The role of functional foods for healthy aging

Content

- 21st century - the century of aging
- Nutrition for a healthy life
- Gut health in elderly is key
- Factors to support a healthy gut
- Summary
The goal: **healthy nutrition for all**
Demographic changes predict an aging world

- 21st Century: Century of Aging
- Life expectancy increases, fertility rates decrease
- By 2040, more than one in four persons be ≥ 65 y
- Health expectancy is ~10 years less than life expectancy, i.e. the last decade is marked by disability and disease

“Nutrition is a key component to promote healthy living and to reduce the dysfunctional life span”

IOM 2012 Nutrition & Healthy Aging in the Community
A healthy life starts from conception …

... and can be positively impacted in all phases of the life cycle!
Nutrition is complex ...

Vitamins
- Vitamin A
- Vitamin E
- Vitamin C
- Vitamin D
- Vitamin B1
- Vitamin B2
- Vitamin B6
- Vitamin B12
...

Enzymes
- Phytase
...

Omegas
- DHA
- EPA
- ARA

Minerals
- Calcium
- Magnesium
- Iron
- Zink
- Iodine
- Selenium
...

Carotenoids
- B-carotene
- Lutein
- Zeaxanthine
...

Omegas
- DHA
- EPA
- ARA

Enzymes
- Phytase
...

Minerals
- Calcium
- Magnesium
- Iron
- Zink
- Iodine
- Selenium
...

Fibers

Amino acids
- Methionine
- Lysine
...

... and we require all ingredients to act in concert
A balance of all nutrients is essential for a healthy life.
Inadequate nutrient intake is a risk for non-communicable diseases

<table>
<thead>
<tr>
<th></th>
<th>Vitamin A</th>
<th>β-Carotene</th>
<th>Thiamine</th>
<th>Riboflavin</th>
<th>Niacin</th>
<th>Vitamin B5</th>
<th>Vitamin B6</th>
<th>Vitamin B12</th>
<th>Folate</th>
<th>Biotin</th>
<th>Vitamin C</th>
<th>Vitamin D</th>
<th>Vitamin E</th>
<th>Vitamin K</th>
<th>Dietary AO</th>
<th>Multivitamin</th>
<th>PUFA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aging</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Cancer</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Dementia</td>
<td>●</td>
<td>●</td>
<td></td>
<td>●</td>
<td>●</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Bone Health</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Hypertension</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Diabetes</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>CVD</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>COPD</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>AMD</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>
Malnutrition in elderly is a serious issue

**Hospital**
- Malnourished: 39%
- At risk of malnutrition: 47%
- Well nourished: 14%

86% of patients are either malnourished or at risk of malnutrition.

**Nursing home**
- Malnourished: 14%
- At risk of malnutrition: 53%
- Well nourished: 33%

67% of patients are either malnourished or at risk of malnutrition.

**Community**
- Malnourished: 6%
- At risk of malnutrition: 32%
- Well nourished: 62%

38% of patients are either malnourished or at risk of malnutrition.

**Rehabilitation**
- Malnourished: 50%
- At risk of malnutrition: 41%
- Well nourished: 9%

91% of patients are either malnourished or at risk of malnutrition.
Many factors impact nutrition intake in elderly

- Altered taste and smell
  - decreased appetite

- Oral health problems
  - poor diet quality

- Decreased physical mobility
  - impaired ability preparing meals

- Illness
  - multiple medications

- Psychosocial issues
  - decreased stimulation to eat
Traffic light system to profile vitamin intake

- General population >70 years from NHANES 2003 to 2008
- US recommendations that cover 97.5% of population used (RDA)
- Grouped into <5%, 5 to 25%, >25 to 50%, >50 to 75%, >75% not achieving recommended intakes
- Translated into color groups from green (<5%) to red (>75%)

Objective: Draw attention to the situation in the elderly
Example vitamin intake: US elderly

