Healthy Nutrition
The role of Broccoli Sprouts

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ISGA Rotterdam;23-04-2015

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Healthy Nutrition; *The role of Broccoli sprouts*

Good food is good for your health!

Healthy Nutrition; *The role of Broccoli sprouts*

What about your *personal* life style?

Healthy Nutrition; *The role of Broccoli sprouts*

Good food is good for your health,

Healthy Nutrition; *The role of Broccoli sprouts*

Good food is good for your health,

BUT:

Healthy Nutrition; *The role of Broccoli sprouts*

Good food is good for your health,

BUT:

1. I do not have time

Healthy Nutrition; *The role of Broccoli sprouts*

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*

Good food is good for your health,

BUT:

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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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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: **Treatment (repair)**

- acute effect needed
- strong effect needed
- side effects have to be acceptable

Food: **Prevention (maintenance)**

- long term effect
- subtle effect
- almost no side effects

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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Nobody tells me what to eat

Communication!

Education from primary school all the way to university (including medical doctors)

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What is good food?

- Communication

- Education

- Science

What is good food?

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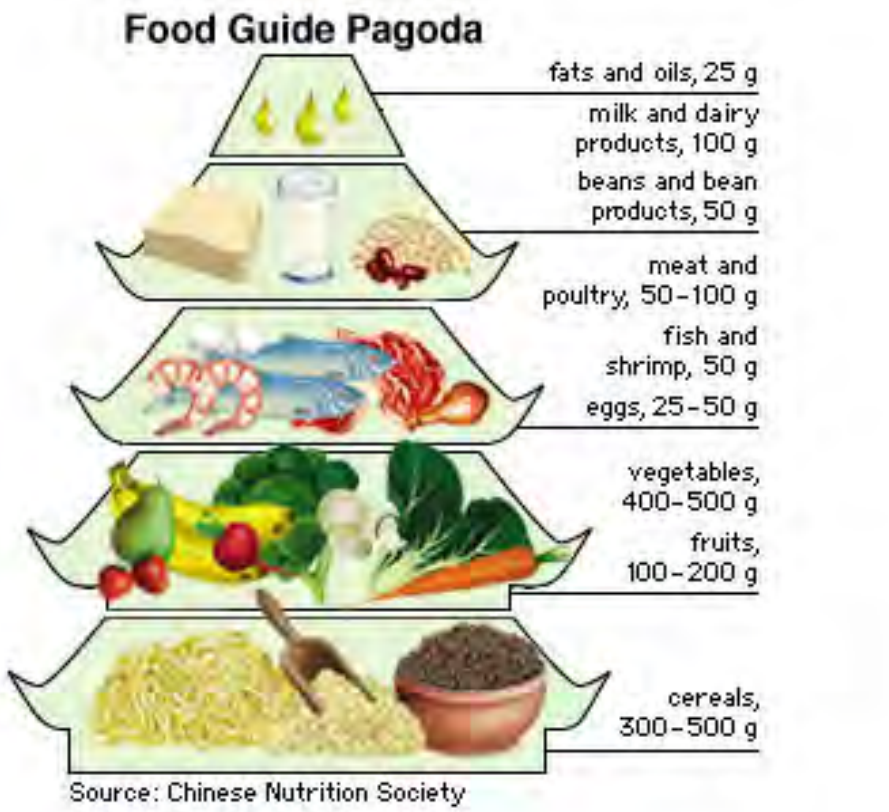
What is good food?



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-inflammatoir, anti-oxydant, others

current food pattern
many products with low nutriënt density
and high energy density

