Healthy Nutrition

The role of Broccoli Sprouts

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Good food is good for your health!
What about your *personal* life style?
Good food is good for your health,
Healthy Nutrition; *The role of Broccoli sprouts*

Good food is good for your health,

**BUT:**
Good food is good for your health,

**BUT:**
1. I do not have time
Good food is good for your health,

**BUT:**
1. I do not have time
2. Good food is expensive
Healthy Nutrition; *The role of Broccoli sprouts*

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3. Nobody tells me what to eat
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5. I have a good medical doctor
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5. I have a good medical doctor
6. I have other priorities
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**BUT:**
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3. **Nobody tells me what to eat**
4. I do not know exactly what good food is
5. I have a good medical doctor
6. I have other priorities
I have a good medical doctor

- Medical doctors are central in health care
- Medical doctors are not trained in prevention, but in treatment!
- Nutrition is not a major item in medical education in contrast to farma and surgery
- Consumers rely on medical doctors
- Consumers are not trained in taken responsibility in their own health
Farma(drugs) vs Food

**Pharma:**
- acute effect needed
- strong effect needed
- side effects have to be acceptable

**Treatment (repair)**

**Food:**
- long term effect
- subtle effect
- almost no side effects

**Prevention (maintenance)**
Conclusions (1)

- The health system is not ready for you!
  - they believe more in repair and not ready for maintenance

- Medical doctors are not ready for you!
  - they believe more in pharma.

- The consumers are not ready for you!
  - they believe more in medical repair

- This is a challenge!!
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Communication!

Education from primary school all the way to university (including medical doctors)
Healthy Nutrition; *The role of Broccoli sprouts*

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What is good food?

- Communication
- Education
- Science
What is good food?
What is good food?
What is good food?

![Food Guide Pagoda]

- Fats and oils: 25 g
- Milk and dairy products: 100 g
- Beans and bean products: 50 g
- Meat and poultry: 50-100 g
- Fish and shrimp: 50 g
- Eggs: 25-50 g
- Vegetables: 400-500 g
- Fruits: 100-200 g
- Cereals: 300-500 g

Source: Chinese Nutrition Society
Lifestyle - advice

› MORE PHYSICAL ACTIVITY
› Eat less
› Limit saturated fat, salt and sugar

› EAT A VARIETY OF FOODS
› EAT MORE VEGETABLES AND FRUIT
(un)balanced food

**high nutriënt density**
- vitamins
- bioactives: anti-inflammatory, anti-oxidant, others

**current food pattern**
- many products with low nutriënt density and high energy density
  - fast food
  - sweets/cookies
  - beverages
Nutrients

Energy density - nutrient density

Macronutrients - carbohydrates
  - fats
  - proteins

Micronutrients - vitamins
  - minerals
  - trace elements
  - bioactives
Bioactives

- What are bioactives?
- Role of bioactives in our food
<table>
<thead>
<tr>
<th>Phytonutrients</th>
<th>Found in</th>
<th>Great for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allicin</td>
<td>Garlic, onions, jicama</td>
<td>Eliminating toxins from the body</td>
</tr>
<tr>
<td>Capsaicin</td>
<td>Cayenne peppers, red peppers</td>
<td>Preventing toxic molecules from invading cells; reducing inflammation</td>
</tr>
<tr>
<td>Carotenoids</td>
<td>Carrots, tomatoes, cantaloupe, arugula, spinach, collard greens, kale, mustard greens, Swiss chard, turnip greens, broccoli, Brussels sprouts, sweet potatoes, butternut squash, pumpkin, red peppers</td>
<td>Removing damaging free radicals from the cells, slowing macular degeneration, preventing cataracts, repairing DNA and blocking carcinogens from entering cells</td>
</tr>
<tr>
<td>Catechins</td>
<td>Green and black teas</td>
<td>Inhibiting the activation of carcinogens</td>
</tr>
<tr>
<td>Ellagic Acid</td>
<td>Grapes, strawberries, blackberries, cranberries, walnuts</td>
<td>Preventing cancer</td>
</tr>
<tr>
<td>Genistein</td>
<td>Tofu, soymilk, soybeans</td>
<td>Inhibiting the formation of the blood vessels that help tumors grow</td>
</tr>
<tr>
<td>Indoles and Isothiocyanates</td>
<td>Collard greens, kale, broccoli, cauliflower, cabbage</td>
<td>Blocking carcinogens and interfering with the action of a precancerous form of estrogen</td>
</tr>
<tr>
<td>Isoflavones</td>
<td>Kudzu, soybeans, peas, peanuts, legumes</td>
<td>Modulating estrogen levels; preventing breast, uterine and prostate cancers; and reducing the risk of heart disease and osteoporosis</td>
</tr>
<tr>
<td>Lignans</td>
<td>Seeds and grains, especially flaxseed</td>
<td>Inhibiting excessive estrogen action, and possibly reducing breast, colon and ovarian cancer</td>
</tr>
<tr>
<td>Limonoids</td>
<td>Citrus fruit peels</td>
<td>Clearing congestive mucus from the lungs, detoxifying enzymes in the liver, and supporting detoxification of hormones and other substances that cause cellular decay</td>
</tr>
<tr>
<td>Lycopene</td>
<td>Tomatoes</td>
<td>Fighting heart disease and prostate cancer, plus reducing the risk of stomach, lung and prostate cancers</td>
</tr>
<tr>
<td>Phenols</td>
<td>Black and red berries, celery, cabbage, grapes, eggplant, peaches, nectarines</td>
<td>Preventing cancer, blocking specific enzymes that cause autoimmune diseases, protecting against heart attacks and strokes, preventing platelets in the blood from clumping, reversing nerve-cell aging, and destroying hepatoxins, which damage the liver</td>
</tr>
<tr>
<td>Phytosterols</td>
<td>Pumpkin, rice, soybeans, yams, all green and yellow vegetables</td>
<td>Blocking &quot;bad&quot; cholesterol uptake, reducing inflammation and blocking the growth of tumors</td>
</tr>
<tr>
<td>Polyphenols</td>
<td>Buckwheat, wheat germ</td>
<td>Restoring a lagging immune system</td>
</tr>
<tr>
<td>Saponins</td>
<td>Alfalfa, legumes</td>
<td>Lowering cholesterol and inhibiting the growth of cancer cells by interfering with their DNA</td>
</tr>
<tr>
<td>Zeaxanthin</td>
<td>Kale, daikon, collard greens, green sorrel, arugula</td>
<td>Enhancing immune function and preventing several types of cancer</td>
</tr>
</tbody>
</table>
Oxidative stress