**Population % below reference value**
- >75%
- 50 - 75%
- 25 - 50%
- 5 - 25%
- <5%

**Vitamin A**
- Men: 50 - 75%
- Women: 50 - 75%

**Vitamin D**
- Men: >75%
- Women: >75%

**Vitamin E**
- Men: 25 - 50%
- Women: 25 - 50%

**Thiamin**
- Men: 25 - 50%
- Women: 25 - 50%

**Riboflavin**
- Men: <5%
- Women: <5%

**Niacin**
- Men: 5 - 25%
- Women: 5 - 25%

**Vitamin B6**
- Men: 25 - 50%
- Women: 25 - 50%

**Folate**
- Men: 5 - 25%
- Women: <5%

**Vitamin B12**
- Men: 25 - 50%
- Women: 25 - 50%

**Vitamin C**
- Men: 50 - 75%
- Women: 50 - 75%

**Vitamin K**
- Men: >75%
- Women: >75%

**NHANES 2003-2008**
Digestive health is a key factor

The gut is enormously important for the availability of nutrients.

Digestive health depends on:

- Good food choices
- Proper breakdown of nutrients and absorption
- Good balance of healthy gut flora
- Healthy elimination

A balance of billions of microorganism (healthy and pathogenic) is managed in the gut; nutritional factors stimulate optimal balance.
Pro- and prebiotics - next to other factors - stimulate a healthy gut flora

Regulate intestinal function

- Aid in digestion
- Improve lactose intolerance
- Support growth of healthy bacteria
- Inhibit growth of pathogenic bacteria
- Aid in the absorption of minerals
- Prevent Diarrhea
Four criteria for eligibility as prebiotic (Gibson et al., 2007)

- Resistance to gastric acidity, to hydrolysis by mammalian enzymes, and to gastrointestinal absorption;

- Selective stimulation of the growth and/or activity of those intestinal bacteria that contribute to health and well-being.

- Fermentation by intestinal micro flora; to produce short chain fatty acids (SCFA) and gas.

- Induce LUMINAL or SYSTEMIC beneficial effects.
### A number of prebiotics are part of the food chain or fortified foods

<table>
<thead>
<tr>
<th>Prebiotic Type</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast milk oligosaccharides</td>
<td>represent a large component of human milk</td>
</tr>
<tr>
<td>Polydextrose - Fructans</td>
<td>fruits</td>
</tr>
<tr>
<td>Inulin</td>
<td>wheat, banana, onions, garlic, ..</td>
</tr>
<tr>
<td>Fructo-oligosaccharides</td>
<td>plants</td>
</tr>
<tr>
<td>Galacto-oligosaccharides</td>
<td>milk</td>
</tr>
<tr>
<td>Lactulose</td>
<td>milk</td>
</tr>
<tr>
<td>Soy-oligosaccharides</td>
<td>soy</td>
</tr>
<tr>
<td>Xylo-oligosaccharides</td>
<td>fruits</td>
</tr>
<tr>
<td>Isomalto-oligosaccharides</td>
<td>corn, wheat</td>
</tr>
<tr>
<td>Lactitol</td>
<td>milk</td>
</tr>
<tr>
<td>β - glucan</td>
<td>oat, barley</td>
</tr>
</tbody>
</table>
**β-glucans from oat**

- β-D-glucan (1→3), (1→4) is found in grain cereals.
- β-glucans are linear polysaccharides and the main component of the soluble dietary fibre.
- The solubility is enhanced by the (1→3)-linkages compared to cellulose which only has (1→4)-linkages.