- **fast food**
- **sweets/cookies**
- **beverages**

Nutrients

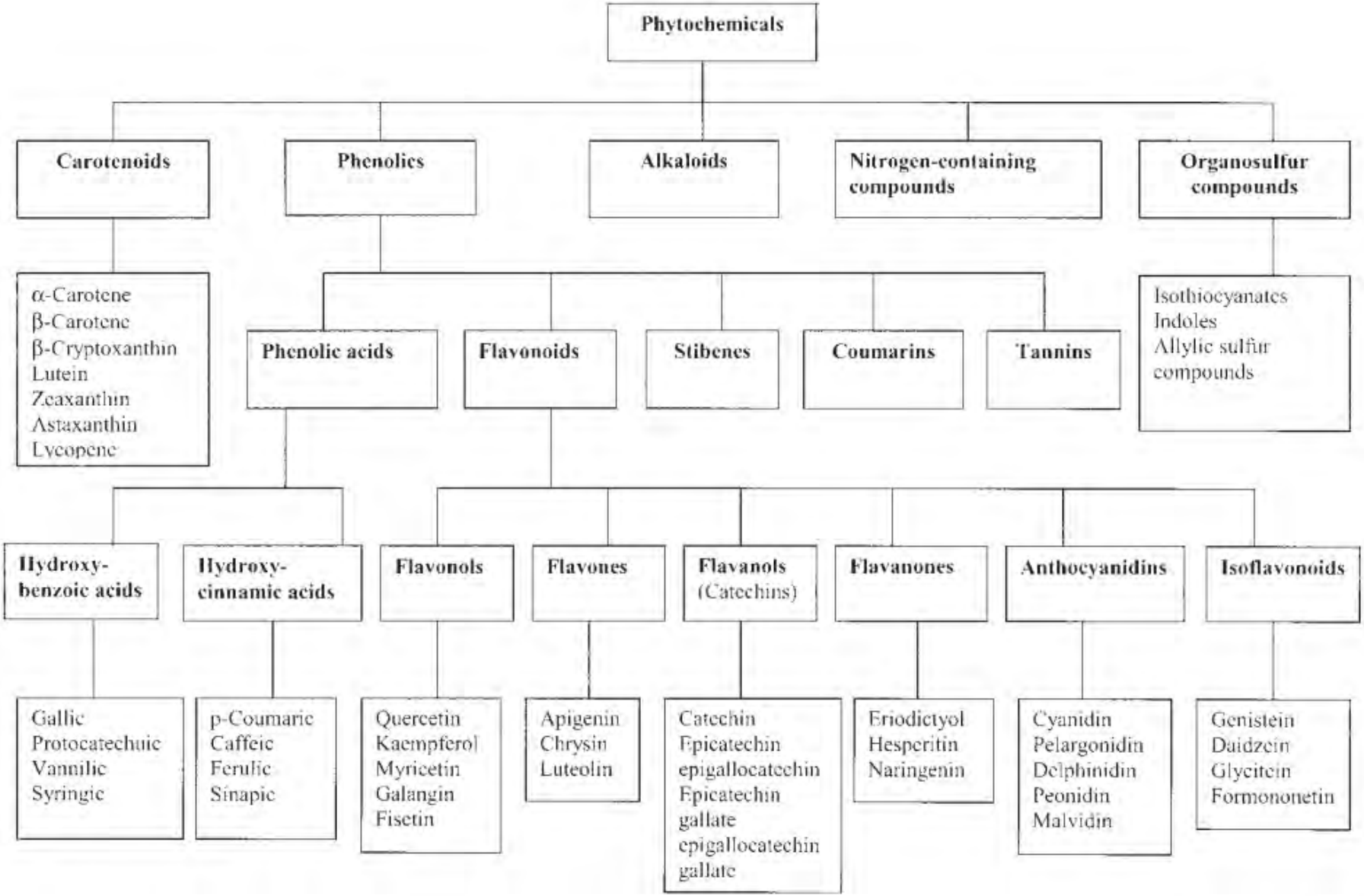
Energy density - nutrient density

Macronutrients - carbohydrates
- fats
- proteins

Micronutrients - vitamins
- minerals
- trace elements
- **bioactives**

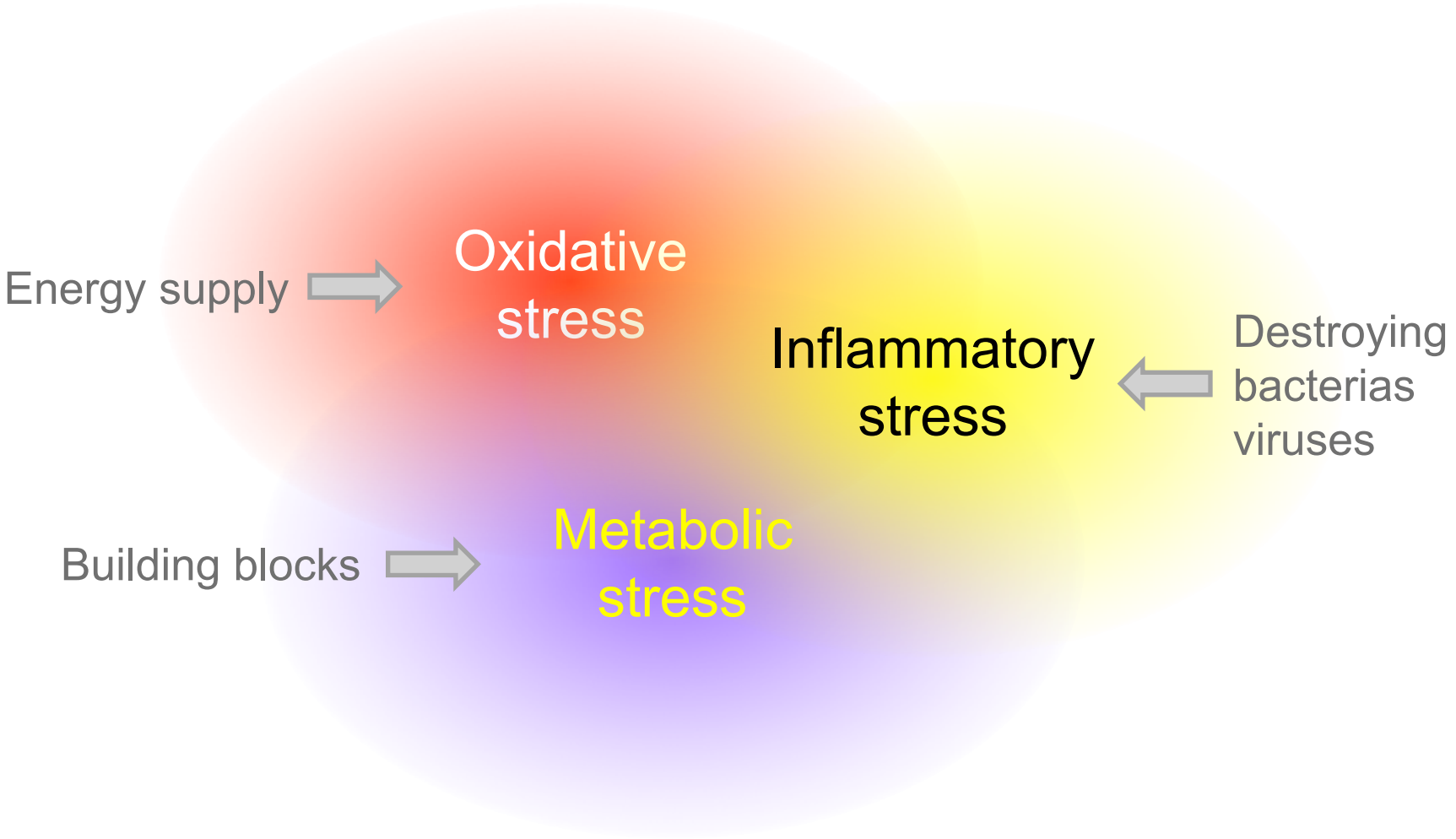
Bioactives

- What are bioactives?
- Role of bioactives in our food

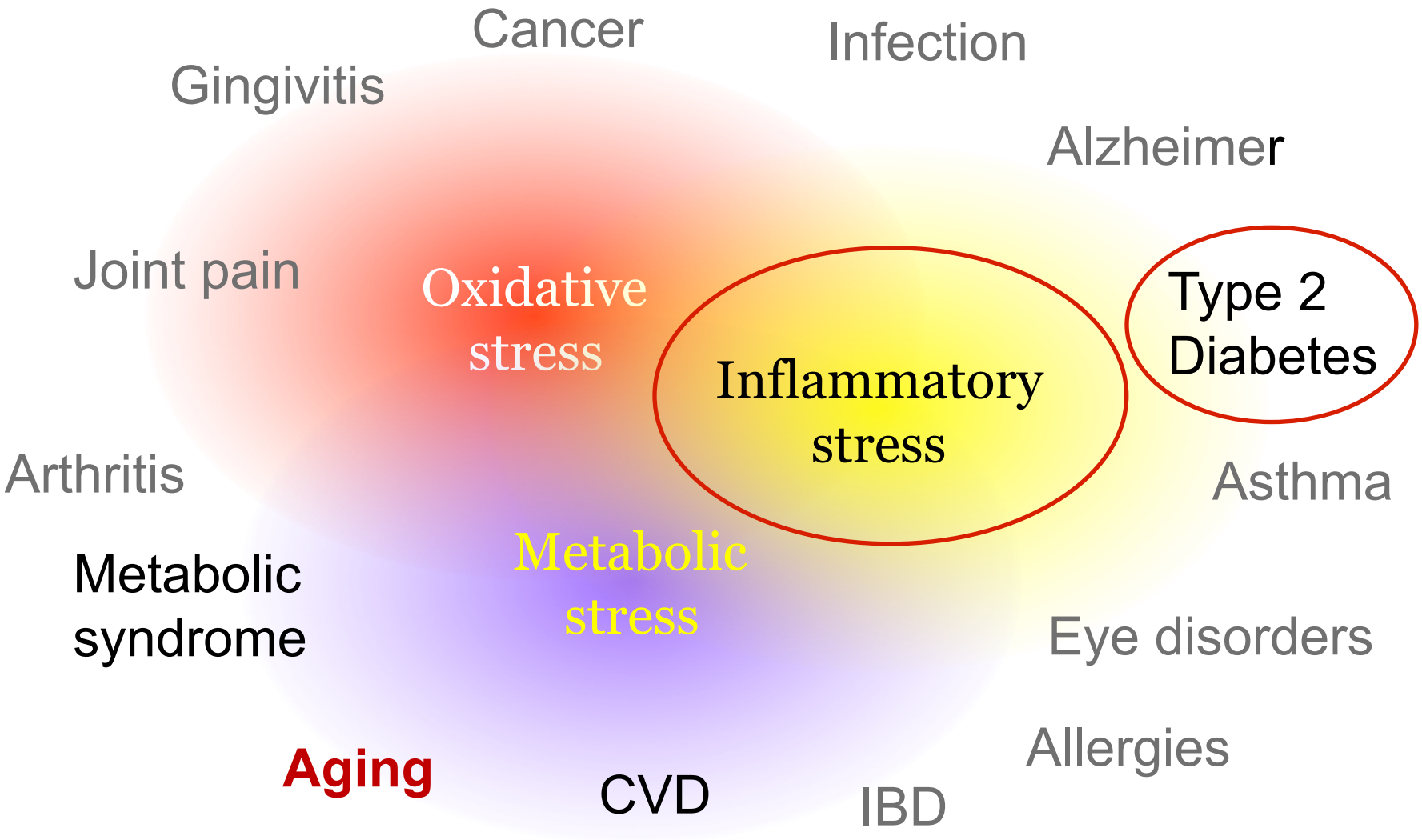

Phytochemicals
Carotenoids
Phenolics
Alkaloids
Nitrogen-containing compounds
Organosulfur compounds
α-Carotene
β-Carotene
β-Cryptoxanthin
Lutein
Zeaxanthin
Astaxanthin
Lycopene
Phenolic acids
Flavonoids
Stibenes
Coumarins
Tannins
Isothiocyanates
Indoles
Allylic sulfur compounds
Hydroxy-benzoic acids
Hydroxy-cinnamic acids
Flavonols
Flavones
Flavanols (Catechins)
Flavanones
Anthocyanidins
Isoflavonoids
Gallic
Protocatechuic
Vanillic
Syringic
p-Coumaric
Caffeic
Ferulic
Sinapic
Quercetin
Kaempferol
Myricetin
Galangin
Fisetin
Apigenin
Chrysin
Luteolin
Catechin
Epicatechin
epigallocatechin
Epicatechin gallate
epigallocatechin gallate
Eriodictyol
Hesperitin
Naringenin
Cyanidin
Pelargonidin
Delphinidin
Peonidin
Malvidin
Genistein
Daidzein
Glycitein
Formononetin

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

Metabolic balance



Metabolic dysbalance and chronic diseases



Metabolic inflammation

Metabolic inflammation or chronic low grade inflammation

↓

Induces / attenuates **insulin resistance** and disrupts **β cell function**

↓

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?

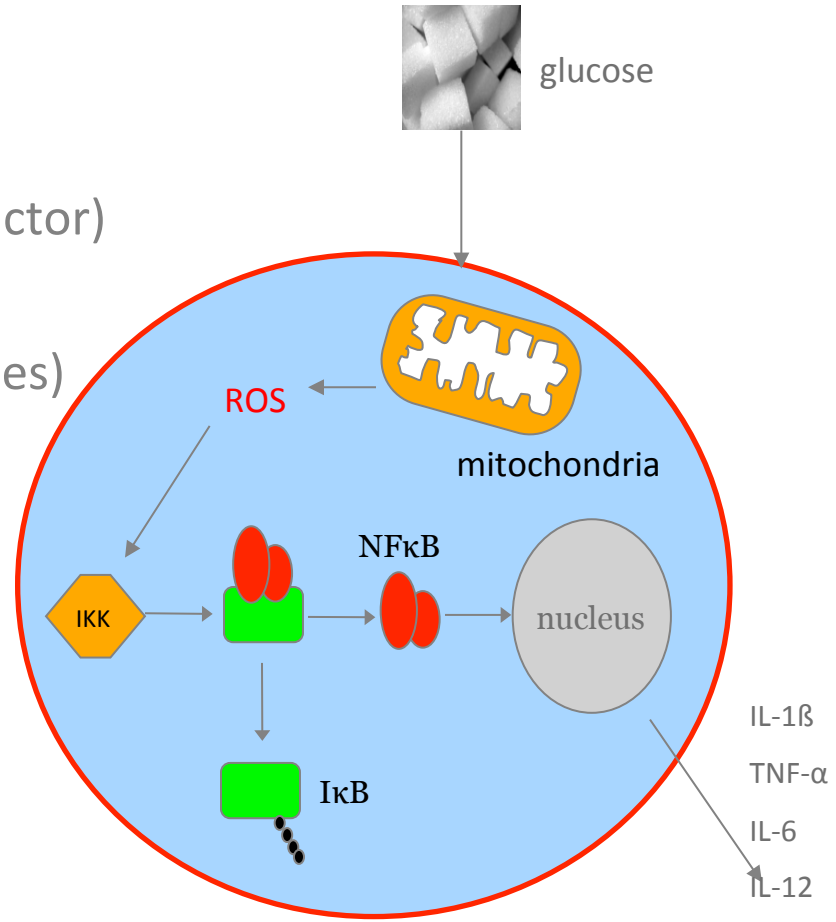
Metabolic inflammation

Where does it come from?