Metabolic stress

Inflammatory stress

Energy supply → Oxidative stress

Building blocks → Metabolic stress

Destroying bacterias viruses
Metabolic dysbalance and chronic diseases

- Oxidative stress
- Metabolic stress
- Inflammatory stress
- Metabolic syndrome
- Aging
- Joint pain
- Arthritis
- Cancer
- Infection
- Gingivitis
- Type 2 Diabetes
- Alzheimer
- Asthma
- Eye disorders
- Allergies
- CVD
- IBD
- UMCG
- Medical Biomics
Metabolic inflammation or chronic low grade inflammation

\[ \downarrow \]

Induces / attenuates \textbf{insulin resistance} and disrupts \( \beta \) \textbf{cell function}

\[ \downarrow \]

Development of type 2 diabetes
Several types of Inflammation

a. acute inflammation- (organ damage)

b. chronic inflammation- (arthritis)

c. chronic low grade inflammation or metabolic inflammation (origin unknown)
Metabolic inflammation

Where does it come from? What are treatment targets?
Metabolic inflammation

Where does it come from?

1. Postprandial inflammation induced by overload of saturated fat or sugars (unbalanced diet)
Intracellular signalling of inflammation in PBMC in human

- Stimulation by fat or glucose
- Intracellular signalling
- Activation of NF-kB (nuclear transcription factor)
- Production of inflammatory factors (cytokines)
  - IL-6, TNF-a, ICAM, VCAM
- PBMCs and cytokines can be used to monitor inflammation
Postprandial (inflammatory) response

![Graph showing nutrient concentration over time]

Nutrient Concentration

0 1 2 3 4

Nutrient Concentration
Postprandial inflammatory response
Postprandial inflammatory response
Cumulative inflammatory response

![Graph showing cumulative inflammatory response over time with two lines representing unbalanced and balanced diets.](graph.png)
Where does it come from?

1. Postprandial inflammation induced by overload of saturated fat or sugars (unbalanced diet)

2. Dysfunction of adipose tissue (fat tissue)
Chronic low-grade inflammation

Where does it start?

Fat tissue
Adipose cells secrete inflammatory factors

Genomic and proteomic analyses of adipose cells

Adipose cells have the machinery to secrete inflammatory factors  (Meijer et al. Plos One 2011)
Counteracting metabolic inflammation

Metabolic inflammation → type 2 diabetes

Anti-inflammatory compounds
Anti-inflammatory components

- Many components in fruit & vegetables

- Can dietary fiber (SCFA), SFN inhibit metabolic inflammation?
Sulforaphane (SFN)

Sulforaphane (SFN) is an isothiocyanate (N=C=S)

Obtained from glucoraphanin (glucosinolate) in cruciferous vegetables (broccoli, Brussels sprouts, cauliflower, etc.)

Enriched in broccoli sprouts and seedlings
Screening (micro-) vegetables using *Reporter cell line*: inhibitory effect of bioactives on NF-κB activation

- Significant inhibition of TNF-α-induced NF-κB activation in H293-NF-κB-RE reporter cell line (Meijer et al. Food Chemistry 2014)
SCFAs inhibit NF-κB activation in a HEK293 reporter cell line

IC₅₀ but: 78.3 μM
IC₅₀ prop: 370.3 μM
IC₅₀ acetate: 3337.8 μM
NF-κB activation; inhibitory effect of SFN

- activation by TNF-α in H293-NF-kB-RE reporter cell line
- significant inhibition of TNF-α-induced NF-kB by SFN
B. Design pilot study in human

Timeline pilot study

-60 -45 -30 -15 0 15 30 45 60 75 90 105 120
Intake BroccoCress oral glucose load blood samples

