- Nickel (Ni) is quite common in the rocks of the earth's crust and can therefore be found in foodstuffs and drinking water.
- Ni intake in the EU Member States varies and depends on the natural occurrence in the environment, local industry and consumption habits.
- Exposure: food intake, leaching from stainless steel cooking ware, ...
- Ni toxicity relates in allergic skin reactions in people sensitised to this metal.
- Inhalation of Ni may increase the risk of lung fibrosis and cancer of the respiratory tract.
- It is estimated that up to 17% of women and 3% of men are allergic to nickel.
- In 2015, EFSA fixed the tolerable daily intake at 2.8 µg/kg body weight which was updated to 13 µg/kg body weight in 2020.
- No official limits have been set.
Market monitoring

- Monitoring of contaminants in food allows:
  - obtaining representative data on the occurrence of substances in food and other commodities that are undesirable to health,
  - assess consumer exposure,
  - analysis of trends and recognition of potential health risks.

- The Luxembourgish market is unique in Europe; 625 000 residents, of which 47.4% are of foreign background representing 170 nationalities.

- The aim of this study was to analyse nickel content in plant based foods and beverages most commonly consumed in Luxembourg.

- 580 analysed samples from 2017-2020.
Ni content in analyzed food categories

- Beverages
- Food for infants and young children
- Fungi
- Fruits
- Grains and grain-based products
- Herbs, spices, and condiments
- Legumes, nuts, and oilseeds
- Products for special nutritional use
- Seaweed
- Vegetables
Kruszewski *et al.* reported a maximum Ni content of 12.1 mg/kg in raw cocoa and 4.5 mg/kg in chocolate.

Babaahmadifooladi *et al.* reported a nickel concentration varying from 0.883 to 8.457 mg/kg for chocolate and derived products.

EFSA reported high mean values for certain types of chocolate products (3.8 mg/kg) and cocoa products (9.5 mg/kg)
Ni content in analyzed food categories

The diagram above shows the nickel (Ni) content in various food categories. The x-axis represents different food categories, including Beverages, Chocolate, Food for infants and young children, Fungi, Grains and grain-based products, Herbs, spices and condiments, Legumes, nuts and olives, Products for special nutritional use, Seaweed, and Vegetables. The y-axis represents the Ni content in milligrams per kilogram (mg/kg). The box plots and individual data points illustrate the range and distribution of Ni content across these categories.
### Aromatic herbs and spices

<table>
<thead>
<tr>
<th>Product</th>
<th>N</th>
<th>Minimum (mg/kg)</th>
<th>Maximum (mg/kg)</th>
<th>Mean (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basil</td>
<td>1</td>
<td>0.010</td>
<td>0.010</td>
<td>0.010</td>
</tr>
<tr>
<td>Chive</td>
<td>1</td>
<td>0.020</td>
<td>0.020</td>
<td>0.020</td>
</tr>
<tr>
<td>Oregano</td>
<td>13</td>
<td>0.300</td>
<td>8.600</td>
<td>3.383</td>
</tr>
<tr>
<td>Parsley</td>
<td>3</td>
<td>0.058</td>
<td>0.240</td>
<td>0.146</td>
</tr>
<tr>
<td>Rosemary</td>
<td>1</td>
<td>0.370</td>
<td>0.370</td>
<td>0.370</td>
</tr>
<tr>
<td>Chilis</td>
<td>3</td>
<td>0.400</td>
<td>2.500</td>
<td>1.240</td>
</tr>
<tr>
<td>Curry</td>
<td>5</td>
<td>0.810</td>
<td>1.600</td>
<td>1.128</td>
</tr>
<tr>
<td>Paprika</td>
<td>6</td>
<td>0.710</td>
<td>2.200</td>
<td>1.125</td>
</tr>
</tbody>
</table>

A study of the polish market revealed a Ni content in oregano of 10.6 mg/kg. Oregano seems to accumulate more Ni than other aromatic herbs.
Ni content in analyzed food categories

- Beverages
- Chocolate
- Food for infants and young children
- Fruits
- Fungi
- Grains and grain-based products
- Herbs, spices and condiments
- Legumes, nuts and oilseeds
- Products for special nutritional use
- Seaweed
- Vegetables

Luc Schuler – Monitoring of Ni in foodstuffs
## Legumes

<table>
<thead>
<tr>
<th>Product</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black beans</td>
<td>4</td>
<td>5.700</td>
<td>8.100</td>
<td>7.000</td>
</tr>
<tr>
<td>Red beans</td>
<td>3</td>
<td>1.400</td>
<td>3.200</td>
<td>2.567</td>
</tr>
<tr>
<td>Soybeans</td>
<td>2</td>
<td>2.300</td>
<td>3.700</td>
<td>3.000</td>
</tr>
<tr>
<td>White beans</td>
<td>5</td>
<td>1.200</td>
<td>2.800</td>
<td>2.040</td>
</tr>
</tbody>
</table>

According to EFSA, dried beans contain mean levels of Ni ranging from 3.055 to 3.077 mg/kg.