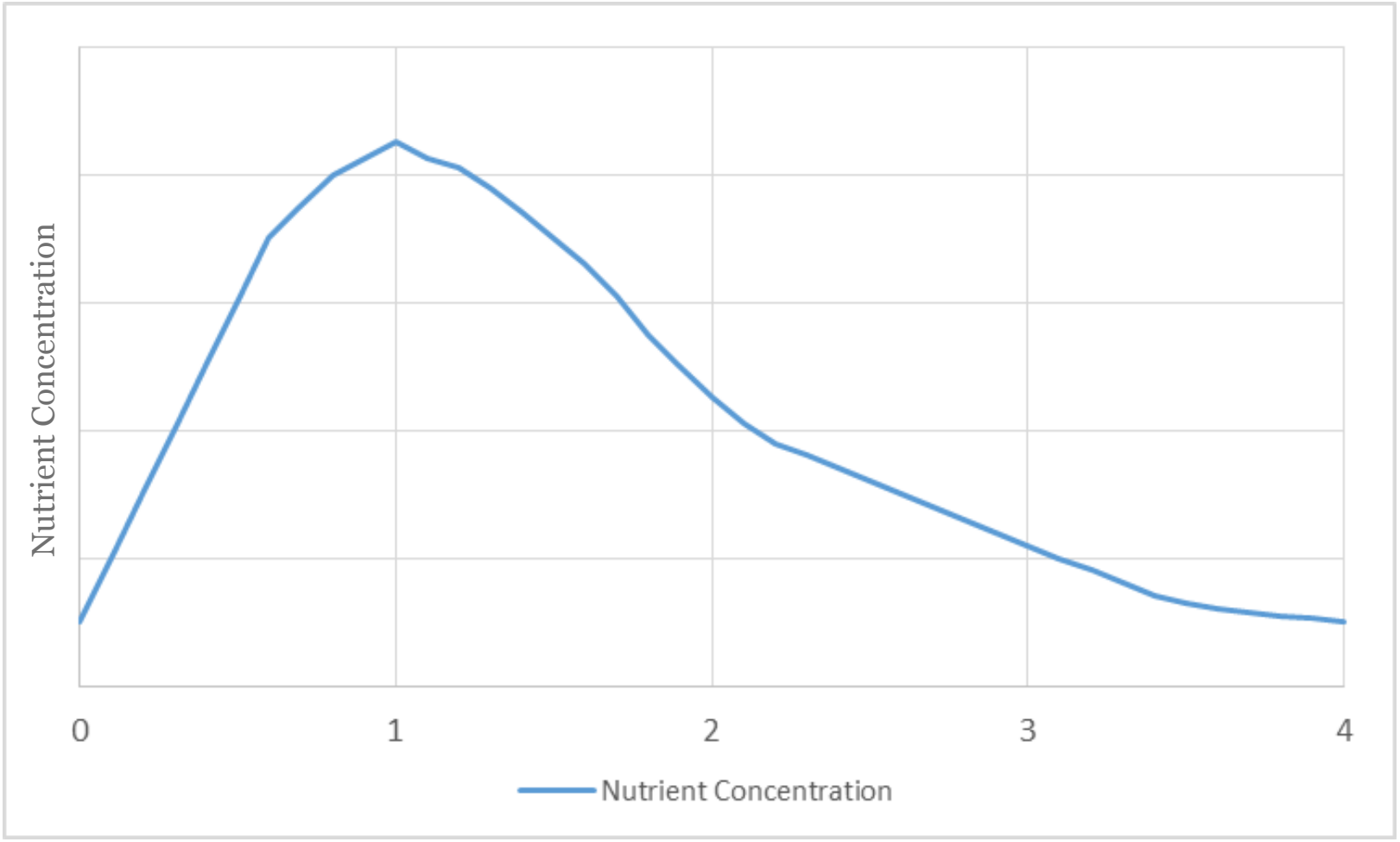
1.Postprandial inflammation induced by overload of saturated fat or sugars (**unbalanced diet**)

Intracellular signalling of inflammation in PBMC in human

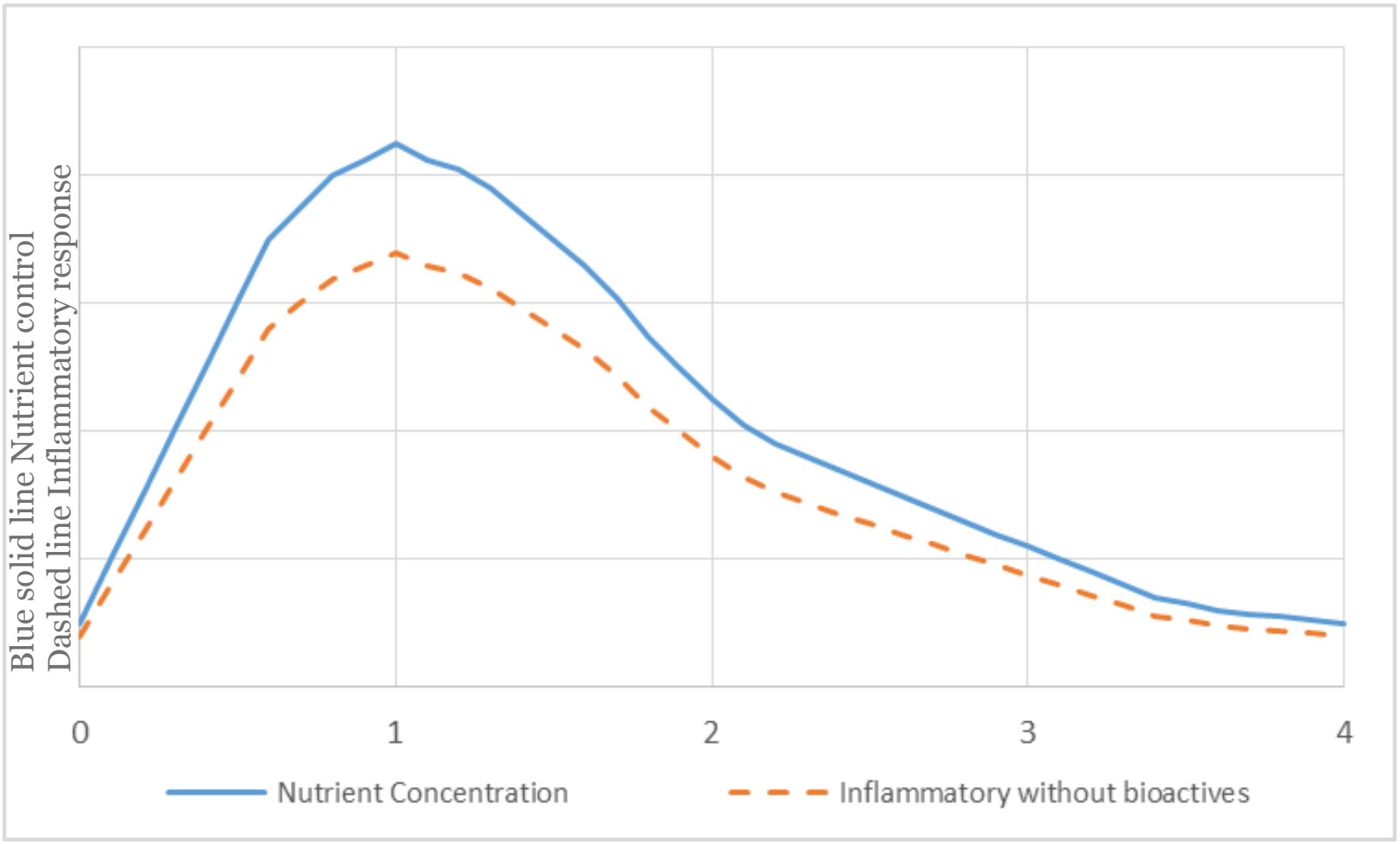
- Stimulation by fat or glucose
- Intracellular signalling
- Activation of NF-kB (nuclear transcription factor)
- Production of inflammatory factors (cytokines)
  - IL-6, TNF-a, ICAM, VCAM
- PBMCs and cytokines can be used to monitor inflammation



