NMDF121

Session 22
MICROMINERALS
PART 4

Naturopathic Medicine
Department
Student Feedback Surveys

Your feedback is important to us!

In the first fifteen minutes of this class you are being provided with the opportunity to complete the Student Feedback Survey for this subject.

You can use your laptop, tablet, or smart phone to access the survey on the LMS. Alternatively you may wish to use a Library computer to complete the survey.
Topic Summary

• Microminerals
  • Fluoride
  • Molybdenum
  • Boron
  • Silica
  • Bromide
Fluorine

http://www.tu-chemnitz.de/chemie/theochem/research_part_html_m59fb4e8.jpg
Fluoride

<table>
<thead>
<tr>
<th>Food</th>
<th>Amount of food</th>
<th>Fluoride level (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tea</td>
<td>100mL</td>
<td>0.1-0.6</td>
</tr>
<tr>
<td>Canned sardines (with bones)</td>
<td>100g</td>
<td>0.2-0.4</td>
</tr>
<tr>
<td>Fish (without bones)</td>
<td>100g</td>
<td>0.01-0.17</td>
</tr>
<tr>
<td>Chicken</td>
<td>100g</td>
<td>0.06-0.10</td>
</tr>
<tr>
<td>Toothpaste</td>
<td>1g</td>
<td>1</td>
</tr>
</tbody>
</table>

(Higdon, 2003)
Fluoride

• Naturally found in minute amounts in all foods

• Although once considered an essential nutrient, it is no longer considered to be essential but rather “beneficial” for human health.

• Fluoride supports bone and teeth mineralisation

• About 2.6g is found in the body
  • 95% is found in bones and teeth
Function

- Bone and joints
  - Stimulates osteoblast proliferation and mineral deposition in bone
  - Thought to occur via cell signaling pathways
  - Demonstrated in children
  - Newly formed bone stimulated from fluoride administration may lack normal structure and strength in adults

(Gropper 2013)
Function

• Teeth

• Some fluoride binds to tooth minerals and forms the hard composite fluorapatite (from hydroxyapatite)

• Topical application can accelerate the remineralisation of teeth.

• Affects the ability of bacteria to attach to the teeth and reduce acid production by bacteria.
Toxicity

- Fluorosis
  - Irreversible pitting and discolouration of the teeth
  - May accumulate in the joints and cause skeletal abnormalities with large prolonged doses

- Kidney stones
  - May be involved in kidney stone formation
    (Kohlmeier, 2003)
Recommended Intake

- Safe range for therapeutic effects = 0.3 to 2mg per day.
  - AI for men 4mg/day
  - AI for women 3mg/day
  - UL of intake for adults 10mg/day
- Chronic intakes of up to 5mg/day in healthy adults appear to be safe.
- The first visible sign is dental fluorosis.
- Ingestion of more than 8-10mg/day may produce skeletal deformities, osteoporosis, and osteomalacia along with secondary hyperparathyroidism and calcification of soft tissues.
Activity

- Watch the following videos
  - Water fluoridation (13 mins)  
    [http://www.youtube.com/watch?v=MAXwv7j_jbY](http://www.youtube.com/watch?v=MAXwv7j_jbY)
  - Professional perspectives on fluoride (15 mins)  
    [http://www.youtube.com/watch?v=ePxDTS9beQ](http://www.youtube.com/watch?v=ePxDTS9beQ)

- Discuss your views in small groups then present a summary from your group to the class
- Online students discuss in the online forums
Further Information

A bibliography of scientific literature on health effects of fluoride

http://www.slweb.org/bibliography.html
Molybdenum

http://commons.wikimedia.org/wiki/File:Molybdenum(VI)-oxide.png
Molybdenum

• An essential trace element.

• A cofactor in enzymes involved in carbon, nitrogen and sulphur cycles.

• Food content depends on soil content
  • High sources – legumes e.g. beans, lentils and peas
  • Moderate sources – grain products and nuts
  • Low sources – animal products, fruit and vegetables
Function

• Sulphur metabolism – converts sulphite to sulphate
  • Amino acids methionine and cysteine
  • Iron-sulphur clusters in cytochrome C
  • Liver detoxification

• Uric acid formation
  • Converts xanthine to uric acid for excretion (xanthine dehydrogenase)
  • Without this occurring, xanthine can build up in the kidneys to form kidney stones
Function

- **Aldehyde Oxidase** –
  - Retinal form of vitamin A
  - Pyridoxal form of B6

- **Copper metabolism**
  - Appears to complex copper, resulting in increased urinary loss
  - Used as an experimental chelator for Wilson’s Disease and also as an anticancer agent

(Gropper, 2013)
Recommended Intake

- Need in minuscule amounts.

- No deficiency symptoms, no reported toxicity symptoms in humans.