A recent study from the Belgian market reported a nickel concentration of 2.892 mg/kg in different types of beans including white red and black beans.

Black beans seem to contain more than twice as much Ni than any other analysed sample of this category.
### Ni content (mg/kg)

<table>
<thead>
<tr>
<th>Product</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almonds</td>
<td>10</td>
<td>0.571</td>
<td>1.450</td>
<td>1.007</td>
</tr>
<tr>
<td>Cashew nuts</td>
<td>5</td>
<td>4.000</td>
<td>12.000</td>
<td>6.780</td>
</tr>
<tr>
<td>Hazelnuts</td>
<td>5</td>
<td>1.100</td>
<td>2.500</td>
<td>1.920</td>
</tr>
<tr>
<td>Macadamias</td>
<td>5</td>
<td>0.860</td>
<td>1.500</td>
<td>1.128</td>
</tr>
<tr>
<td>Pistachios</td>
<td>30</td>
<td>0.086</td>
<td>1.400</td>
<td>0.804</td>
</tr>
<tr>
<td>Walnuts</td>
<td>5</td>
<td>1.800</td>
<td>3.800</td>
<td>2.820</td>
</tr>
</tbody>
</table>

Soares *et al.* reported a Ni content in cashews ranging from 3.6 to 6.8 mg/kg (mean 6 mg/kg).

Babaahmadifooladi *et al.* reported Ni content for almonds (0.577 to 1,092 mg/kg), hazelnuts (1.196 to 3.846 mg/kg), pistachio (0.406 to 1.740 mg/kg) and walnuts (0.721 to 4.624 mg/kg).

*The setting of a potential maximum limit for Ni in nuts should be considered.*
## Oilseeds

### Ni content (mg/kg)

<table>
<thead>
<tr>
<th>Product</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chia seeds</td>
<td>4</td>
<td>0.760</td>
<td>3.000</td>
<td>1.990</td>
</tr>
<tr>
<td>Hempseeds</td>
<td>4</td>
<td>0.760</td>
<td>8.000</td>
<td>2.890</td>
</tr>
<tr>
<td>Linseed</td>
<td>3</td>
<td>0.270</td>
<td>1.800</td>
<td>1.013</td>
</tr>
<tr>
<td>Maize</td>
<td>5</td>
<td>0.044</td>
<td>0.450</td>
<td>0.243</td>
</tr>
<tr>
<td>Peanuts</td>
<td>5</td>
<td>0.400</td>
<td>5.300</td>
<td>1.804</td>
</tr>
<tr>
<td>Poppy seeds</td>
<td>4</td>
<td>0.240</td>
<td>1.800</td>
<td>0.975</td>
</tr>
<tr>
<td>Pumpkin seeds</td>
<td>4</td>
<td>0.620</td>
<td>2.200</td>
<td>1.605</td>
</tr>
<tr>
<td>Sesame seeds</td>
<td>5</td>
<td>0.890</td>
<td>1.600</td>
<td>1.238</td>
</tr>
<tr>
<td>Sunflower seeds</td>
<td>3</td>
<td>3.200</td>
<td>8.100</td>
<td>5.533</td>
</tr>
</tbody>
</table>

Mihoc et al. reported a Ni content of up to 6 mg/kg in hempseeds depending on the variety.

Andersen et al. reported nickel contents of 25 samples of sunflower kernels ranging from 2.3 to 5.3 mg/kg.

Hemp (*Cannabis sativa* L.) and sunflower (*Helianthus annuus*) are known for their tolerance to elevated heavy metals in soils and their ability to bioaccumulate these pollutants.

*Therefore, the use of hemp seeds, sunflower kernels, peanuts and their derived products in food for human consumption raises concerns about elevated Ni content.*
Conclusions

- Soil contamination and geographical origin has a strong influence on contaminants level in the raw material.
- Ni is one of the substances for which the toxicological reference values are easily exceeded taking into account average exposure data for children.
- Increased nickel contents were found in nuts, oilseeds, legumes and chocolate/chocolate derived products.
- The careful selection of food with relatively low nickel concentration can result in the reduction in the total dietary intake of nickel per day.
References