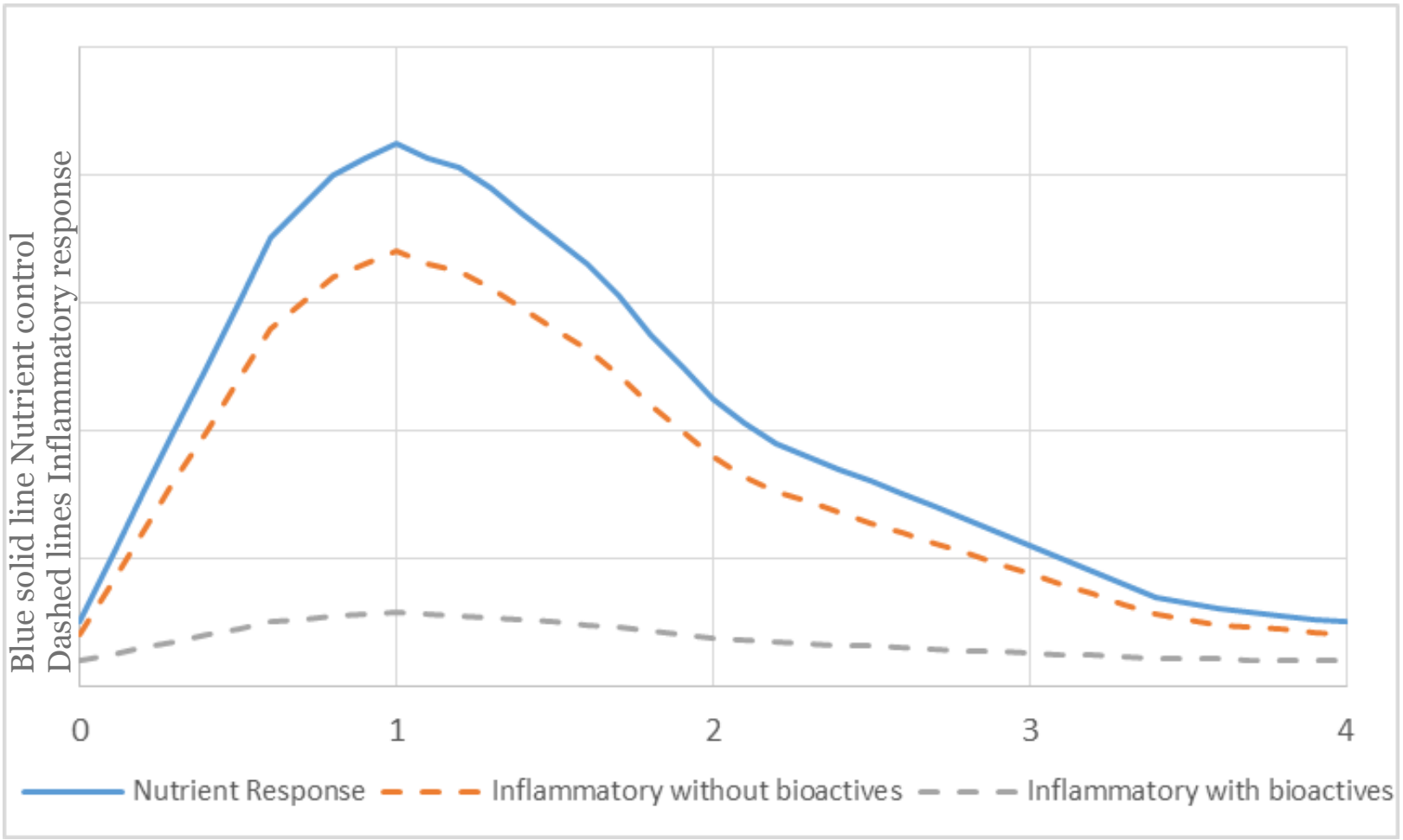
Postprandial (inflammatory) response



Postprandial inflammatory response



Postprandial inflammatory response



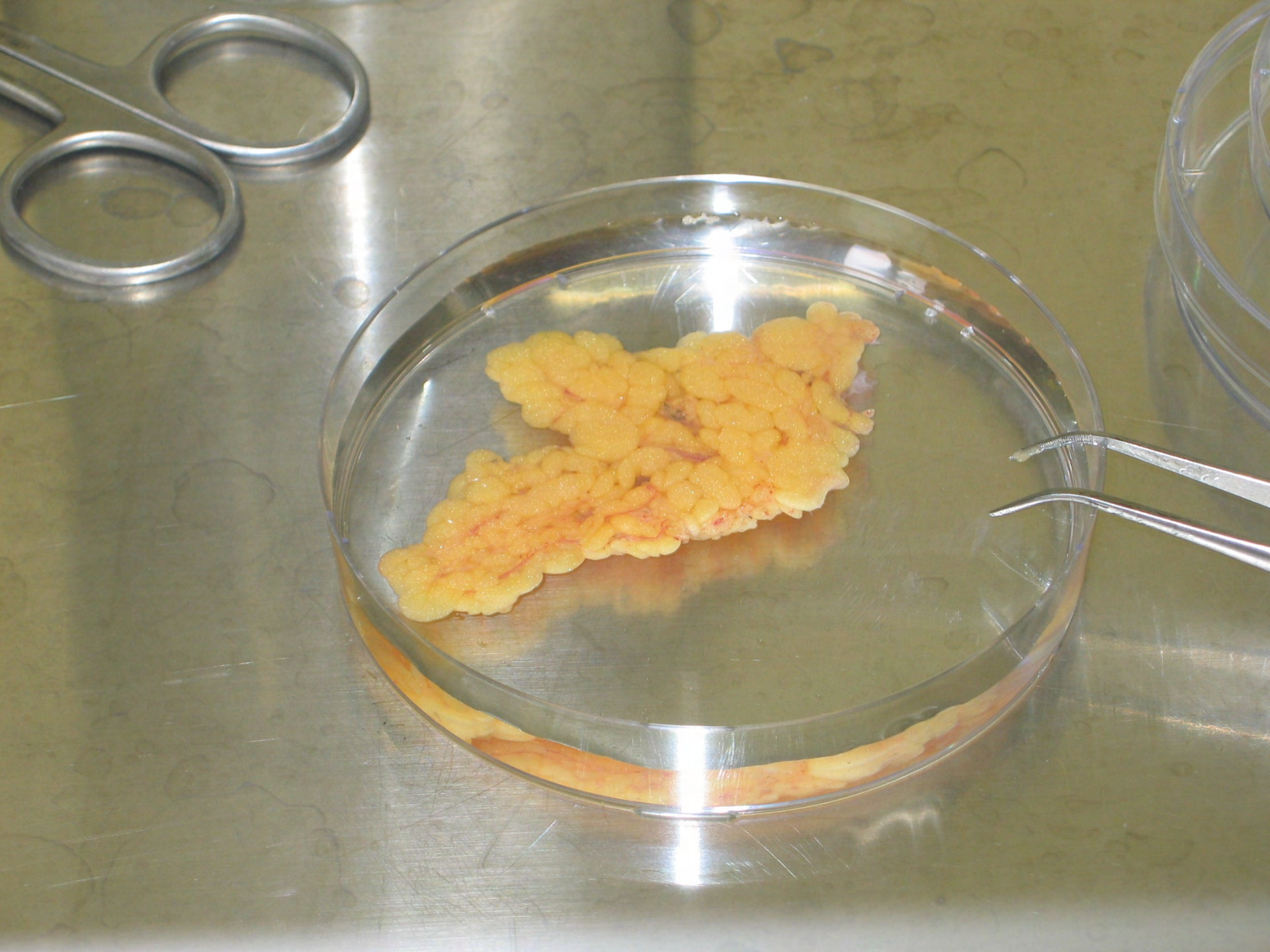
Cumulative inflammatory respons

Metabolic inflammation

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)