- RDI adults = 45mcg/day
- UL of intake for adults is 2000mcg/day

- Safe range for therapeutic effects = 100 – 500mcg per day.
Review Questions

1. List the foods high in fluoride and molybdenum

2. What are the main functions of fluoride?

3. What are the main functions of molybdenum?
Boron

http://commons.wikimedia.org/wiki/File:Boron.jpg
# Boron

<table>
<thead>
<tr>
<th>Food</th>
<th>Boron (mcg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prunes</td>
<td>20-30</td>
</tr>
<tr>
<td>Raisins</td>
<td>22</td>
</tr>
<tr>
<td>Peanuts</td>
<td>17</td>
</tr>
<tr>
<td>Peaches</td>
<td>5.3</td>
</tr>
<tr>
<td>Apples</td>
<td>3.6</td>
</tr>
</tbody>
</table>
Function

• Promotes cell membrane stability
• Anti-inflammatory action in response to injury or infection
• Bone and connective tissue
  • Appears to improve growth, mineralisation and mineral retention of bone
  • Improves rates of wound healing
  • May act through improving proteoglycan synthesis
• Blood pressure
  • May increase both systolic and diastolic blood pressure

(Kohlmeier, 2003)
Toxicity Effects

- Boron is easily absorbed and subsequently eliminated primarily via the kidneys, use cautiously in renal insufficiency.

- Acute –
  - Nausea, vomiting, diarrhoea
  - Dermatitis
  - Lethargy

- Chronic
  - Nausea, poor appetite
  - Anaemia
  - Dermatitis
  - Seizures (Gropper 2013)
Recommended Intake

- RDA (adult) = 2-3mg/day
- Safe range for therapeutic effects (adults) = 2-7mg/day
- Toxicity - >100mg/kg food intake
- Acute lethal dose = 18-20gm (Due to circulatory collapse and shock)

(Oseicki, 2002)
Silicon

http://commons.wikimedia.org/wiki/File:SiO2_Quartz_extra-O.svg
Silicon

• Silicon does not appear to be essential to humans, and no functions have been clearly defined or confirmed.

• Major food sources are food additives, as it is mainly found in sand and quartz.

• Whole cereal grains and root vegetables

• Water

• Magnesium trisilicate is commonly used as an antacid.
Silicon

- Thought to have metabolic and structural roles
- Influences formation and growth processes in bones
  - Orthosilicic acid stimulates collagen synthesis and bone cell differentiation in culture cells
  - Decreases in femoral and vertebral Ca, Cu, Zn and K, also increased plasma alkaline phosphatase in deficient rats
  - Effects on bones may be related to proton buffering
  - Decreased collagen formation and increased breakdown in deficient rats
    (Gropper 2013)
- May reduce aluminium toxicity by complexing with it and hindering absorption
Therapeutic Uses

- Ortho-silicic acid potential therapeutic uses include:
  - Promote bone formation and bone density maintenance
  - Alzheimer’s disease
  - Immunodeficiency
  - Promote growth and condition of skin, hair and nails
  - Possible anti tumour effect (Jurkic LM et al 2013)
Toxicity

- Inhalation may cause progressive fibrosis of the lungs
- General side effects and symptoms of toxicity include:
  - Bruising
  - Stomach irritations
  - Skin, rashes / irritations
  - Diminished antioxidant enzyme activity eg. GSH, SOD and catalase

(Gropper 2013)
Recommended Intake

• RDA (adult) = 9-14mg

• Safe range for therapeutic effects (adult) = 20-30mg
Bromine

http://commons.wikimedia.org/w/index.php?title=Special%3ASearch&redirs=1&search=bromide&fulltext=Search&ns0=1&ns6=1&ns12=1&ns14=1
Bromine

• Bromine is found in grains, nuts, seafood and sea salt

• Required for:
  • Immune defense
    • Used by eosinophils as an oxidant
  • Thyroid function
    • May compete with iodide for transport into the thyroid gland
  • Sleep
    • Low bromine status may relate to insomnia

(Kohlmeier, 2003)
Deficiency

- A she-goat whose mother was kept for two years on a bromine deficient diet demonstrated –
  
  - Anomalies of the bones and joints of the anterior limbs,
  - Disturbances of carbohydrate, lipid and mineral metabolism
  - Liver fat degeneration

(Zhavoronkov 1996)
Toxicity Symptoms

- Can occur at low doses
- Loss of appetite, nausea and/or vomiting
- Lethargy
- Mental changes such as loss of concentration and memory, confusion, headache and depression.
- Loss of neural sensitivity
- Abnormal speech, delirium, aggressiveness, psychoses
Recommended Intake

- A specific therapeutic index is not known but only very small amounts of bromide are needed for health.

- Estimated median daily intake of bromine worldwide from food and water is 1mg - 3mg per day
Review Questions

1. List the foods high in boron, silica and bromine

2. What are the main functions of boron?

3. What are the main functions of silica?

4. What are the main functions of bromine?
Discussion

- Little recent research-based information is available on the therapeutic benefits of nutrients such as boron, silica and bromide.
- With this in mind, why do you think that would they still be found in multi-vitamins?

Discuss your thoughts with the class
Online students should discuss within the online forum
References

• Zhavoronkov et al. 1996. Pathology of congenital bromine deficit (experimental observation). *Arkh Patol.* 58: 2; 62-7
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