The functional benefits of oat β-glucans (BG) are attributed to the increased viscosity in the intestine after ingestion.
- The viscosity is a function of solubility, concentration and molecular weight
Soluble β-glucan and insoluble fibers work in concert

Benefits in improvement of bowel function of β-glucan in relation to fermentation of soluble and insoluble fibres demonstrated in human studies

- Soluble (oat β-glucan), fermentable DF
  - Stimulation of microflora
    - Increased gas
    - SCFA‘s

- Insoluble, poorly fermentable DF
  - 2011: positive opinion to improve bowel function
    - Enlargement of food-volume
    - Acceleration of transit time
    - Reduced water resorption in colon
    - Increased stool bulking and improved stool consistency
Viscosity effect of β-glucans

1. Increased viscosity
2. Reduced reabsorption of bile acids
3. Bile acids are deprived from the enterohepatic circle
4. Increased synthesis of bile acids from cholesterol
5. Reduced circulating LDL-cholesterol concentrations
Cholesterol reduction vs molecular weight

Foods containing high-MW oat β-glucan reduce LDL by about 0.21 – 0.55 mmol/L (5.5% - 14%).

Low MW is not supported by clinical data.

MW and dose of bioavailable β-glucan influence LDL-cholesterol lowering ability.

MW ≤ 250,000 is ineffective in lowering LDL

“The evidence indicates that the cholesterol-lowering effect of oat beta-glucan may depend on the increased viscosity in the small intestine that reduces the reabsorption of bile acids and circulating (LDL) cholesterol concentrations and increases the synthesis of bile acids from cholesterol,
Glucose control - bioactive oat β-glucan and viscosity

- Reduction in molecular weight resulted in increase in peak blood glucose rise.

- Treatments with molecular weights less than 400,000 were not significantly different from whole wheat control.

Tosh et al 2008

“The mechanism of β-glucan is well established, and relates to the increased viscosity of the meal bolus when beta-glucans are added. A high viscosity delays the rate of absorption of nutrients.”
Oat β-glucans
Approved health benefits and accepted biomarkers

3-4 grams bioactive oat β-glucan daily required

- **Cholesterol lowering (CVD)**
  - EFSA art. 14
  - EFSA art. 13.1
- **Blood glucose control (Diabetes)**
  - EFSA art. 13.1
- **Gut Health (IBS)**
  - EFSA art. 13.1
- **Weight control (Obesity)**
  - Work in progress
**EFSA claim wording**

**Cholesterol**  
**EFSA art 13.1**  
- Regular consumption of oat and barley beta-glucans contributes to maintenance of normal blood cholesterol concentrations  
**EFSA art 14 (1)(a)**  
- Oat beta-glucan has been shown to lower/reduce blood cholesterol  
- High cholesterol is a risk factor in the development of coronary heart disease.

**Blood glucose;**  
**EFSA art 13.1**  
Consumption of beta-glucans from oats or barley contributes to the reduction of the glucose rise after a meal.

**Gut health;**  
**EFSA art 13.1**  
Oat grain fiber contributes to an increase in faecal bulk.
Global health claims

Intakes of at least 3g oat beta-glucan per day significantly lower the risk of heart disease and health claims are now approved in Europe, USA, Canada, Australia and some Asian countries.

UK, Netherlands, Sweden and other European authorities
- similar health claims for oat beta glucans.
- the UK Joint Health Claims Initiative recommend the consumption of three grams of beta glucan each day.

Switzerland (BAG)
- EFSA-identical approval for the health claim of oat beta-glucan

USA (FDA)
- Oat beta glucan approved for a heart health 1997; ruling was reaffirmed in 2003.

Both the FDA and the EFSA health claims are based on a daily intake of 3g oat beta glucan.
Health claims continued

Canada (Health Canada)
According to Health Canada: "oat fiber helps reduce/lower cholesterol, (which is) a risk factor for heart disease". The recommended daily intake of oat fiber is 3g.

Malaysian Ministry of Health
Has approved oat soluble fibre (beta-glucan) under its nutrient function claim section.

Australia, New Zealand (FSANZ) Food Standards Australia New Zealand
As part of a diet low in saturated fat, 3g of Beta-Glucan each day is required to help lower cholesterol re-absorption.
In summary: A healthy eating and...

...a glass of β-glucans a day keeps the doctor away!