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

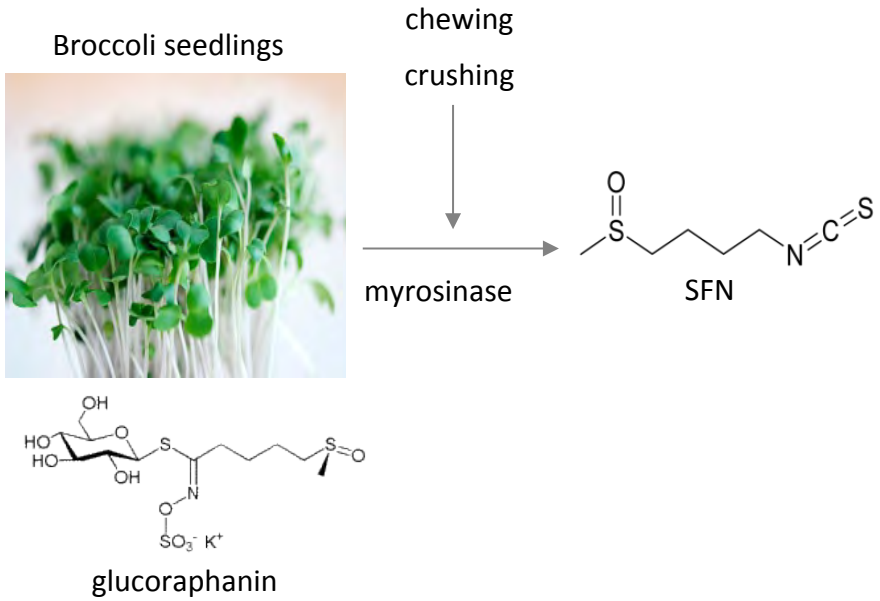
Anti-inflammatory compounds

Anti-inflammatory components

- Many components in fruit & vegetables

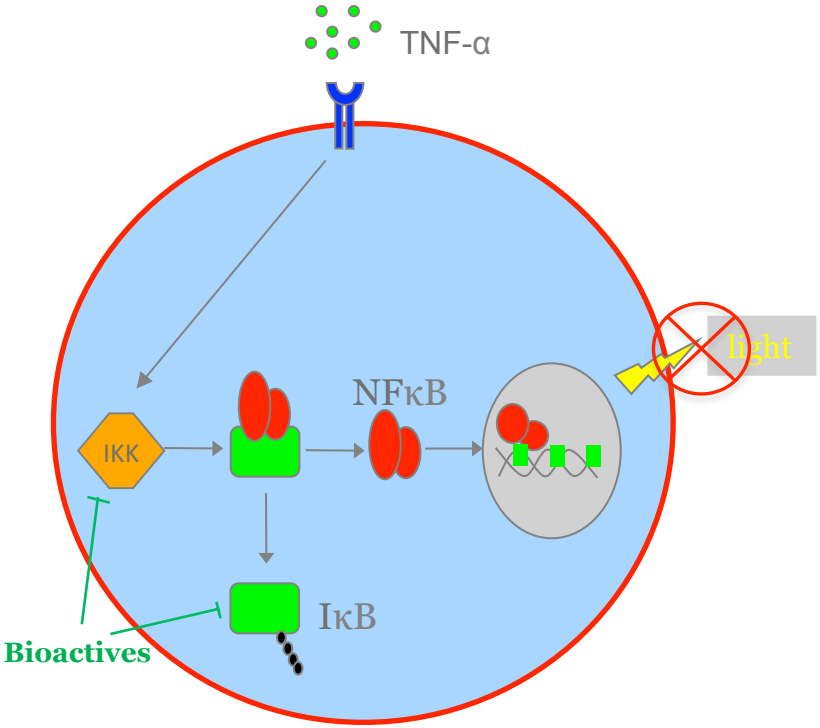
- Can dietary fiber (SCFA) , SFN inhibit metabolic inflammation?

Sulforaphane (SFN)



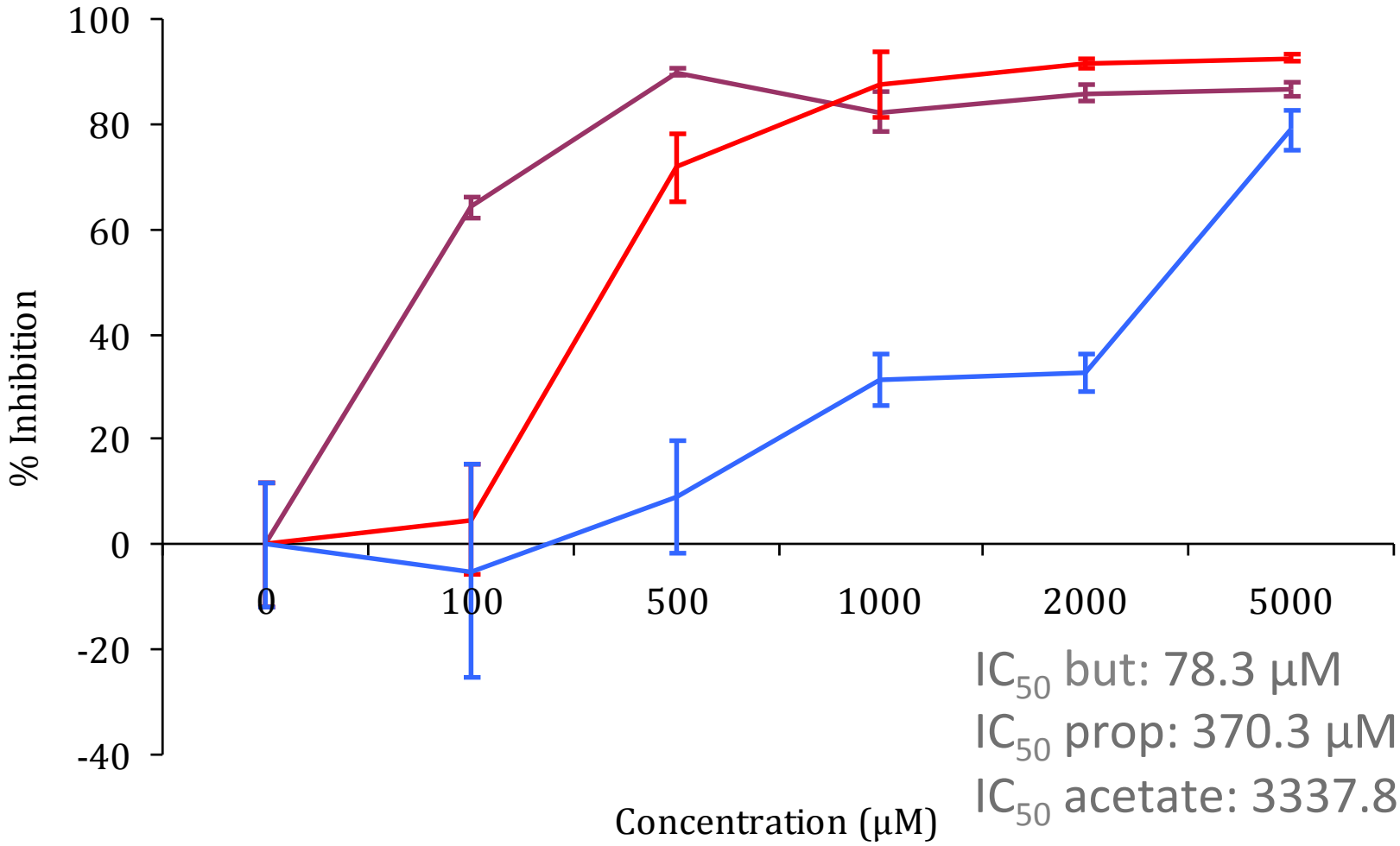
- Sulforaphane (SFN) is an isothiocyanate (N=C=S)
- Obtained from glucoraphanin (glucosinolate) in cruciferous vegetables (broccoli, Brussels sprouts, cauliflower, etc.)
- Enriched in broccoli sprouts and seedlings

Screening (micro-) vegetables using *Reporter cell line*: inhibitory effect of bioactives on NF-kB activation



› Significant inhibition of TNF-α-induced NF-kB activation in H293-NF-kB-RE reporter cell line (Meijer et al. Food Chemistry 2014)