[glucose] measurements

Blood collection
PBMC isolation
Nuclear extraction

Blood sample

Blood sample

75 g glucose drink

Glucose (mM)

Elisa

LC-MS/MS

ELISA
BroccoCress inhibits glucose-induced NF-kB activation in human

Broccoli seedlings can reduce glucose-induced NF-kB activation (n=5)
Conclusion Human Pilot Study

- 75 gram glucose activates NF-kB in PBMCs

- (one serving!!) Broccoli seedlings seem to be able to prevent NF-kB activation
Research strategy phytochemicals (sulforaphane)

› A. in vitro assays (screening systems)

› B. pilot experiments (in human)

› C. registered randomized human intervention study (according to EFSA criteria)
Nutrition & health (prevention)

Communication strategies

Mismatching

Functional foods & supplements

- Nutrition & emotion
- Nutrition and imagination
- Nutrition & taste
- Nutrition & health
  - Lack of time
  - Lack of knowledge
  - Lack of discipline
How to overcome mismatching?

› Supplements, functional foods or (micro) - vegetables?
Anti-inflammatory components

Micro-vegetables (broccoli seedlings) of Koppert Cress

> containing sulforaphane (SFN) as the main phytochemical

> No de novo-synthesis of SFN in broccoli seedlings !!!!!!

> (Gorissen et al. 2011)
Conclusions (2)

- Metabolic inflammation involved in developing type 2 diabetes
- Adipose tissue (obesity / inflammation) plays a role
- Post-prandial inflammation plays a role
- Anti-inflammatory compounds are highly relevant
- SFN important for reducing risk type 2 diabetes
- Much scientific evidence to support SFN ((micro-) vegetables)
- Health evidence for Broccoli seedlings
- Balanced diets should be promoted
Quality of our food: balanced vs un-balanced diets

Unbalanced food
products with low nutriëntdensity and high energydensity

- fast food
- Cookies
- Soft drinks

Balanced food:
high nutriëntdensity
dietary fiber, vitamins, essential nutrients, bioactives (anti-inflammatory compounds)
Acknowledgements

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- Kees Meijer
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- Martijn Koehorst
- Coby Eelderink

TI – FN Netherlands

FND partners

- Isolife, Wageningen, The Netherlands
- Koppert Cress, Monster, The Netherlands
Future ISGA

- good perspectives
- clear challenge

Good luck!
questions and contact

> 谢谢！

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Metabolic dysbalance

- Oxidative stress
- Inflammatory stress
- Metabolic stress
- Metabolic syndrome
- Cancer
- Infection
- Joint pain
- Arthritis
- Metabolic syndrome
- Obesity
- CVD
- IBD
- Alzheimer
- Diabetes
- Asthma
- Eye disorders
- Allergies
Claims of high scientific level

Problems with food industry

No communication with consumers
Promotion of functional foods always simultaneously with promotion of healthy lifestyle
Functional foods

Functional foods and supplements
Education!
high nutrient density
vitamins
bioactives: anti-inflammatory/ anti-oxidant/ others

Current food pattern
many products with low nutrient density
and high energy density

- Fast food
- sweets/cookies
- beverages
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› A. in vitro assays (screening systems)

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Inhibition of inflammation by SCFA & SFN

- Can SCFA & SFN inhibit metabolic (NF-kB related) inflammation?

![Diagram showing the inhibition of inflammation by SCFA & SFN](image)
Sulforaphane (SFN)

- Sulforaphane (SFN) is an isothiocyanate (N=C=S)
- Obtained from glucoraphanin (glucosinolate) in cruciferous vegetables (broccoli, Brussels sprouts, cauliflower, etc.)
- Enriched in broccoli sprouts and seedlings
Inhibition of inflammation by SFN

- Can SFN inhibit metabolic (NF-κB related) inflammation?
Nutrition is not a major item in medical education in contrast to farma and surgery

- prevention vs action

- economic reasons (patents)
Nutrition & health (prevention)

• Nutrition & emotion
• Nutrition and imagination
• Nutrition & taste
• Nutrition & health
  – Lack of time
  – Lack of knowledge
  – Lack of discipline

communication strategies

mismatching

functional foods & supplements
Chronic low-grade inflammation

drugs  *(acute, strong, side effects)*

vs

nutrients *(very small effect, maintenance, chronic)*

nutrients: bioactives
Anti-inflammatory components

› Micro-vegetables (broccoli seedlings) of Koppert Cress

(www.koppertcress.com)

containing sulforaphane (SFN) as the main phytochemical
Nomenclature

- **Dietary/nutritional supplements**
  A preparation intended to provide nutrients, such as vitamins, bioactives, minerals, fiber, fatty acids or amino acids, that are missing or are not consumed in sufficient quantity in a person's diet.

- **Nutraceuticals**
  Food, or parts of food, that provide medical or health benefits, including the prevention and treatment of disease.

- **Functional foods**
  Foods with modified composition
Conclusions (1)

› consumers are not ready for you!
› You have to educate them

› medical doctors are not ready for you!
› You have to educate them

› the society is not ready for you!
› They believe more in medical doctors and farmacology