SCFAs inhibit NF-kB activation in a HEK293 reporter cell line

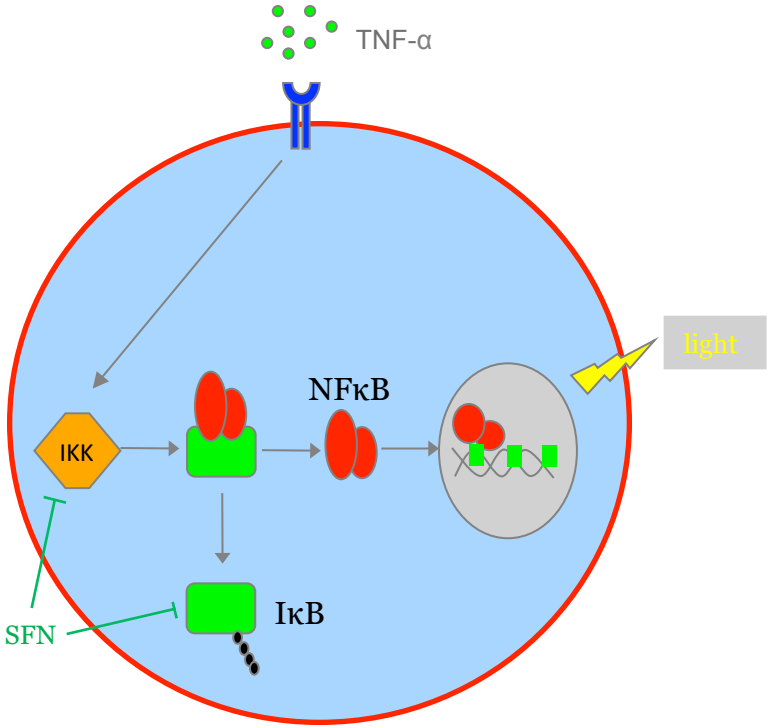


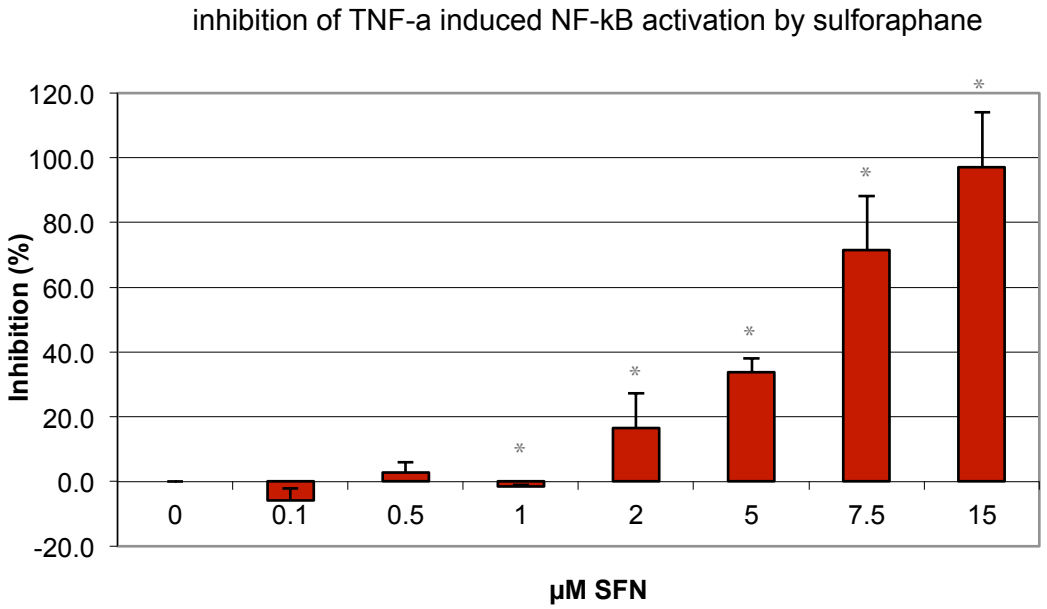
IC_{50} but: 78.3 µM

IC_{50} prop: 370.3 µM

IC_{50} acetate: 3337.8 µM

NF-kB 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

BroccoCress intake

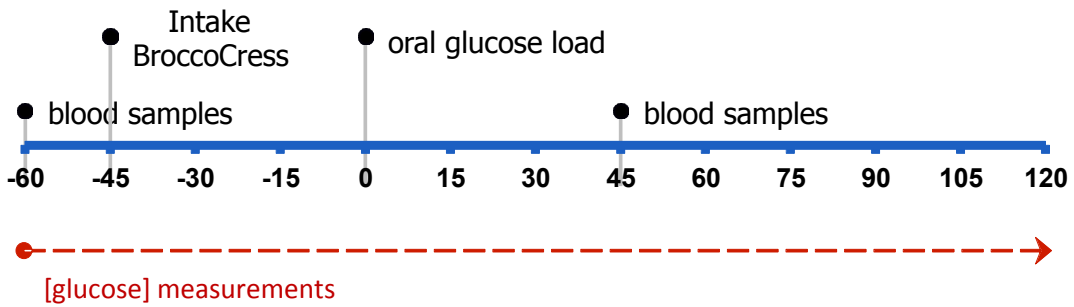
Oral glucose load

Glucose measurements

Blood collection

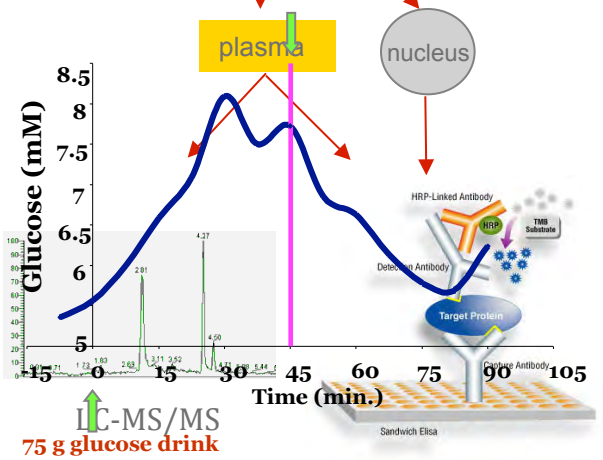
PBMC isolation

Timeline pilot study



Blood sample

Nuclear extraction

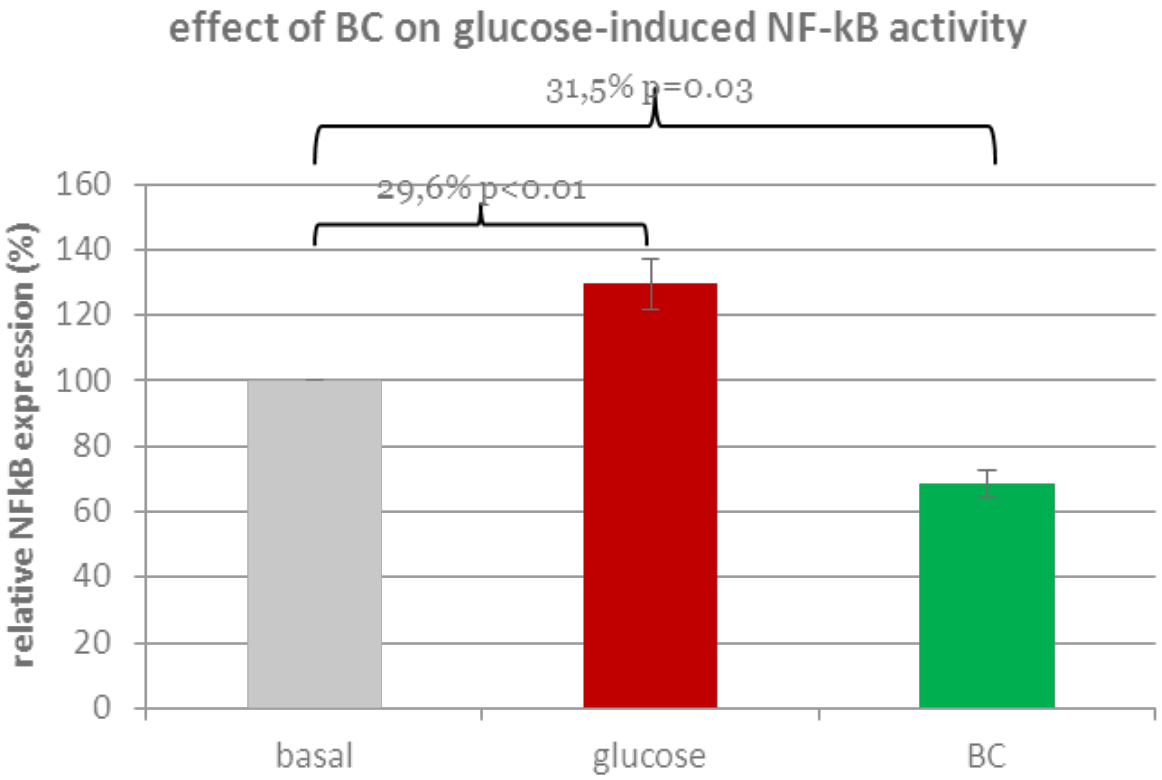


LC-MS/MS

75 g glucose drink

ELISA

BroccoCress inhibits glucose-induced NF-kB activation in human



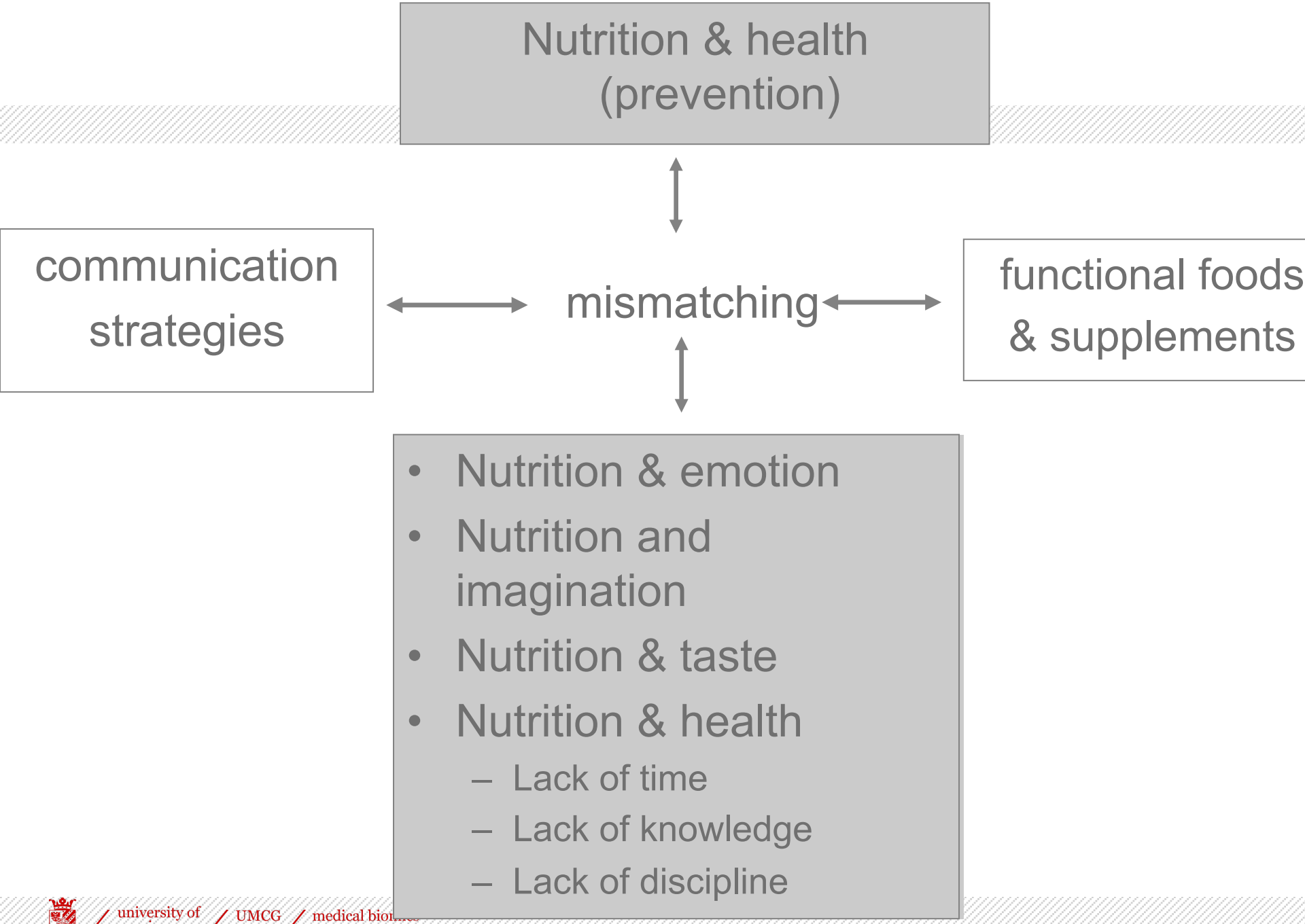
Broccoli seedlings can reduce glucose-induced NF-kB activation (n=5)

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

(www.koppertcress.com)

- **containing sulforaphane (SFN) as the main fytochemical**

- 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, vitamines, esential nutrients, bioactives
(anti-inflammatory compounds)

Acknowledgements

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- *Kees Meijer*
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- *Han Roelofsen*
- *Marcel de Vries*
- *Gerlof Reckman*
- *Martijn Koehorst*
- *Coby Eelderink*

TI –FN Netherlands

FND partners

- *Isolife, Wageningen, The Netherlands*
- *Koppert Cress, Monster, The Netherlands*

Food & Nutrition Delta
Food for Business

ISOLife
Stable Isotope Labelled Plant Products for the Life Sciences

KOPPERT CRESS
Architecture Aromatique

Future ISGA

- -good perspectives
- -clear challenge

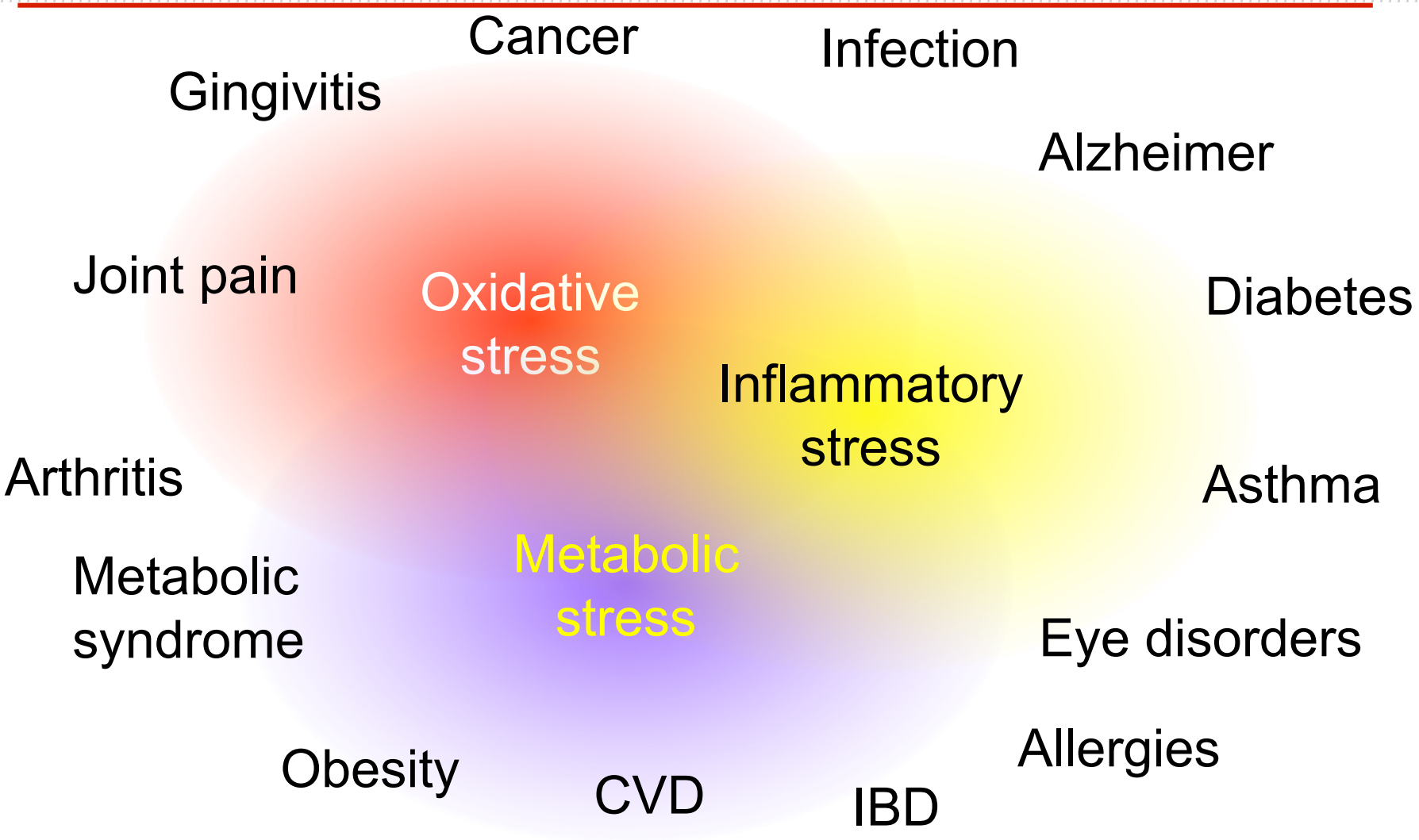
- Good luck!

questions and contact

- 谢谢！

- roelvonk@icloud.com

Metabolic dysbalance



EFSA

Claims of high scientific level

Problems with food industry

No communication with consumers

Promotion/advertising

Promotion of functional foods always simultaneously with promotion of healthy lifestyle

Functional foods

Functional foods and supplements

Education!

(un)balanced food

high nutriëntdensity

vitamins

bioactives: anti-inflammatoir/ anti-oxydant/ others

Current food pattern
many products with low nutriëntdensity
and high energydensity

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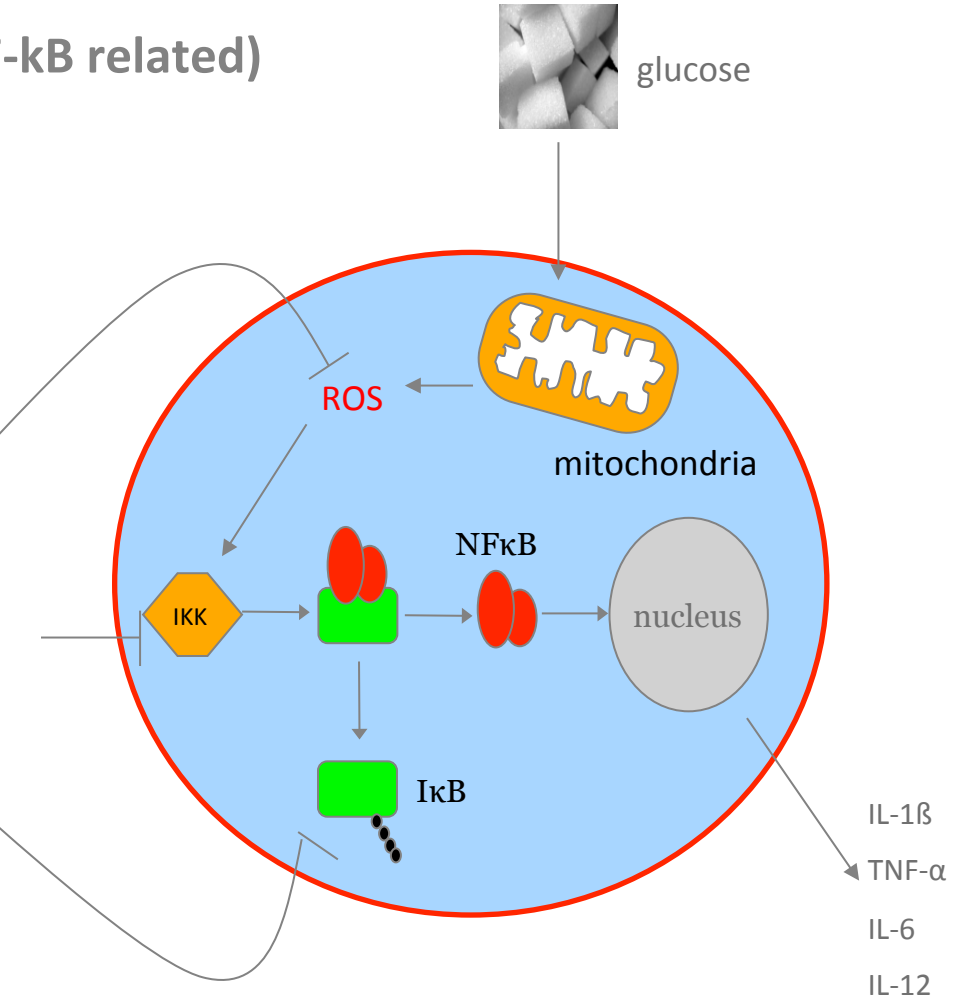
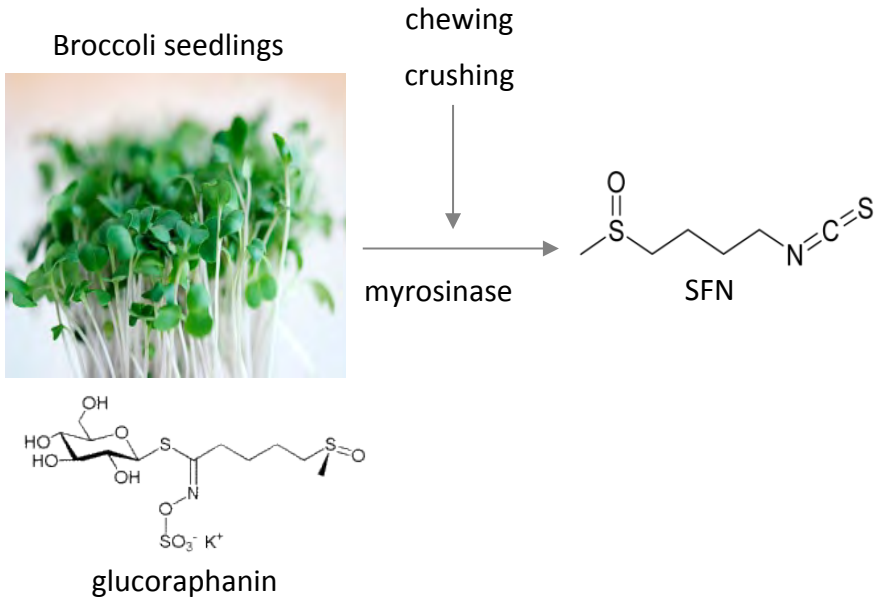
Inhibition of inflammation by SCFA & SFN

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



Brocco sprouts → **SFN**

Sulforaphane (SFN)



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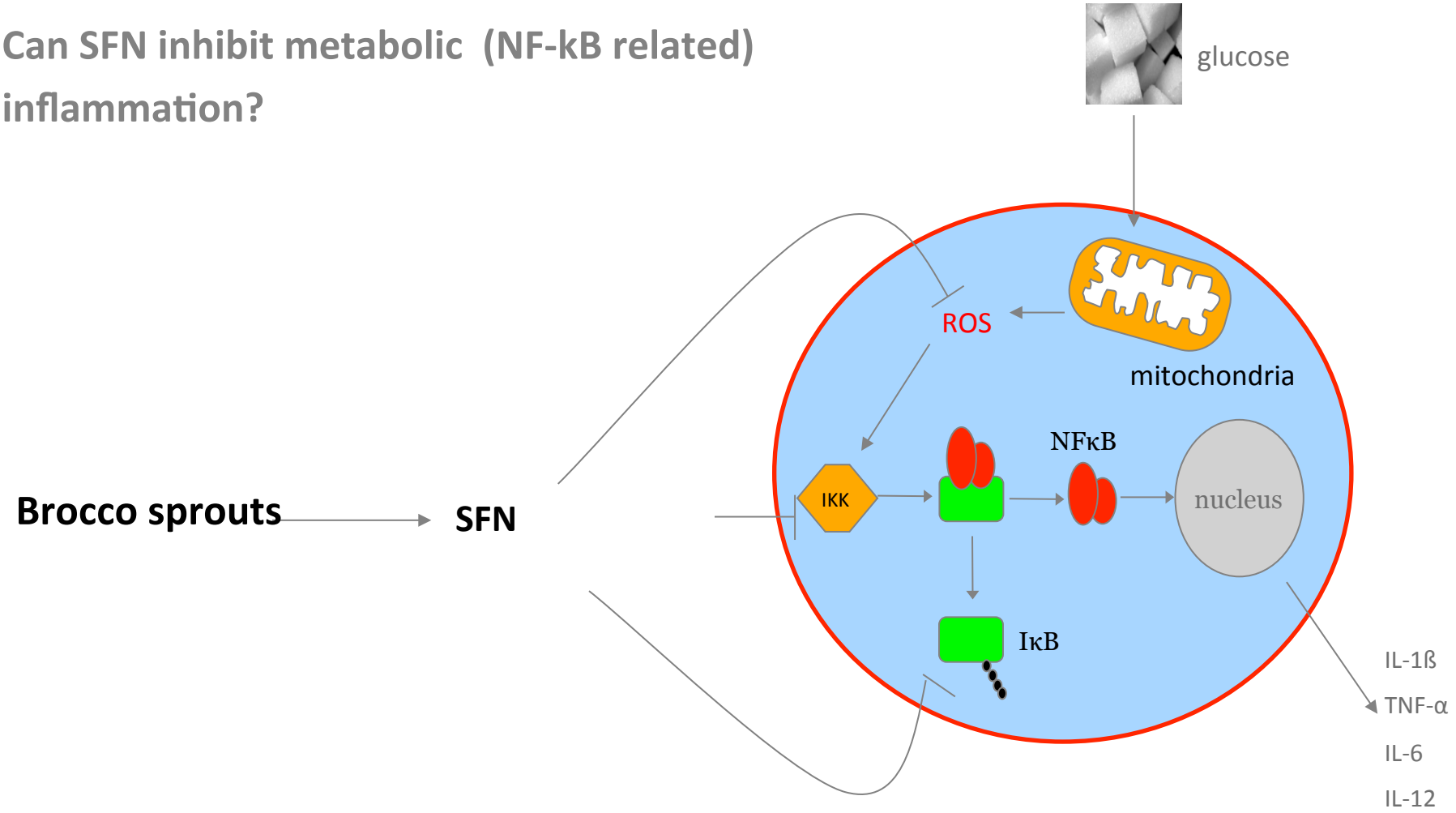
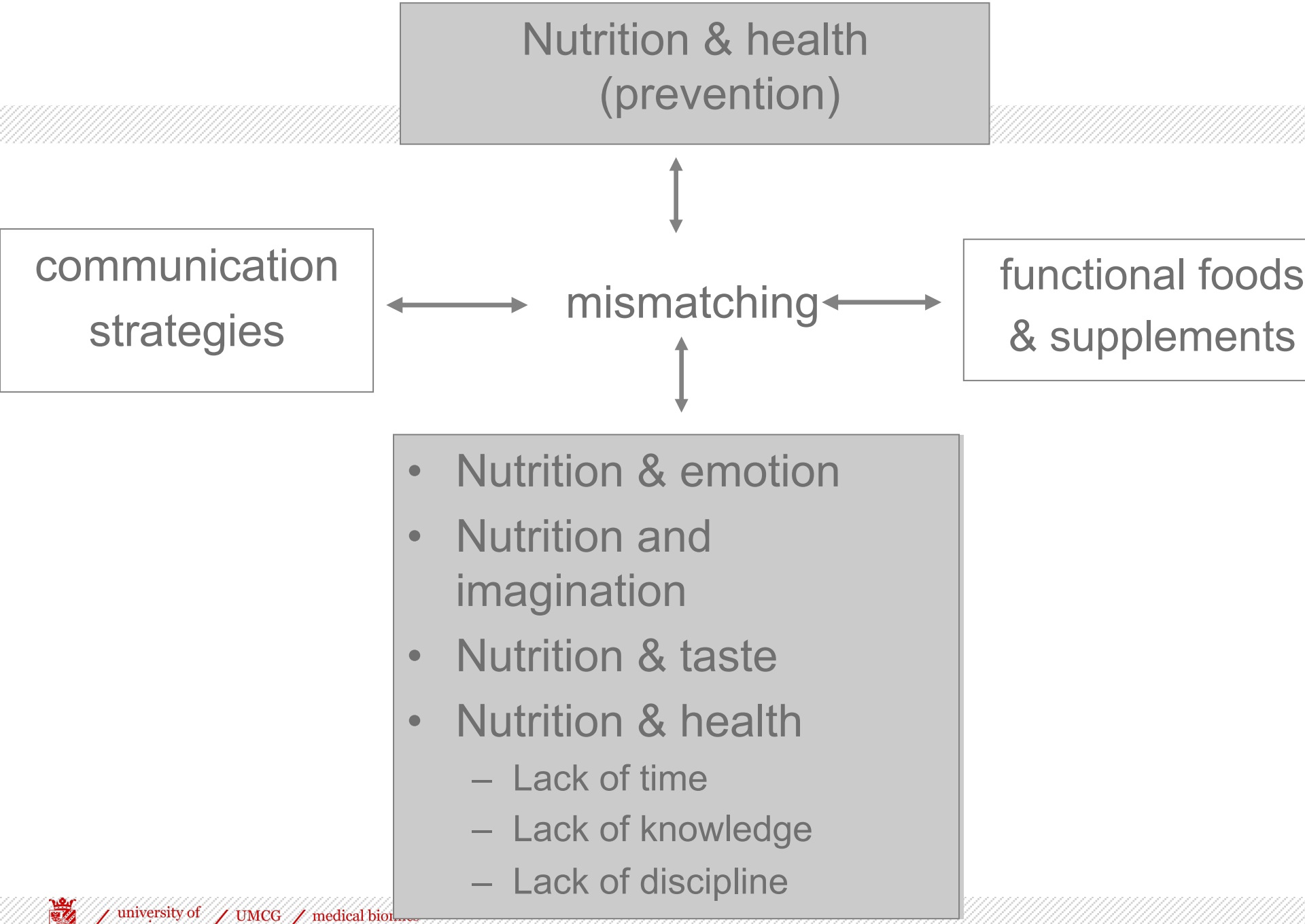


Nutrition is not a major item in medical education in contrast to farma and surgery

- -prevention vs action
- -economic reasons (patents)


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

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 fytochemical

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